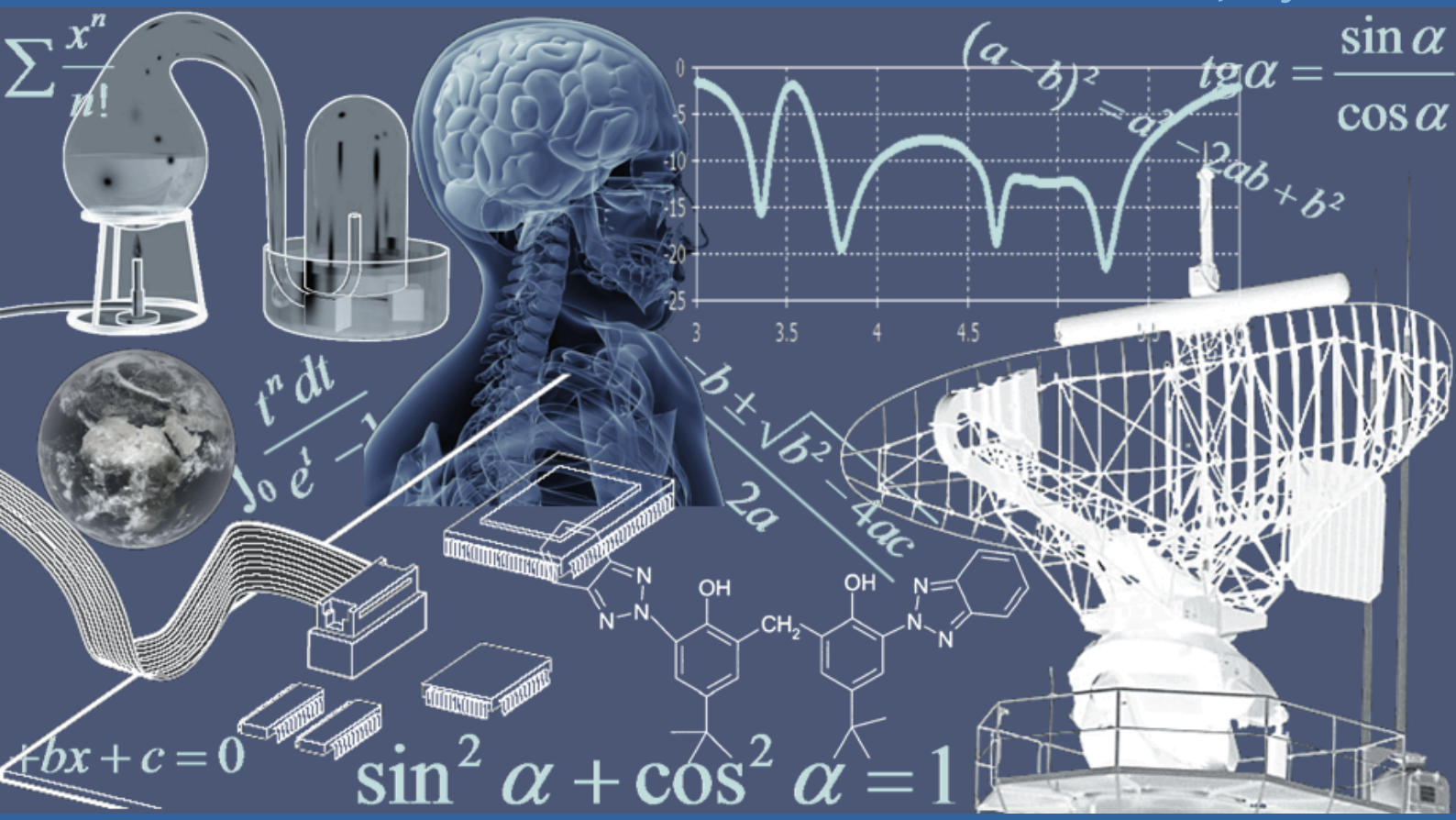
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Analyse du Processus de la décision d'achat dans le Social E-Commerce

[Process analysis of the purchasing decision in the Social E-Commerce]

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ABSTRACT: It is important for future web-based companies to understand the value of virtual communities in order to identify new and potential shoppers (Lorenzo, Constantinides, Geurts, & Gómez, 2007; Wu Ye, S. Yang, Wang &, 2009).
In this article, we aim to contribute to this research effort assessing the effects of the social web on various stages of making purchasing decision. We propose a model for understanding the market on the social web.
Our goal is to identify and discuss the various social factors that influence the different stages of the decision process of a client, while providing a model for understanding the social e-commerce.
Our goal is to highlight the factors affecting the decision-making process in the Social E-commerce and analyze the interdependence of the steps leading to the purchase.

KEYWORDS: Online shopper, cyberconsumer, customer cyber, social commerce, e-commerce, Social Web, Web 2.0.

RESUME: Il est important pour les futures entreprises basées sur le web de comprendre la valeur des communautés virtuelles pour pouvoir cibler de nouveaux et de potentiels cyberacheteurs (Lorenzo, Constantinides, Geurts, & Gómez, 2007; Wu, Ye, S. Yang,Wang &, 2009).
Dans cet article, nous visons à contribuer à cet effort de recherche en évaluant les effets du web social sur diverses étapes de la prise de décision d'achat. Nous proposons un modèle pour mieux comprendre le commerce sur le web social.
Notre objectif est d'identifier et de discuter des divers facteurs sociaux qui influencent les différentes étapes du processus de décision d'un client, tout en présentant un modèle pour comprendre le e-commerce social.
Notre but est de mettre en évidence les facteurs affectant le processus décisionnel dans le Social E-commerce et analyser l'interdépendance des étapes aboutissant à l'achat.

MOTS-CLEFS: cyberacheteur, cyberconsommateur, cyber client, commerce social, e-commerce, Web social, Web 2.0.

1 INTRODUCTION

Les progrès technologiques dans le domaine du Web, la sécurité informatique, et les systèmes de paiement en ligne ont augmenté le rôle de l'Internet comme outil de vente et canal de commercialisation. Ainsi, les entreprises ont augmenté leur présence et leurs activités sur le web afin de bénéficier de réseaux d'affaires à moindre coût et attirer plus de cyberacheteurs. Pendant ce temps, l'émergence des technologies Web 2.0 voir Web 3.0, des blogs, des wikis et des réseaux sociaux ont connu de spectaculaires changements dans la structure de la collaboration, de la communication sur le Web, dans l'autonomisation et la sophistication des clients traditionnels. Ces technologies ont aussi modifié le concept de contribution du contenu web. En effet, ils ont offert de nouveaux moyens pour les utilisateurs afin de générer une autre

forme de contenu et ils ont fait de telle sorte que le web devienne plus social, mieux interconnecté et mieux resauté. (Voir le Graphique 1-Annexe 1: **De l'e-commerce 1.0 au Social E-Commerce 3.0**).

La capacité des cyberacheteurs d'interagir et de générer du contenu est extrêmement importante pour les webmarketeurs, car elle facilite généralement le crowdsourcing - c'est-à- dire l'externalisation vers la foule (issue de l'internet) ce qui permet aux entreprises de tirer profil du contenu de l'utilisateur et de ses idées (Howe, 2006).

Les réseaux sociaux se composent d'un grand nombre de personnes qui sont génératrices potentiels de contenus et sont aussi une source considérable d'informations. Le crowdsourcing utilise le potentiel d'utilisateurs du Web en réseau pour générer des idées nouvelles, de la publicité, et créer de la valeur ajoutée à moindre coût voir même sans cout tout en augmentant l'efficacité par la compréhension des besoins des cyberacheteurs, l'identification des cyberacheteurs potentiels, et la fidélisation de la cyber clientèle.

Récemment, dans un effort pour exploiter la puissance de crowdsourcing, Volkswagen (VW) a lancé une action concernant le «facteur plaisir». Il s'agit d'une campagne publicitaire utilisant les médias Web (en particulier YouTube) en mettant l'accent sur les questions environnementales. La campagne encourage les utilisateurs à développer des solutions environnementales (avec un accent sur l'élément "fun et ludique") et de les partager sur le web. De même, l'utilisateur qui a généré des vidéos sur YouTube au sujet de la réaction de Mentos avec Coca-Cola a augmenté les ventes Mentos sans cout pour à l'entreprise. De plus, Mentos a fourni les stocks gratuits de ses produits aux cyberclients afin de générer plus de vidéos.

En abordant les entreprises en ligne, nous définissons l'e-commerce comme un processus en trois étapes:

- a/ Avant : attirer des cyberacheteurs sur le site par le biais de marketing en ligne;
- b/ Pendant : offrir les moyens pour exécuter et finir la transaction;
- c/ Après : offrir les moyens pour l'interaction des clients et le service après vente ;

Un achat impliquant une ou toutes les étapes du processus se définie comme une transaction commerciale. Ainsi, un client qui découvre un produit sur le web, l'achète en ligne, et se rend physiquement au magasin pour en bénéficier d'autres services complémentaires ou supplémentaires. Il se livre alors à l'e-commerce. L'appui sur les communautés virtuelles dans le commerce électronique offre de multiples avantages pour les clients potentiels et les entreprises en ligne ainsi que pour les acheteurs ayant accès à de grands volumes d'informations fournies par leurs communautés dites de confiance (Leitner et Grechenig, 2008). Par ailleurs, d'autres entreprises pratiquent du Customer Relationship Management (CRM) afin de mieux prévoir les tendances du marché et maintenir de meilleures relations avec leurs cyberacheteurs (Wu et al., 2009). L'utilisation de CRM dans le contexte du Web 2.0 et réseaux sociaux est appelée "Social CRM".

Toutefois, l'impact du web social sur le commerce électronique n'est pas toujours positif, en raison des différents risques et périls d'achat de médicaments, de la contrefaçon, et du paiement en ligne. Un comportement de prudence est donc nécessaire sans pour autant résister massivement contre le social E-commerce a pu se traduire par une hausse des ventes, l'augmentation des recettes de 5%, tandis que la recherche distinctive pourrait diminuer les ventes de 14 % (Ivengar, Han, et Gupta, 2009).

Les réseaux sociaux ne servent pas toujours que pour influencer à acheter, ils influencent parfois de ne pas acheter. Le "minimalisme ", tendance actuelle sur le web social (c.-à-d. communautés visant à minimiser les achats) a attiré de nombreuses personnes au cours de ces dernières années, et encore plus récemment en raison de l'effondrement économique.

L'intérêt accru pour les technologies Web 2.0 et de leurs applications ~~du~~ au commerce électronique a conduit à une tendance nouvelle, où le shopping des cyberacheteurs s'appuient sur les réseaux sociaux pour faire des achats répondant mieux aux besoins exprimés. C'est ce qu'on appelle le «shopping collaboratif» ou «social shopping» (Stephen et Toubia, 2009). En revanche, le «commerce social» désigne les entreprises se regroupent pour former des réseaux de vendeurs (par exemple, www.zlio.com). Nous utilisons le terme du social E-commerce pour désigner les deux «réseaux de vendeurs» et «réseaux d'acheteurs » car nous pensons que le social E-commerce doit englober les deux catégories: les acheteurs et les vendeurs. Nous voyons le social e-commerce comme l'évolution du « e-commerce 2.0 », qui est basé sur les interactions one-to-one, en une forme plus sociale et interactive de l'e-commerce (Voir l'Annexe 1- Graphique 1: **De l'e-commerce 1.0 au Social E-Commerce 3.0**).

Bien qu'il y ait un consensus sur l'impact des réseaux sociaux sur les décisions des cyberacheteurs, une analyse systématique de cet impact fait défaut. Notre objectif est d'identifier et de discuter des divers facteurs sociaux qui influencent les différentes étapes du processus décision d'un client, tout en présentant un modèle pour comprendre le social e-commerce.

2 CONTEXTE ET ÉTAT DES LIEUX

Analyser le comportement des cyberacheteurs pour l'achat de produits et services est un sujet de recherche intéressant, autant dans le cadre des achats traditionnel que dans les achats en ligne. Le comportement d'achat des cyberacheteurs a été étudié à partir de différents aspects de la psychologie, des sciences sociales, du marketing et des systèmes d'information. En effet, les recherches les plus rigoureuses ont fourni des modèles qui recueillent le comportement de la clientèle lors des achats, y compris dans le modèle de Nicosie (Nicosie, 1966), le modèle Howard-Sheth (Howard & Sheth, 1969), dans le modèle Engel-Blackwell (Fr-gel & Blackwell, 1982), dans le modèle Bettman (Bettman, 1979) et finalement dans le modèle d'Andersen (Anderson & Vincze, 2000).

Le modèle Nicosie fut le premier à réorienter les priorités des consommateurs à propos de l'acte décisionnel d'achat vers un processus décisionnel plus complexe. Comme un modèle de la communication, il commence avec de la publicité et se termine par les commentaires des consommateurs. Plus tard, le modèle Howard-Sheth a guidé le comportement des acheteurs en présence d'un choix de multiples produits. Le modèle Engel-Blackwell a détaillé le processus décisionnel du consommateur en des étapes successifs. Sur la base de ces modèles et ceux de Bettman et Anderson, nous avons identifié les six étapes de base de notre modèle proposé pour la compréhension du e-commerce social présenté dans la section 4.

Les technologies du web et leurs applications mûrissent rapidement, et leur revalorisation a rapidement évolué vers l'intégration de nouveaux modèles dans le commerce électronique (Guttman, Moukas, & Maes, 1998; Maes, Guttman, & Moukas, 1999). Une adoption des modèles d'affaires plus anciens de type « one-to-one interactions » est la résultante du développement des relations client-vendeur (Dwyer, Schurr, et Oh, 1987). En effet, les réseaux sociaux ont transformé l'interaction client-vendeur de one-to-one en une interaction communautaire (Stephen & Toubia, 2009). Par conséquence, les nouveaux modèles d'affaires (Voir Annexe1) ont dû compter sur une interaction communautaire de communication et de collaboration (Godes & Mayzlin, 2004; Jansen, Zhang, So-Bel, & Chowdury, 2009; W. Yang, Dia, Cheng, & Lin, 2006).

Pourtant, la plupart des recherches sur les communautés dans le e-commerce gravitent autour de l'augmentation des chiffres d'affaires en utilisant le bouche-à-oreille, les techniques de publicité ainsi que des systèmes de recommandation. Par ailleurs, peu d'efforts ont ciblé un processus décisionnel complet et les moyens de l'améliorer. Bien que certains modèles ont été proposés pour expliquer le rôle des réseaux sociaux dans le processus décisionnel du cyberacheteur. Presque tous les stades du processus ont peu évolué, laissant ainsi la place à une vision incomplète ou restreinte du rôle de la communauté virtuelle dans la prise de décision de ces membres (en tant que cyberacheteurs).

Par ailleurs, dans le but de préciser les caractéristiques du social e-commerce, certains chercheurs ont centrés ces éléments nécessaires à la conception des espaces commerciaux sociaux et intelligents (Leitner et Grechenig, 2009). De plus, Ils ont analysé l'effet des réseaux sociaux sur le commerce électronique en observant les sites de e-commerce, les éléments de leur structure et les applications qui facilitent la création d'environnements sociaux. Finalement, les réseaux sociaux construits au-dessus de sites e-commerce ont reçu peu ou assez l'attention des chercheurs, et ce domaine nécessite d'être approfondie.

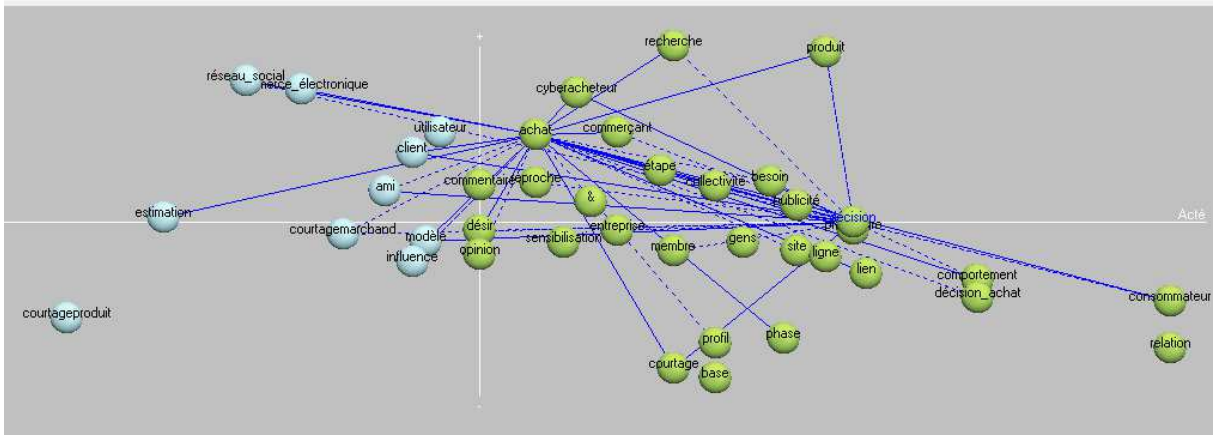
3 L'APPROCHE DU SOCIAL E-COMMERCE WEB

Le comportement des consommateurs envers l'achat à distance, n'est pas nouveau. Il se réfère à la prise de décision qui a évolué en plusieurs étapes. Etudier ce comportement permet de mieux comprendre les facteurs influant sur les processus d'achat, et répond à la question de savoir pourquoi les cyberacheteurs achètent lors de simple navigation. Il permet également aux entreprises d'amarrer la réaction des cyberacheteurs à leurs stratégies de marketing, dont les campagnes ciblent de grande population de cyberacheteurs ~~et~~ avec étalage de gammes de produits et de services hyper variés.

A cet effet, nous avons procédé à une étude qualitative auprès de 24 bénévoles (dont 14 femmes) recrutés sur des critères tels que leur intérêt pour le web, le E-marketing, la pratique et le management des communautés virtuelles. Ils ont une moyenne d'âge comprise autour 26 ans environs (minimum 21 ans et maximum 45 ans). Ils ont des comptes (nom et ou), des groupes dans divers réseaux sociaux et aussi ils ont souvent visité les e-magasins, ce qui indique qu'ils sont représentatifs et des acteurs modèle du Social E-Commerce. Ce sont aussi des « acteurs » qui connaissent le vocabulaire du E-marketing, ce qui implique que notre échantillon soit représentatif des « Cyberconsommateurs ». Notre grille d'entretien qualitatif a été bâti à fur à mesure des discussions. Nous avons centré nos réunions et conversations autour de la communauté virtuelle et son importance lors du processus d'achat dans le commerce électronique et plus particulièrement au sein des réseaux sociaux.

Nous avons ensuite procédé à une analyse sémantique et un traitement par le logiciel TROPES (Voir Annexe 1 : Analyse TROPES) des donnés qualitatif.

Nous avons pu faire ressortir certains facteurs qui affectent le processus d'achat des cyberconsommateurs dans les communautés virtuelles. Nous avons relevé des termes que nous retrouverons dans le graphique 2 (les facteurs composants le processus de décision dans le Social E-Commerce) ainsi que dans l'Annexe 2 et les Annexe 3 relatifs aux Sénarios possibles.



Graphique 2: Les facteurs composants le processus de décision dans le Social E-Commerce

Nous remarquons la mise en évidence de certains facteurs à travers ce graphe. L'analyse du comportement d'achat des cyberacheteurs dans des contextes différents, permet d'établir six étapes courantes relatives au comportement des cyberacheteurs, à savoir le besoin de reconnaissance, le courtage de produits, le courtage marchand, la décision d'achat, l'achat et l'évaluation. Ces étapes seront la base de notre modèle proposé, nous détaillerons ces étapes dans les prochaines sections. Chaque étape représente un processus décisionnel faisant étape dans le processus d'achat, non suivi totalement par tous les cyberacheteurs dans l'ordre spécifié. Par exemple, dans les marchés traditionnels les coûts d'achats les plus faibles sont effectués sans intention préalable où la recherche par les acheteurs qui voient les produits sur l'étagère et prennent la décision d'acheter ou de ne pas acheter. Même pour des produits chers, l'ordre des étapes peut changer. Par exemple, pour acheter un ordinateur portable, un cyber client peut être déterminé à acheter un Mac, alors il commence immédiatement la navigation à travers les produits Apple, en plaçant la scène de courtage marchand avant le courtage du produit. Néanmoins, dans la plupart des cas, les cyberacheteurs suivent les différentes étapes de façon séquentielle **(Voir Le Graphique 3**).



Graphique 3: Les étapes séquentielles composants le processus de décision dans le Social E-Commerce

L'adoption des réseaux sociaux a introduit un nouvel ensemble de composantes pour l'environnement e-commerce. Fisher (Fisher, 2010) divise ces composantes en six catégories: l'achat social, les notes et avis, les recommandations, les forums et les communautés, les médias sociaux, et la publicité sociale. Chaque composante a apporté de nouveaux défis et des avantages à l'expérience de magasinage en ligne, appelant à l'analyse du comportement d'achat des consommateurs dans le contexte des réseaux sociaux. Dans notre modèle proposé, nous évaluons les effets des composantes mentionnées ci-dessus sur le comportement social shopping selon les points de vue des consommateurs et des entreprises. Intégrer les entreprises dans le modèle devrait permettre d'améliorer l'analyse, car les entreprises font généralement partie de réseaux de consommateurs et de leur incidence sur les décisions d'achat. Dans les paragraphes suivants, nous détaillons les étapes de notre modèle (Voir Graphique 2 : **Processus de prise de décision dans le social E-Commerce**).

4 LE PROCESSUS À 6 ETAPES

4.1 BESOINS, DÉSIRS ET CHOIX

La première étape du processus de la décision d'achat du cyberacheteur est l'identification de la nécessité d'un produit ou d'un service spécifique. Bien que cela soit considéré comme la première étape dans le processus, le rôle joué par les entreprises dans la création de la marque et la notoriété du produit commence longtemps avant que les cyberacheteurs prennent conscience du besoin.

Le besoin de reconnaissance est associé à de nombreuses questions qui doivent être abordées pour une compréhension claire de l'ensemble du processus du social shopping. L'une de ces questions doit traiter avec les besoins et les désirs de la clientèle. Campbell (Campbell, 1998) définit le besoin en tant que l'exigence, la nécessité, ou le sentiment de carence, et associe le désir avec des phrases telles que « envie », «fantaisie», «amour», «attirer par», et «aimer». Le contraste entre besoin et désir repose sur la différence entre la privation et l'envie. Le besoin réfère à un état de privation, et il se produit lorsqu'il y a un manque d'éléments nécessaires pour maintenir une situation existante, alors que le désir se réfère à une disposition de motivation pour découvrir le plaisir de posséder un produit ou un service.

Les besoins et les désirs des cyberacheteurs peuvent être motivés par les réseaux sociaux. Par exemple, deux types d'influence sociale corrélées à la génération et la reconnaissance des besoins et désirs de la clientèle sont observés (Bearden, Calcich, Netemeyer, & Teel, 1986). L'influence sociale normative (alias la norme subjective) crée une pression sociale et psychologique (c.-à-d. désir) sur les gens pour acheter un produit (ou service) - quel que soit l'intérêt de l'individu dans le produit- dès lors, la non adoption du produit peut les décrire comme des personnes démodées dans leur société ou dans leur réseau d'amis. Par conséquent, certains achats ont une corrélation positive avec le prestige et la concurrence. Cependant, l'influence sociale de l'information est un processus d'apprentissage atteint par l'observation des expériences des adeptes précoces avec un produit spécial (ou service) afin de comprendre les raisons de l'acquérir. Le produit peut ensuite être modifié pour répondre à ces besoins de manière plus efficace, et le profil de produit devrait aborder la question d'attirer des cyberacheteurs ayant des besoins similaires. Par exemple, si votre ami se vante de son nouveau téléphone qui vérifie les emails, alors la nécessité de vérifier les emails peut être réveillée en vous.

Les entreprises, d'autre part, sont intéressées à éveiller la nécessité ou de générer le manque chez les cyberacheteurs. La clé pour faire connaître leurs produits à des cyberacheteurs potentiels est une publicité efficace. Notez que les systèmes de CRM peuvent aider les entreprises à prévoir leurs cyberacheteurs potentiels et leurs besoins potentiels.

L'Impact mutuel. La décision d'un client d'acheter un produit ou un service est souvent influencée par la famille, amis, collègues, partenaires commerciaux, etc. En raison des influences réciproques, il est plus probable d'observer des comportements d'achats similaires entre des cyberacheteurs ayant des liens étroits dans un réseau social. L'adoption d'un produit par un réseau de personnes connectées à un individu peut éveiller la nécessité pour le produit en cette personne ou créer un désir (vouloir) pour l'acquisition de ce produit ou, dans certains cas, un produit similaire.

4.2 COURTAGE DE PRODUITS

Courtage de produits (alias recherche d'information) est le stade où les consommateurs déterminent ce qu'il faut acheter, après qu'un besoin ou qu'un désir, ait été reconnu. Ce résultat est obtenu grâce à une recherche complète sur les produits, suivis par une évaluation critique de l'information sur le produit détenue par le candidat. La procédure de recherche est normalement effectuée par la recherche "interne" ou "externe" ou les deux. La recherche interne se

concentre sur la connaissance personnelle et les expériences passées, alors que la recherche externe utilise les sources dominées par les marketeurs, les comparaisons, les sources publiques, et les amis et les parents qui peuvent influencer sur la décision par le bouche-à-oreille. Les réseaux sociaux ont le potentiel d'améliorer le processus de courtage de produits en offrant un environnement de ressources à des personnes physiques ayant différentes expériences et spécialités qui répandent le bouche-à-oreille, ce qui amène potentiellement à abaisser le coût de la recherche pour des produits différents (Guttman et al., 1998). Les réseaux sociaux peuvent aider à atteindre ce moyen à moindre coût de recherche en fournissant ce qui suit:

Trusted Reviews et la puissance du réseau d'amis. Trusted Reviews peut apparaître sous deux formes, formelles et informelles. Lorsque les cyberacheteurs visitent un site web marchand, ils fournissent des critiques officiels sur les produits là-bas et à un moment précis. **E**n revanche, des critiques informelles sont fournies chaque fois que les cyberacheteurs partagent de manière informelle, certaines opinions sur les produits parmi leur réseau social d'amis. Les commentaires informels peuvent avoir plus de crédibilité, car ils proviennent de membres de la même communauté en ligne qui sont censés partager les mêmes valeurs.

Impact de l'identité sociale. Les achats et les abonnements peuvent signaler l'identité social des cyberacheteurs (Belk, 1988; Berger & Heath, 2007) et, par conséquent l'identité sociale d'un client peut entraver l'achat de produits spécifiques. Les gens peuvent converger ou diverger dans leur choix de produits, ce choix révèle leur identité sociale. Une couleur, des vêtements, ou une coiffure est socialement accepté pour représenter un groupe, mais si d'autres personnes commencent à adopter le même style, le sens de l'adoption de ce style spécifique peut devenir diffuse. Par exemple, Berger et Heath (Berger & Heath, 2007) abordent l'exemple des motos Harley qui sont un symbole de tenacité, un si grand nombre achète une Harley pour signaler leur identité sociale difficile, et l'identité sociale qui lui est associée peut empêcher beaucoup de gens de l'acheter. Toutefois, si les différents groupes, par exemple, les comptables, commencent à adopter Harleys, leur identité sociale difficile peut disparaître au fil du temps.

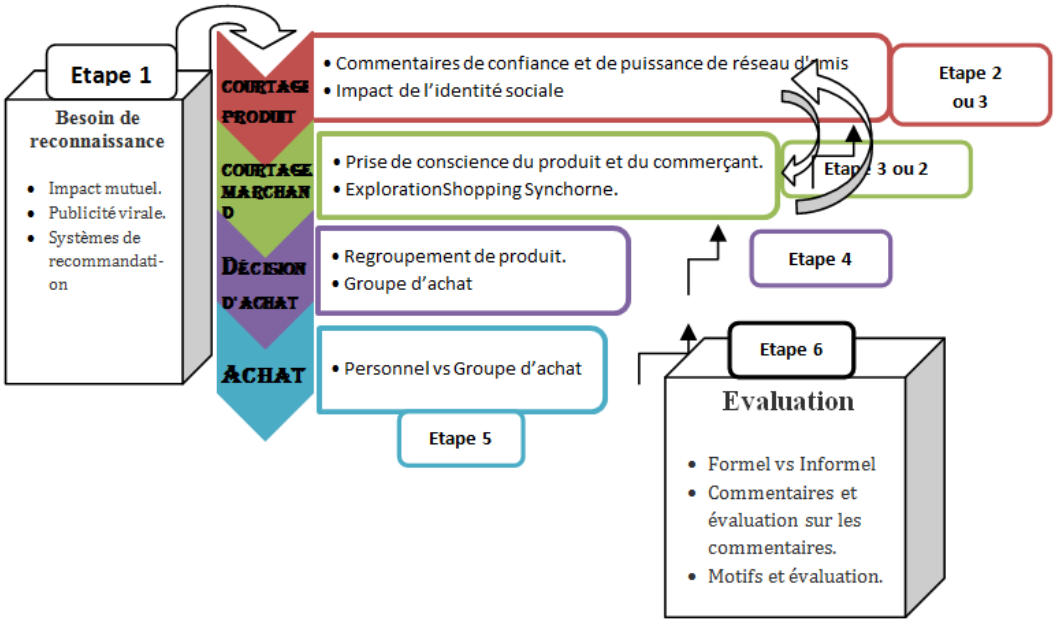
Shopping synchrone. Les réseaux sociaux permettent aux utilisateurs dans des endroits différents de magasiner ensemble et simultanément. Avec le Web 2.0, les pages Web peuvent être intégrées dans des outils de chat, et un groupe de personnes est capable de naviguer ensemble sur le Web tandis qu'il communique sur les profils des produits (Fisher, 2010). Cette méthode de shopping synchrone conserve le plaisir de faire du shopping ensemble tout en bénéficiant des idées des autres. En fait, cette méthode reflète l'expérience de magasinage hors-ligne, où un groupe d'acheteurs visite un centre commercial et aide l'acheteur potentiel en discutant des produits et des marques. Mattel, fabricant de poupées Barbie, fournit le shopping synchrone sur son site Internet, afin que les enfants dans des lieux différents, puissent jouer ensemble et concevoir leur propre poupée Barbie.

4.3 COURTAGE MARCHAND

L'étape de courtage marchand compare les alternatives marchandes. Le résultat de la comparaison peut conduire à la prochaine étape du processus de commerce social ou d'un circuit de retour à l'étape précédente et de mener plus de recherches (Annexe 2). À ce stade, l'acheteur établit des critères pour l'évaluation des spécificités des produits marchands, ainsi que des promotions et des accessoires que fournit un commerçant. De plus, la relation client-commerçant joue un rôle dans la décision de l'acheteur de choisir un commerçant. Scanzoni (Scanzoni, 1979) a identifié cinq phases dans le développement de la relation commerçant-client dans un marché classique, à savoir la sensibilisation, l'exploration, l'expansion, l'engagement, et la dissolution.

4.4 DÉCISION D'ACHAT

Les mêmes phases s'appliquent à un marché en ligne, les deux premiers ayant un impact direct sur le courtage marchand. (Voir Graphique 2 : **Processus de prise de décision dans le social E-Commerce**).



Graphique 2 : Processus de prise de décision dans le social E-Commerce

Sensibilisation. La sensibilisation se réfère à une partie reconnaissant une autre partie comme un partenaire d'échange possible. Cela signifie que les cyberacheteurs comprennent ce que leur fournit un commerçant comme produit ou service nécessaire dans l'état désiré. La présence du commerçant dans les réseaux sociaux, que ce soit officiellement ou officieusement, amplifie la sensibilisation des cyberacheteurs du commerçant. Amazon a développé une méthode pour amplifier sa reconnaissance en offrant des liens affiliés à ses utilisateurs, de sorte lorsque les utilisateurs parlent d'un livre sur leur blog, ils peuvent utiliser le lien affilié de sorte à diriger les autres à la description du livre hébergé sur Amazon. Dans cette situation gagnant-gagnant, les descriptions des livres sont à la disposition des cyberacheteurs, tandis qu'Amazone bénéficie des avantages de la reconnaissance et de l'augmentation des ventes.

Exploration. Les cyberacheteurs évaluent les avantages, les charges, les engagements et les conditions de l'accord associé avec le vendeur. Les premiers achats sont proposés en tant que facilitateurs pour l'évaluation des avantages et des inconvénients des produits ou services, tout en augmentant la confiance (Dwyer et al., 1987). Mais les réseaux sociaux aident à sauter l'étape d'achat procès et à aller directement à la phase d'exploration. La qualité des critiques et des évaluations associées avec le marchand, en particulier ceux qui viennent de personnes de confiance, accélère cette étape. Les cyberacheteurs s'appuient généralement sur des recommandations d'autres personnes. Par exemple, un compte Twitter nommé «AskAroundOttawa » donne la possibilité aux résidents d'Ottawa d'obtenir une rétroaction rapide sur les questions liées à Ottawa. Un utilisateur peut recevoir des centaines de retours d'enquêtes au sujet d'un restaurant servant une cuisine spécifique. Par ailleurs, les commerçants peuvent offrir des promotions et des rabais sur leur profil social qui permet aux utilisateurs d'être à jour plus fréquemment qu'un site Web.

Cette étape (alias négociation) est l'endroit où le prix et autres conditions de la transaction sont déterminés. Similaire aux deux précédentes, cette étape ne conduit pas toujours à l'étape suivante. Il y a une possibilité que le client retourne aux étapes précédentes pour faire une analyse plus approfondie (annexe 2). Comme les réseaux sociaux comptent sur les membres et les communautés, deux types d'achats existent: les achats individuels et les achats de groupe. La valeur des réseaux sociaux est plus apparente dans les achats groupés.

Une fois qu'un client choisit le commerçant et procède à la phase d'achat, le commerçant va essayer d'extraire de l'achat un maximum de bénéfice, par exemple en utilisant des systèmes de recommandation et de suggestion d'accessoires ou de produits connexes. Recommander des systèmes de levier des activités des cyberacheteurs au sein des réseaux sociaux permet d'identifier leurs intérêts et les habitudes pour qu'ensuite on recommande le bon produit pour eux. Les produits en Bundle qui se traduisent généralement par de meilleurs prix pour que la clientèle puisse commencer une nouvelle tendance commerciale sociale. Si il y a un choix dans les accessoires proposés, les cyberacheteurs peuvent faire retourner le produit et les étapes de courtage marchand permet de réexaminer la décision sur le choix des accessoires.

Le processus d'achat peut impliquer de multiples cyberacheteurs, surtout quand la marchandise est un abonnement à un produit numérique (par exemple Safari Books). Bien que les prix de gros et le groupe étaient toujours disponibles pour les différents produits, la plupart des produits sont vendus un à la fois parce que les cyberacheteurs ont généralement besoin d'un élément. Cependant, les communautés sociales ont le potentiel d'échanger cette situation. Les communautés au sein d'un réseau social peuvent être formées à adopter un produit, de sorte à augmenter les ventes et baisser de prix. CommunityShopper (www.communityshopper.com) a récemment lancé un service qui permet aux cyberacheteurs d'acheter des produits dans les groupes. Les cyberacheteurs peuvent rejoindre le service et former des groupes en montrant l'intérêt qu'ils ont pour les différents produits, conduisant l'achat de groupe. CommunityShopper exploite également la puissance d'autres réseaux sociaux, de sorte que toute acquisition ou manifestation d'intérêt peut-être affichée sur le compte Twitter de l'utilisateur.

En général, les réseaux sociaux offrent potentiellement aux cyberacheteurs et aux commerçants les possibilités suivantes: Rangement des produits (1): systèmes de recommandation : recommander des accessoires ou des produits connexes à des cyberacheteurs basés sur leurs relations sociales. Achat de Groupe (2): permet aux cyberacheteurs d'utiliser leur pouvoir d'achat collectif pour obtenir des prix plus bas.

4.5 ACHETER

Bien que l'achat est une étape importante dans le commerce social, les réseaux sociaux ne l'affectent pas de façon spectaculaire si l'achat se fait hors-ligne. Sur la base de ce qui a été cité précédemment, l'achat peut se faire individuellement ou en groupe. Dans le cas d'un achat individuel par le biais d'un réseau social, le client peut commenter l'influence des réactions sur son réseau. Par exemple, le statut d'un membre de fans de films (www.community.netflix.com) est mis à jour quand il achète un billet de cinéma. Si des amis voient son statut et n'aiment pas le choix de sa salle de cinéma, ils peuvent proposer de meilleures salles. Il peut alors prendre en considération leurs suggestions pour sa prochaine sortie de film. Dans le cas d'un achat de groupe, les commerçants, les cyberacheteurs et leurs réseaux sociaux tirent profit de l'achat. Les cyberacheteurs acquièrent le produit à un moindre coût, tandis que les réseaux sociaux multiplient les ventes pour les marchands. Par ailleurs, les commerçants peuvent promouvoir le produit en permettant aux cyberacheteurs de publier leurs achats sur leurs profils sociaux (peut-être pour gagner une acceptation sociale). En outre, le commerçant peut demander à la clientèle de recommander un produit à des amis ou de recommander des personnes qui sont intéressées par son produit.

Néanmoins, dans certains types d'achats, où l'achat a "une durée" associée avec elle, l'effet des réseaux sociaux sur cette étape peut augmenter. Par exemple, quand un client commande de la nourriture dans un restaurant, il s'est engagé à payer, même si le paiement sera achevé dans un proche avenir. L'action d'achat commence lorsque la commande est reçue. Si l'utilisateur poste des messages de son emplacement et de son intention de dîner sur un site de réseautage social tels que Foursquare (www.foursquare.com), des amis (membres de son réseau social) peuvent se joindre à lui. Foursquare encourage les utilisateurs à être des acheteurs fréquents et à afficher leur statut sur le site, en les récompensant avec une reconnaissance sociale et des promotions.

4.6 ÉVALUATION

La phase post-achat est la dernière phase et probablement l'étape la plus influente dans le modèle du commerce social. Elle affecte toutes les étapes précédentes, implique le service clientèle, et le plus important : l'évaluation de la satisfaction de l'expérience d'achat. Il s'agit d'une étape de transition pour que les cyberacheteurs passent d'influencés à des prescripteurs potentiels. La rationalité de la décision prise par le client est évaluée, ce qui conduit à la satisfaction ou la dissonance cognitive. Les commentaires en ligne sont importants si nous acceptons que les systèmes de critique de la clientèle en ligne soient l'un des canaux les plus puissants pour générer du bouche-à-oreille en ligne (Foster &Rosenzweig, 1995; Godes & Mayzlin, 2004). Cependant, tous les chercheurs s'accordent sur l'impact des revues en ligne sur les ventes. Les résultats de désaccord sont dû au fait que certains chercheurs se concentrent sur l'aspect convaincant de commentaires en ligne et sur l'évaluation de la qualité des produits dans les commentaires, tandis que d'autres se concentrent sur la sensibilisation des utilisateurs et la diffusion de la parole sans accorder une attention à la qualité des produits (Duan, Gu, &Whinston, 2008). Néanmoins les critiques ont une relation positive avec la qualité de l'expérience de magasinage. Si un produit se vend bien, alors le nombre de commentaires va croître et finira par provoquer une plus grande reconnaissance (Eliashberg & Shugan, 1997). Le nombre de commentaires positifs au cours d'une certaine période de temps est également un signe d'augmentation des ventes futures, de sorte que les commerçants peuvent prévoir les ventes et affecter des ressources pour plus de production.

Les critiques peuvent être divisées en trois catégories: les commentaires, les avis d'experts, et les avis sponsorisés. Bien qu'il soit prévu que les critiques d'experts qui aient le plus d'effet sur la prise de décision de la clientèle, en réalité, les informelles et les avis des utilisateurs affectent le plus les cyberacheteurs (Eliashberg & Shugan, 1997). Les entreprises devraient donc se focaliser sur l'encouragement des cyberacheteurs à générer des commentaires personnalisés.

Dans les réseaux sociaux, les cyberacheteurs sont encouragés à laisser des commentaires pour plusieurs raisons. Une importante raison est que les membres de réseaux sociaux cherchent à se faire reconnaître et tenter de montrer qu'ils sont toujours en première ligne, ce qui est plus vérifiable dans les réseaux sociaux où les membres se connaissent, par conséquent, ils s'attendent à la satisfaction sociale. Foursquare, par exemple, fournit des badges pour accorder la reconnaissance sociale de ses utilisateurs quand ils postent des critiques. Une autre incitation à laisser des critiques est d'aider les amis lors de la prise de décision en fournissant des expériences personnelles avec des produits ou services. Alors que le nombre et la qualité des commentaires changent en fonction des produits, une plus grande attention est dirigée vers les commentaires d'une critique (Eliashberg & Shugan,1997). Faire confiance à un avis ou une critique dans un réseau d'amis est plus facile puisque les utilisateurs sont conscients du background du critique (Kim et al. 2008).

À la lumière de ce qui précède, les réseaux sociaux sont mieux pour la production d'avis que les sites marchands.

5 CONCLUSIONS

Le Web 2.0 a généré un nouveau flux d'e-commerce nommé le commerce social, permettant aux cyberacheteurs d'exploiter la puissance du web social pour prendre des décisions plus précises. Bien que les réseaux sociaux aient un impact sur les décisions d'achat des cyberacheteurs ", peu d'études ont porté sur de telles influences parce que jusqu'à récemment les données sur les effets de l'interaction sociale sur les ventes n'ont pas été suffisamment analysées. Avec un nombre élevé de cyberacheteurs utilisant le web social, les entreprises développent des outils pour atteindre plus de cyberacheteurs et pour créer des produits et une notoriété pour la marque.

Ce document passe en revue et évolue les cadres existants et présente l'influence du web social sur le commerce électronique au niveau de la prise de décision dans un modèle global. Le modèle guide tous les acteurs impliqués dans le commerce social (entreprises, les développeurs et les cyberacheteurs) en tirant parti de la puissance des réseaux sociaux. Cela inclut l'activation des entreprises à améliorer leurs campagnes de marketing et à augmenter les ventes. À l'autre extrémité, les cyberacheteurs sont mieux habilités par le biais des achats plus éclairés. Tout cela est possible lorsque les développeurs se mettent à créer des outils plus ciblés pour les communautés.

En utilisant les bons outils à bon escient, l'e-commerce des entreprises peut en fin de compte augmenter les ventes tout en réduisant les coûts de marketing. Nous croyons que l'e-commerce des entreprises peut bénéficier de l'analyse du comportement du client dans l'expérience de magasinage social. Ils doivent aussi reconnaître et appliquer les bonnes stratégies à la bonne étape de la prise décision de l'achat. Le modèle d'affaires guide à travers le processus de sélection des bonnes stratégies pour différents produits et différents groupes cibles, puisque le modèle fournit une vue d'ensemble des techniques possibles pour l'emploi de réseaux sociaux dans les entreprises et leurs effets positifs et négatifs. Le résultat rend le web social un outil supplémentaire pour être utilisé par les entreprises afin d'influencer les achats des cyberacheteurs.

Le modèle explore différents outils de commerce social avec leurs avantages et leurs défauts prévus. Les développeurs de systèmes de commerce sociaux peuvent utiliser le modèle pour améliorer les technologies actuelles.

Les cyberacheteurs qui ne disposent pas des informations complètes au sujet d'un produit ou un service désirent d'apprendre à partir d'autres cyberacheteurs. En outre, la psychologie humaine suggère que les gens sont intéressés à posséder ce que leurs amis ont, si ils en ont besoin ou non. Voir les produits ou en entendre parler peut éveiller des besoins chez la clientèle. Les critiques de haute qualité et des fonctionnalités sur les sites de e-commerce qui se connectent à des réseaux marchands peuvent encourager ou décourager les achats de produits spécifiques provenant de marchands spécifiques. Les cyberacheteurs sont les bénéficiaires ultimes du modèle, car ils améliorent les services qui leur sont fournis par les entreprises et les développeurs.

Conclusion, les résultats montrent que le principal moteur du commerce social est l'interaction et la participation de l'utilisateur. Les entreprises devraient encourager les utilisateurs à s'engager plus dans la fourniture de produits et de commentaires liés aux marchands sur leurs réseaux sociaux et une compréhension globale des stratégies de commerces sociaux est nécessaire pour les gestionnaires.

REFERENCES

[1] Anderson, C. H., & Vincze, J. W. (2000). Stra-tegic marketing management. Houghton Mifflin.

[2] Bearden, W. O., Calcich, S. E., Netemeyer, R., & Teel, J. E. (1986). An Exploratory Inves-tigation Of Consumer Innovativeness And Interpersonal Influences. Advances in Consumer Research, 13(1), 77-82.

[3] Belk, R. W. (1988). Possessions and the Ex-tended Self. Journal of Consumer Research, 15(2), 139. doi:10.1086/209154

[4] Bettman, J. R. (1979). An information processing theory of consumer choice. Addison-Wesley Pub. Co.

[5] Campbell, C. (1998). Consumption and the Rhetorics of Need and Want. J Design Hist, 11(3), 235-246. doi:10.1093/jdh/11.3.235

[6] Duan, W., Gu, B., & Whinston, A. B. (2008). Do online reviews matter? - An empirical investigation of panel data. Decis. Support Syst., 45(4), 1007-1016.

[7] Dwyer, F. R., Schurr, P. H., & Oh, S. (1987). Developing Buyer-Seller Relationships. The Journal of Marketing, 51(2), 11-27.

[8] Eliashberg, J., & Shugan, S. M. (1997). Film Critics: Influencers or Predictors? The Journal of Marketing, 61(2), 68-78.

[9] Engel, J. F., & Blackwell, R. D. (1982). Consumer behavior. Dryden Press.

[10] Fisher, S. (2010, February). Social Commerce Camp - Killer Social Commerce Experience. Retrieved from http://www.slideshare.net/stevenfisher/social-commerce-camp-killer-social-commerce-experience

[11] Foster, A. D., & Rosenzweig, M. R. (1995). Learning by Doing and Learning from Oth-ers: Human Capital and Technical Change in Agriculture. The Journal of Political Economy, 103(6), 1176-1209.

[12] Godes, D., & Mayzlin, D. (2004). Using Online Conversations to Study Word-of-Mouth Communication. Marketing Science, 23(4), 545-560.

[13] Green, H. (2008, September 25). Making So-cial Networks Profitable. BusinessWeek.

[14] Retrieved March 11, 2010, from http://www.businessweek.com/magazine/content/08_40/b4102050681705.htm

[15] Guttman, R. H., Moukas, A. G., & Maes, P. (1998). Agent-mediated electronic com-merce: a survey. Knowl. Eng. Rev., 13(2), 147-159.

[16] Howard, J. A., & Sheth, J. N. (1969). The Theory of Buyer Behavior. New York, NY: Wiley.

[17] Howe, J. (2006, June). The Rise of Crowd-sourcing. WIRED. Magazine, Retrieved Feb-ruary 2, 2010, from http://www.wired.com/wired/archive/14.06/crowds.html

[18] Iyengar, R., Han, S., & Gupta, S. (2009). Do Friends Influence Purchases in a Social Network? SSRN eLibrary. Retrieved from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1392172

[19] Jansen, B. J., Zhang, M., Sobel, K., & Chow-dury, A. (2009). Micro-blogging as online word of mouth branding. In Proceedings of the 27th international conference extended abstracts on Human factors in computing systems (pp. 3859-3864). Boston, MA, USA: ACM. doi:10.1145/1520340.1520584

[20] Jonah Berger, & Chip Heath. (2007). Where Consumers Diverge from Others: Identity Signaling and Product Domains. Journal of Consumer Research: An Interdisciplinary Quarterly, 34(2), 121-134.

[21] Kim, Y. A., Le, M., Lauw, H. W., Lim, E., Liu, H., & Srivastava, J. (2008). Building a web of trust without explicit trust ratings. In ICDE 2008. Presented at the Workshop on Data Engineering for Blogs, Social Medial and Web 2.0, Mexico.

[22] Kim, Y. A., & Srivastava, J. (2007). Impact of social influence in e-commerce decision making. In Proceedings of the ninth inter-national conference on Electronic com-merce (pp. 293-302). Minneapolis, MN, USA: ACM. doi:10.1145/1282100.1282157

[23] Leitner, P., & Grechenig, T. (2008). Collabora-tive Shopping Networks: Sharing the Wis-dom of Crowds in E-Commerce Environ-ments. In BLED 2008 (Vol. 21, p. 321).

[24] Leitner, P., & Grechenig, T. (2009). smart shopping spaces: connecting merchants and consumers by innovative online marketplaces. Presented at the IADIS Interna-tional Conference e-Commerce 2009.

[25] Lorenzo, C., Constantinides, E., Geurts, P., & Gómez, M. (2007). Impact of Web Expe-rience on e-Consumer Responses. In E-Commerce and Web Technologies (pp. 191-200). Retrieved from http://dx.doi.org/10.1007/978-3-540-74563-1_19

[26] Maes, P., Guttman, R. H., & Moukas, A. G. (1999). Agents that buy and sell. Commun. ACM, 42(3), 81-ff. doi:10.1145/295685.295716

[27] Nicosia, F. M. (1966). Consumer decision processes : marketing and advertising implications. Englewood Cliffs, N.J. :: Pren-tice-Hall,

[28] Palmer, M. (2008, January 21). Social shoppers find goods well recommended. Finan-cial Times. Retrieved March 5, 2010, from http://www.ft.com/cms/s/0/349ca1ba-c7c3-11dc-a0b40000779fd2ac.html?nclick_check=1

[29] Scanzoni, J. (1979). Social Exchange and Be-havioral Interdependence. In Social exchange in developing relationships. Aca-demic Press.

[30] Schwartz, M. F., & Wood, D. C. M. (1993). Dis-covering shared interests using graph analysis. Commun. ACM, 36(8), 78-89. doi:10.1145/163381.163402

[31] Stephen, A. T., & Toubia, O. (2009). Deriving Value from Social Commerce Networks. SSRN eLibrary. Retrieved from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1150995

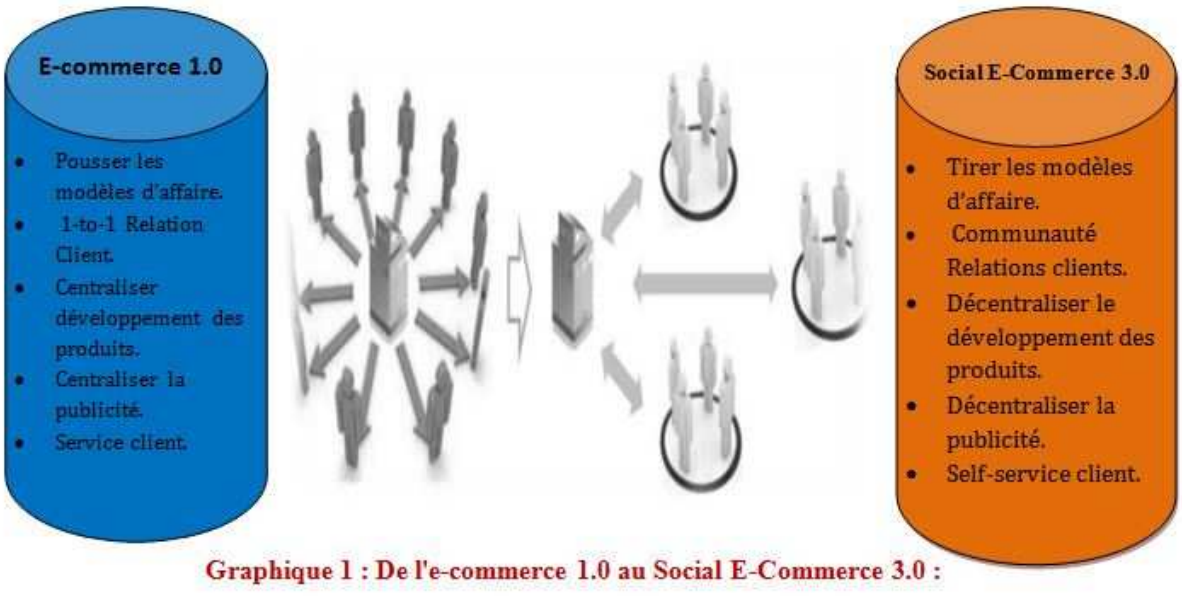
[32] Trusov, M., Bodapati, A. V., & Bucklin, R. E. (2009). Determining Influential Users in Internet Social Networks. SSRN eLibrary. Retrieved from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1479689

[33] Wellman, B. (1999). Networks in the global village. Westview Press.

[34] Wu, B., Ye, Q., Yang, S., & Wang, B. (2009). Group CRM: a new telecom CRM frame-work from social network perspective. In Proceeding of the 1st ACM international workshop on Complex networks meet information & knowledge management (pp.3-10). Hong Kong, China: ACM. doi:10.1145/1651274.1651277

[35] Yang, W., Dia, J., Cheng, H., & Lin, H. (2006). Mining Social Networks for Targeted Adver-tising. In Proceedings of the 39th Annual Hawaii International Conference on System Sciences - Volume 06 (p. 137.1). IEEE Computer Society. Retrieved from http://portal.acm.org/citation.cfm?id=1109714.1109905

ANNEXE 1 : GRAPHIQUE 1



Graphique 1 De l'e-commerce 1.0 au Social E-Commerce 3.0

ANNEXE 1 : ANALYSE TROPES

Méthodologie

Expérimentations et Mise en place

Pour l'amont qualitatif destiné à préparer le quantitatif final, nous avons procédé à une étude qualitative auprès de 24 bénévoles motivés (dont 14 femmes) que nous avons recrutés parce qu'ils étaient intéressés par le Web, le E-marketing et la pratique et le management des communautés virtuelles. Ils ont une moyenne d'âge comprise autour 26 ans environs (minimum 21 ans et maximum 45 ans). Ils ont des comptes, des groupes dans divers réseaux sociaux et aussi ils ont souvent visité les e-magasins (au moins une fois tous les mois), ce qui indique qu'ils peuvent être dans une certaine mesure représentatifs et des acteurs modèle du Social E-Commerce. Ce sont aussi des « acteurs » qui connaissent le vocabulaire du marketing comme du Web, ce qui implique que notre échantillon soit représentatif des « Cyberconsommateurs » et plus que des consommateurs classiques. Notre guide d'entretien qualitatif a été bâti à fur à mesure de nos discussions. Nous avons centré nos réunions et conversations autour de la communauté virtuelle et son importance dans le processus d'achat dans le commerce électronique et plus particulièrement sur les réseaux sociaux.

Nous avons préparé notre échantillon à cette expérimentation sur trois étapes :

- étape 1 : Présentation du projet et des objectifs

Dans cette étape, nous avons réunis l'ensemble des contributeurs à qui nous avons expliqué nos objectifs concernant nos recherches relatives aux effets des communautés virtuelles sur le e.commerce. Nous avons expliqué le fonctionnement de notre plateforme (www.info-webmagazine.com) qui est une forme de site web de réseaux sociaux orienté vers le travail collaboratif à travers l'internet. Nous avons invité les membres à nous parler des communautés virtuelles et de son importance dans le processus d'achat dans le commerce électronique et plus particulièrement sur les réseaux sociaux. Nous

avons aussi insisté sur le fait de bien suivre les publications des membres et de faire les efforts nécessaires pour les commenter et les compléter.

- étape 2 : Apprentissage et adoption de l'outil de l'étude

Cette phase a consisté à tester la plateforme (www.info-webmagazine.com) et s'assurer que nos contributeurs ont bien assimilé ce que nous leur avons demandé. Cette phase n'a pas été réalisée en tête à tête mais plutôt via le web, en non résidentiel.

- étape 3 : Validation des connaissances et déclanchement de l'expérimentation

Cette étape a été réalisée pour faciliter les échanges entre les membres et d'éclaircir les différentes interrogations et zones d'ombres pouvant freiner et/ou empêcher la réussite de notre expérimentation. C'est le point de départ de notre étude qui était exclusivement sur internet.

L'approche sémantique amont : phase de création des scénarios

Nous avons alors crée un « scénario »[1] à partir des « références utilisées » au plan sémantique bâti à partir des thèmes essentiels évoqués. Cette « grille d'analyse » permet de bien visualiser l'essentiel des préoccupations autour des systèmes de recommandation. De plus le modèle Tropes applique le scénario en tant que grille « automatique » sur les textes qualitatifs recueillis et extrait les « phrases représentatives » qui aident à sélectionner les propositions ou affirmations qui serviront comme base pour notre recherche et analyse de la littérature. Naturellement les phrases réelles des exercices cognitifs devront être le plus souvent réécrites pour des raisons de style, de grammaire…

Les textes produits par les discussions et avis individuels ont représenté une dizaine de pages qui ont été reprises pour pouvoir être traitées par un logiciel spécialisé dans les études sémantique Tropes® qui nécessite une mise en place de corrections orthographiques[2] et ponctuation[3].

Recueil des expressions et Création du scénario

Nous avons sollicité notre échantillon de 24 personnes à la fois sur un réseau social et sur Skype et également en offline car certains de nos contributeurs sont des étudiants en master et qui mis en contribution certains de leurs camarades. Les textes ont été repris sur un fichier Word avec correction des textes pour créer des phrases comprises par l'ordinateur (expressions, ponctuation) sans modifier sur le fond l'avis exprimé. Le texte d'une dizaine de pages a été ensuite passé sous le modèle progiciel Tropes ®. En clair nous recherchons une structure de compréhension qui dépend en partie de nos attentes, celles-ci donnant lieu à des créations de thèmes, si cette démarche apparaît justifiée par l'analyse brute des références obtenues. Les Scénarios sont conçus pour enrichir et filtrer les classes d'équivalentes en fonction d'une stratégie d'analyse. Ce sont des ontologies spécifiques, qui permettent de :

-a/ définir les propres classifications en fonction du vocabulaire correspondant à l'environnement d'étude.

-b/ modifier ou restructurer les dictionnaires du logiciel Tropes ®

-c/ définir une grille d'analyse pour générer automatiquement un rapport. Des Scénarios ont été constitué d'un certain nombre de groupes sémantiques, c'est-à-dire de regroupements de mots et/ou de classes d'équivalents, qui peuvent être hiérarchisés sur neuf niveaux de profondeur. La plupart des regroupements peuvent être réalisés à la souris, à l'intérieur de l'outil Scénario ou en interaction avec la fenêtre principale de Tropes. Il suffit de créer un groupe et de mettre quelque chose dedans.

Interprétation et analyse des résultats

Application du scénario comme grille d'analyse

Notre approche a été faite en respectant trois étapes :

---

[1] Un « scénario » de Tropes® est une sorte de grille d'analyse automatique des textes permettant l'émergence du graphe des acteurs dans l'ensemble, des graphes pour chaque thème avec la proximité des autres thèmes évoqués. Le scénario est une construction ad hoc à partir de nos objectifs et de l'analyse des termes utilisés.

[2] Pour la reconnaissance naturelle des mots et des familles verbales.

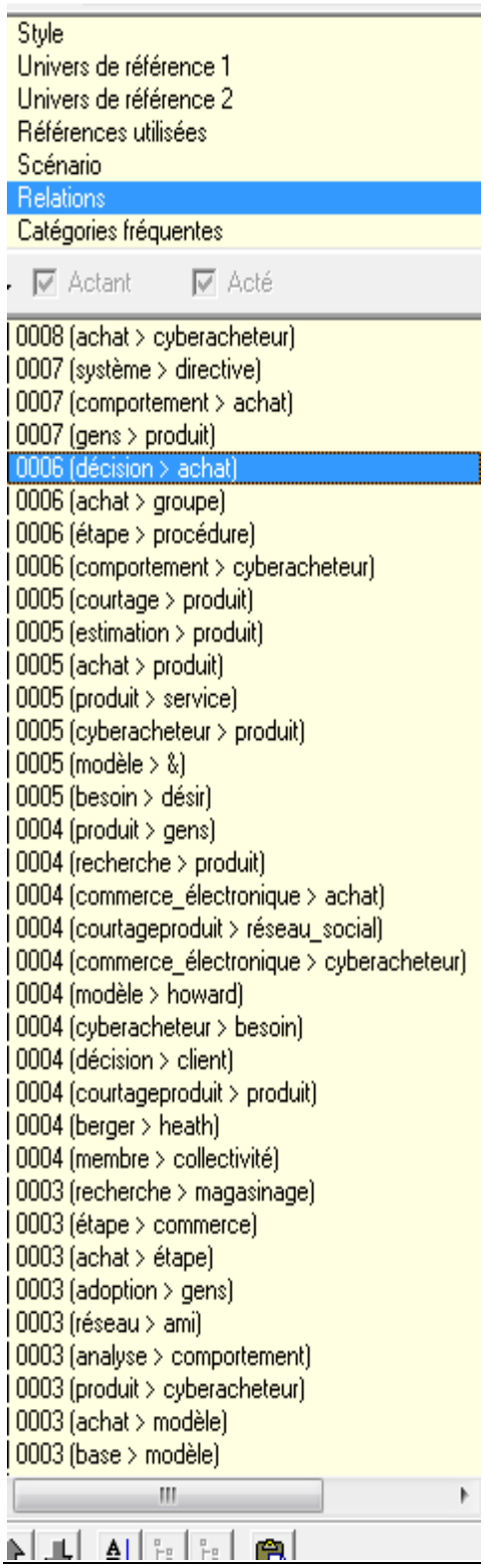
[3] Pour la reconnaissance des liens implicites entre les sujets.

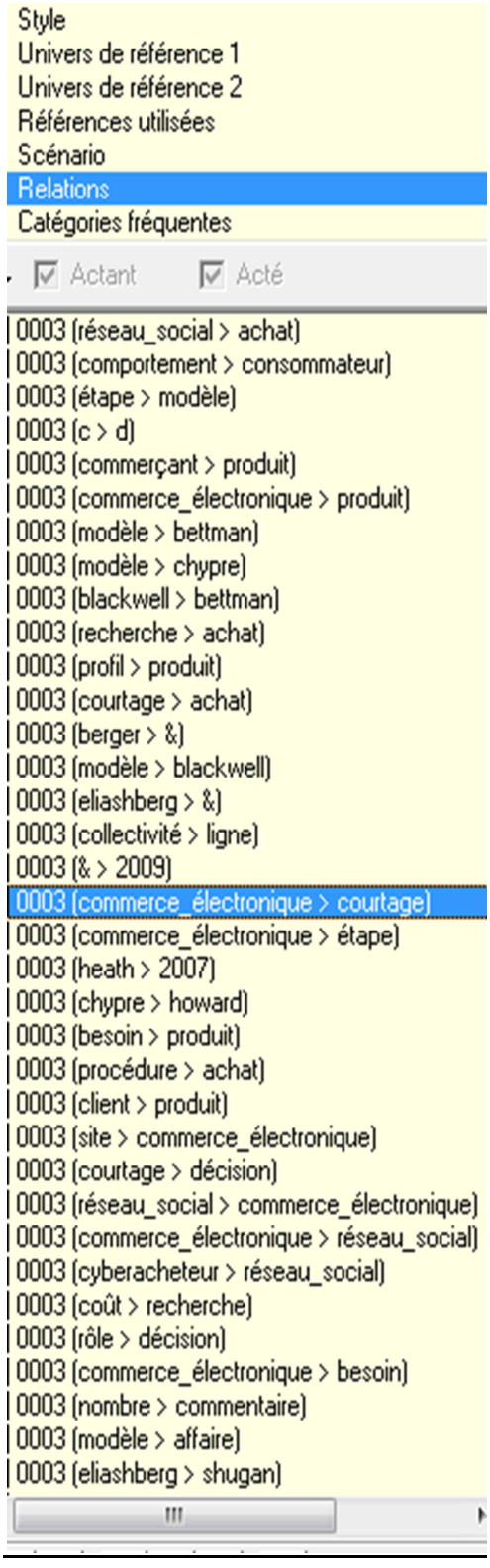
- Etape 1 : C'est la période pendant laquelle les contributeurs et les membres de notre équipe de recherche ont travaillé et discuté autour des avantages relatives aux effets des communautés virtuelles sur le processus de décision d'achat sur internet sans aborder le concept du Social E-commerce.

- Etape 2 : C'est la phase pendant laquelle nous avons introduit **le concept du** Social E-commerce aux contributeurs et aux membres de notre équipe de recherche.

- Etape 3 : C'est au cours de cette étape que les contributeurs et les membres de notre équipe de recherche ont commencé la façon d'utiliser la communauté virtuelle afin d'affecter et/ou d'influencer l'internaute dans ses décisions d'achats.

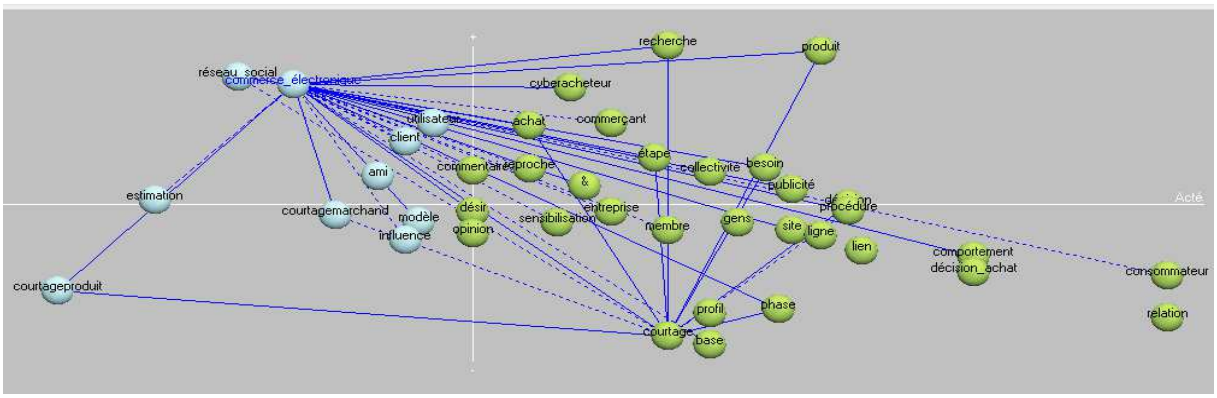
ANNEXE 2 : SÉNARIOS POSSIBLES



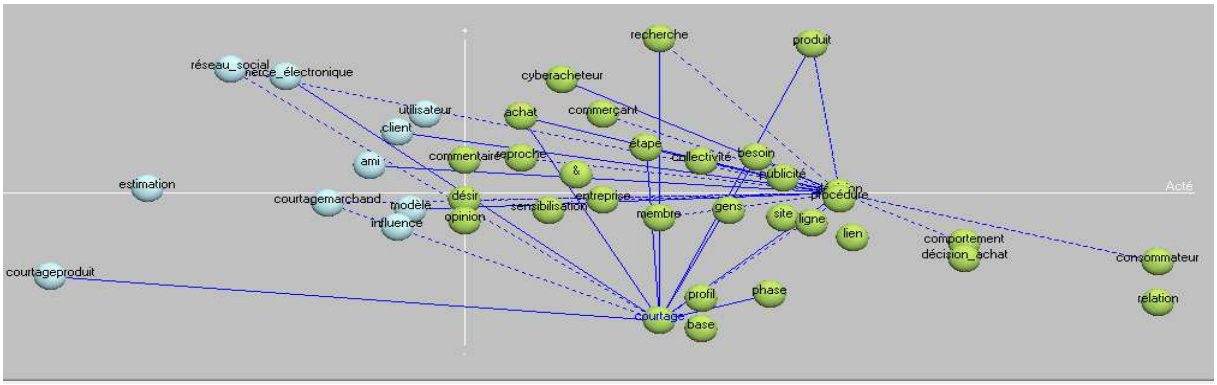


ANNEXE 3 : MISE EN EVIDENCE DES FACTEURS SELON LES SENARIOS POSSIBLES

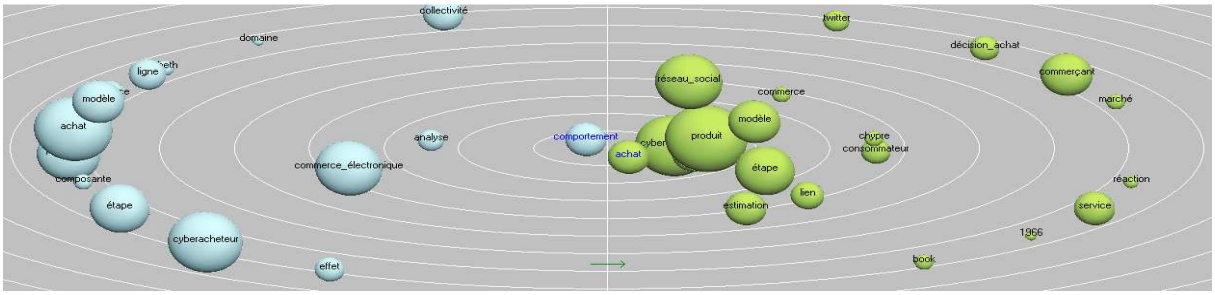
Annexe-3_Graphique 1



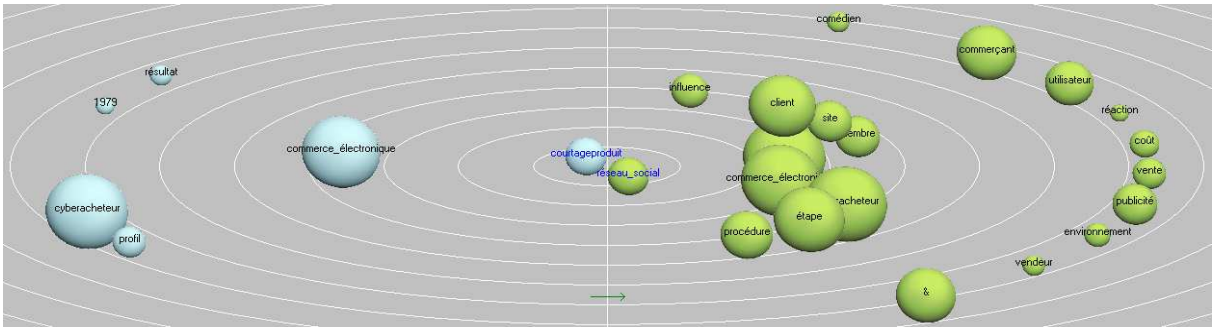
Annexe-3_Graphique 2



Annexe-3_Graphique 3



Annexe-3_Graphique 4



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Women and Non Timber Forest Product Exploitation: the case of Prunus Africana in the Highlands of Mount Cameroon

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ABSTRACT: Prunus Africana (P.A.) is an essence of mountainous areas whose bark is sought after in the international market for the treatment of benign prostate hypertrophy. This product is found particularly in the surroundings of Mount Cameroon, where women's groups play a crucial role in the marketing channel of some Non Timber Forest Products (NTFP). However, this specie's exploitation is strictly framed by the standards of the Convention on International Trade in Endangered Species of Wild Flora and Fauna, making it an extremely vulnerable resource that is threatened by the effects of climate change. This contribution has as purpose to question the implication of rural women of the Mount Cameroon region in the value chain of PA, a Non Timber Forest Product that is a resource of important value in the forestry product trade; also, to appreciate the relationship between the resource profitability and inequity in access.

KEYWORDS: Rural women, Forest resources management, Policy, Social regulation, Access.

1 INTRODUCTION

Gender is a concept that gradually made its entry into the international legal nomenclature, especially in the environmental field. Agenda 21 recognizes the importance of the knowledge and traditional practices of women, and underscores the contribution women have made to biodiversity conservation (section 24.2 (c)).The preamble of the Convention on biological diversity in its 13th section states "*the vital role that women play in the conservation and sustainable use of biological diversity and affirming the need for the full participation of women at all levels of policy-making and implementation for biological diversity conservation…*". In view of the full achievement of this objective, the United Nations adopted the Millennium Development Goals that commit States in its third goal "*to promote gender equity and empower women*" at all levels. These texts are adopted in response to the social considerations related to gender which are the economic, political and cultural attributes associated with being a man or a woman. Considering the variability of the social attributes given to men and women depending on national, cultural and temporal space [1](**Manfre & Rubin,** 2012), gender issues have been for many decades neglected and marginalized in many forest and environmental policies [2](**Aguilar et al, 2011**). Nevertheless, there is a change of perspective with the advent and spread of the concept of sustainable development; more attention is given to the study of the process of change that the said concept implies. It promotes a better management of resources, an establishment and strengthening of institutions and an orientation of investment for a combination of variables that contribute in promoting the capacity of the present generation to satisfy their needs without compromising the ability of the future generations to meet theirs [3](**Bruntland report, 1987**). Among the targeted variables, the question of the involvement of women is a constant present topic in forums' discussion. Lorena Aguilar et al. talk about the vital role of gender mainstreaming in forest and environmental policies by stating that "*If we ignore gender, there is no*

doubt that we will fail in our efforts to strengthen forests' contribution to poverty reduction, biodiversity conservation and sustainable development" **[4](Aguilar et al, 2011).**The Cameroonian forest is part of the Congo basin, second world reserve of carbon. It covers more than 22 million hectares of forest, about 47 per cent of the national territory. This forest area is full of a wide variety of biological resources, including Non Timber Forest Product. They represent an anthropological and cultural fundamental element for the riparian populations. In Cameroon, as in most of the developing countries featuring a canopy, Non Timber Forest Product which is essentially composed of products other than lumber provides the maintenance of food security. Among these NTFPs, Piper Spp, Gnetum Spp, Cola acuminata, etc. In Cameroon, 82.3% of the rural population is involved in non-formal agriculture, among which 68.6% is made-up of women [5] (Institut National de la Statistique, 2008). The significant presence of women in this field is justified by their pronounced state of pauperization. In most cases, women involved in this sector are isolated in rural communities and are not self-governent. These women consider Non Timber Forest Product as a major source of income to meet their basic domestic needs and those of their families. In fact, many households depend on NTFP for their livelihood. They use these products to earn money to meet expenditures for basic necessities. Considering that non-formal activities are not counted among development factors in Cameroon, this study proposes itself to bring out the pertinence of upgrading activities related to the exploitation of Non Timber Forest Products to the formal sector that could thus contribute to the financial empowerment of rural women, who represent the most active population in the value chain. The Non Timber Forest Product exploitation produces the bulk of artisanal material of rural women, representations of their gastronomy, the basics of their mystical-religious belief and components of their traditional pharmacopoeia**.** According to the International Labour Organization, the non-formal sector refers to a set of units producing goods and services in view of creating jobs and revenues for the main actors. These units are characterized by a low organizational level, they operate at a very low scale, with no distinction between the labour and the asset as production factors; working relations are not built on contracts but on casual human connection. This state of facts contributes in limiting women in their participation in more rewarding activities in the value chain of Non Timber Forest Products, thus maintaining them in a state of vulnerability. In the same line, the economic policy on forest management in Cameroon seems confined to the woody resource (timber), the exploitation of Non Timber Forest Product remains a minor aspect in the forest action plans, as well as gender issues, which by dint of considering as a cross-cutting aspect in the dynamics of natural resources management in Cameroon, remains almost invisible in the implementation of adopted measures.

This article is designed to assess the dynamics of gender in the exploitation and management of Non Timber Forest Products, by studying gender social relations in the exploitation of Prunus Africana in the region of Mount Cameroon. It is precisely to focus on the level of women's involvement in this activity. This study has also as purpose to implicitly highlight the evolution of social representations in the attribution of arduous labour following gender criterion in accordance with social norms by the members of forestry rural communities.

2 BACKGROUND OF STUDY: *PRUNUS AFRICANA* PARTICULAR NON TIMBER FOREST PRODUCT IN THE PARTICULAR GEOGRAPHIC CONTEXT

Prunus Africana which is an endemic specie of tropical Africa and Madagascar, is found in 22 African countries specifically in East Africa (particularly in Ivory Coast, Sao Tomé, Ethiopia, Kenya, Uganda, South Africa, Madagascar, Congo, Democratic Republic of Congo, and Cameroon). Indeed, Prunus Africana is dominant in the afro-montane type forests where it grows between 900 m and 3000 m above sea level, in volcanic advanced material soils with good drainage. However, it is also found in transitional forests between the lowlands and Highlands and very rarely in the altitudes of less than 600 m. In Cameroon, Prunus Africana is more prevalent in the Southwest and Northwest regions. In these mountainous regions of the country, the plant has been farmed for long. Its economic importance is indicated by Cameroon's annual export of about 7300 tons since 2005, providing annual export revenues of about 1320 million CFA (2,738,027 US$). It is also one of the major income sources for forest based communities in the Highlands areas of Cameroon [6](**Ewusi, 1998**). Nearly half of the world's bark supply to date comes from Cameroon. Cameroon is the world's largest exporter of Prunus Africana with 38% of the market share from 1995 to 2004 and 48% since 2004, when Kenya stopped exporting. The main countries importing Cameroonian Prunus Africana since 2000 are France (53%), Spain (31%), Madagascar (11%), India, United States of America, Belgium and China (1percent). At the national level, about 80 percent of herbalists in the Southwest are reported to use *Prunus* as one of their key medicinal plants, out of a cornucopia of over 177 plants used [7](**Nfi et al., 2008**).

2.1 THE MOUNT CAMEROON REGION

Mount Cameroon is one of the striking landscapes of central Africa. It is distinguished by its environmental richness and the socio-political dynamics enlivening its management. Mount Cameroon is situated in the South West Region of Cameroon

in Central Africa. Considered as the highest mountain in West and Central Africa with an altitude of 4,095 meters, it expands from the Atlantic Ocean Gulf of Guinea to 20 kilometers inland. At 9.1 degrees east and 4.5 degrees north, Mount Cameroon is still an active volcano. The last eruptions were recorded in 1999 and 2000. Due to its volcanic origin, the surrounding soil is rich in nutrients and provides high fertility for both natural vegetation and farmland. According to the drastic changes in altitude, the natural vegetation is of great diversity and presents a sequence of vegetation forms like mangrove forests and freshwater swamps at sea level, evergreen lowland forests, sub -mountain and mountain forests to mountain and sub alpine grasslands (savannah) above 2000 m. These different habitats host various endangered and endemic species. Mount Cameroon is now a National park.

2.2 STUDY VILLAGES: VILLAGES AROUND THE MOUNT CAMEROUN NATIONAL PARK

The Mount Cameroon as a National Park hosts more than 90% of the exploitable Prunus Africana. It opened its doors to the exploitation of this Non Timber Forest Product in 2011.The population around Mount Cameroon is estimated to about 300,000 people of whom 2/3 live in urban and peri-urban areas, while the rest live in villages. Most of the village communities depend directly or indirectly on the mountain resources for their livelihoods. About 32 villages surround Mount Cameroon National Park. This study focuses on the villages where community forests are found as *Woteva* (1,865 hectares), *Etinde* (4,976 hectares), *Bakingili* (905 hectares), and where the exploitation activities have been more effective as *Mapanja*.

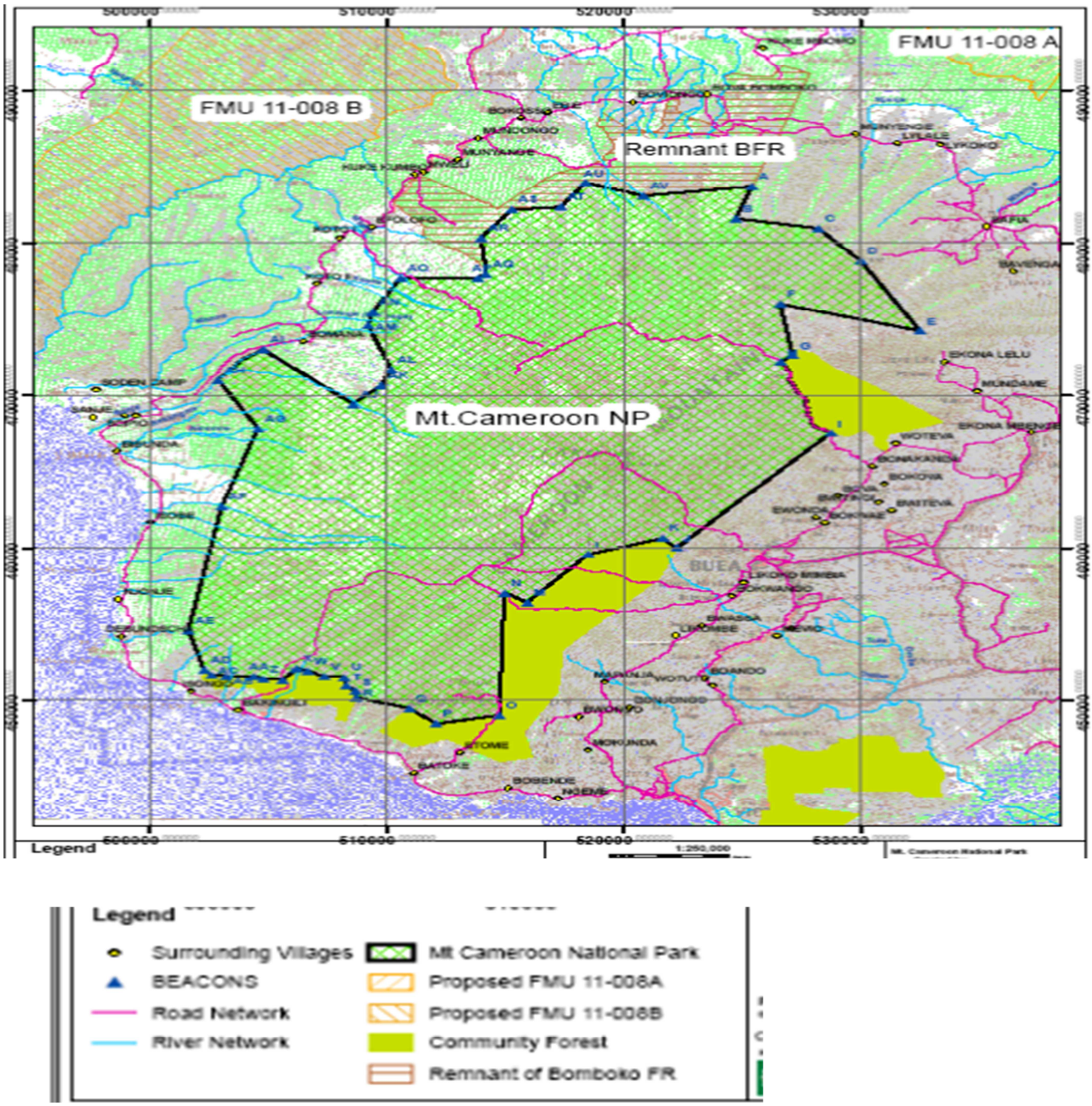


Fig. 1. Map of the study area. FMU= Forest management unity

3 MATERIAL AND METHODS

This study is based more on a qualitative than a quantitative approach. Indeed, in order to effectively carry out this study, existing literature on gender and forestry research was reviewed, such as case studies, reports, rules and regulations of forestry resources management dealing with the involvement of women in the exploitation of natural resources. Some information were gotten from the actors in the management of Prunus Africana in the South-West Region as Non-Governmental Organizations involved in field activities and the Ministry of Forest and Wild Life. The grounded theory method [8] (Glaser and Strauss, 1965) was used to adjust the interview guide for specific information derived from discussions with the actors in the region of Mount Cameroon. This led to the drafting of an objective report of the situation on the field. To achieve theoretical inference, these data were collected following about twenty sessions of discussions and interviews conducted in *Yaounde*, *Buea* and *Mapanja* in a period of two months. Also, semi-structured interviews were

conducted with 8 women directly involved in the management and exploitation of Prunus Africana in the region of Mount Cameroon. Discussion were also conducted with representatives of Convention on International Trade in Endangered Species of Wild Flora and Fauna in Cameroon, State and Council representatives, Traditional leaders involved in the sustainable management of Mount Cameroon and the exploitation of Prunus Africana. During a field trip in the village of *Mapanja* where the exploitation of Prunus Africana is carried out, data were collected through direct observation and reflectivity demonstration during discussion sessions with resource persons involved in the management of Prunus Africana in the Mount Cameroon region.

The theoretical stand adopted in this study focuses on a multidisciplinary analysis. Indeed, sociological and legal approaches were used to assess the role of women in the management and exploitation of Prunus Africana in Mount Cameroon Region. The legal approach enabled us to study the systemic and strategic involvement of women in the exploitation of this Non Timber Forest Product. Thus, through the systemic approach, legal texts were appreciated to better measure the scope to the sort. The strategic approach will help in identifying the various actors and the strategies that they use and that interfere with the status of women in the exploitation of this resource. The sociological approach on which this study relies is based on thorough analysis of the situation of women, with an interactionist perspective.

4 RESULTS AND DISCUSSION

4.1 WOMEN AND FORESTRY IN CAMEROONIAN LAW, FACTS AND SOCIAL PRACTICE IN THE CASE OF PRUNUS AFRICANA

The Cameroonian constitution (January 16th 1996) devotes equal access to resources for all citizens without distinction of sex or race. It thus gives an impersonal tone found in most of the Cameroonian laws, without special emphasis on gender. Forest legal reform from the beginning of the 1990s in Cameroon has promoted various forms of integration of local populations in the management of forest resources and revenues derived from forestry exploitation. However, the role and place of women are not explicitly taken into account, neither in forestry policy document nor in Act implementing the legislation. Thus, in the Cameroonian forest law (January 14th 1994), although the right of access to the resource of rural communities is instituted, there is no specific provision treating the case of women. Indeed, no statutory or regulatory provision imposes gender fairness within the Community institutions in charge of the management of forest resources or the distribution of profits generated by the exploitation of forest resources. The percentage of women involve in institutions in charge of natural resource management is not formally encouraged.

4.1.1 LEGAL RULES AND REGULATIONS OF THE EXPLOITATION OF PRUNUS AFRICANA IN MOUNT CAMEROON REGION

According to Law N° 94/01 of January 20th 1994 and its application Text N° 95/531/PM of August 23rd 1995 regulating the sector, Prunus Africana is classified in the category of "*special product*" whose exploitation is conditioned by several requirements. Among these requirements, there is the prior acquisition of a non-renewable annual exploitation license that indicates the area, quota and specifications of exploitation. In addition, several initiatives were undertaken for a sustainable management of Prunus Africana, among which the mainstreaming of ecological studies and Community based approach in the programs dealing with the exploitation of this product [9] **(Cunningham et al., 2002)**. The exploitation of this particular bark is conditioned by the achievement of management plans that integrate the inventories to assess the acceptable exploiting level which should necessarily be materialized by the allocation of quotas through which the State can ensure its sovereign control **(Awono et al., 2008)**. Moreover, people desiring to exploit PA for trade purposes should obtain an allocation of special permits for Prunus Africana bark exploitation called Prunus Allocation Units. In the region of mount Cameroun, AFRIMED is the main and exclusive trader of the Prunus Africana bark, with 200 tons of bark/ year on average. Due to their low education, low socioeconomic levels, little knowledge on owning and managing income generating activities, women are deprived of the benefits offered by the amendment adopted in the Non Timber Forest Products sector. This gives way to the marginalization or very low inclusion of women in the value chain of Prunus Africana.

4.1.2 WOMEN'S ATTRIBUTES IN THE EXPLOITATION OF *PRUNUS AFRICANA* IN MOUNT CAMEROON REGION

To analyse the role of women in the management of natural resources, it is important to appreciate their access and control on resources, and see how they influence the management of the resources through their participation.

The access of women to the exploitation of Prunus Africana is still difficult because the labour in its actual form is very tedious. In fact, the current method of harvesting is articulated in several stages: the peeling, package and transport. These tasks are carried out by harvesters recruited in the various surrounding villages, members of the community based organization which itself is essentially compound of male actors. The remuneration of these collectors amounts to 150francs

CFA per kilogram collected. Prunus Africana collectors travel considerable distances to reach the spaces allocated to its exploitation. The collection consists in the debarking of the quarter opposite shaft. The measurement is done during the debarking with a string measuring 95 centimeters in length that roughly corresponds to the circumference of a tree of 30 centimeters in diameter. Debarking is done with machetes from 1.30 meters from the ground to the first branch. Thus, to achieve this operation, collectors climb often on the shaft using a hitch. Packaging is the second step, it consists in gathering and giving faggot bark stripped of foam and impurities. Subsequently, tied packets are carried on the back or the head of the collectors to be transported on long distances.

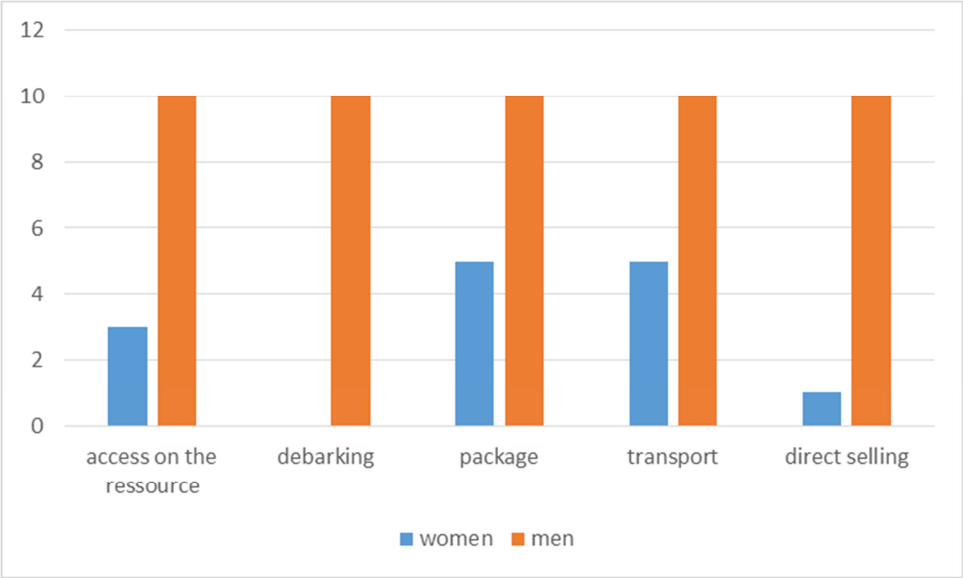


Fig. 2.percentage of distribution of tasks in the exploitation of prunus Africana, around mount Cameroon.

In the region of Mount Cameroon, women involved in the Prunus Africana harvest represent 6% of those active in the field. They are found mainly in the transportation and packaging of the barks collected by their husbands, brothers or sons also involved in the same activity. Several barriers contribute to limit the interest of women in the harvesting of this product in its actual practice in Mount Cameroon. First the arduous nature of this activity; Secondly, the time consuming nature of the harvesting of Prunus Africana; it takes a whole day to collect 20kilograms of bark of Prunus Africana. This then requires the desertion of household and agricultural tasks. Therefore, for women working in the field, the harvest of the bark becomes a temporary activity, to increase their income to invest in other activities. However, to diminish the difficulty due to distance, women organized themselves in groups to invest in the domestication of Prunus Africana in few villages. *Mapanja* for example is one of the villages where Prunus Africana has been domesticated.

4.2 THE PARTICIPATION OF WOMEN IN THE MANAGEMENT OF THE PRUNUS AFRICANA IN FORESTS COMMUNITIES

The ability to participate and the modalities of participation are conditioned by a number of factors which follows: social norms, values, assets [10] (**Agarwal B, 2001**), the political context and the socio-cultural uses. At the legal framework level, regulations provide the representation of all socio-economic categories in community management of forest resources. It is required from community forest management committees to have in their midst a representative of marginalized group without however specifying the number of women. In the three riparian community forests of Mount Cameroon where PA is exploited, there are very few women. There are so far four Community Forests among which three are active: *Woteva Bakingili* with 42 members including 2 women, *Etinde* (no women recorded), *Bimbia* (no women recorded) *Bonadikombo* (no women recorded).The women involved in the management of Prunus Africana operate through the Mount Cameroon Prunus Management Group which is the leading Non-Governmental Organisation that works in the exploitation of this Non Timber Forest Product in the Region of Mount Cameroon. This association brings together 29 villages around Mount Cameroon national park. As a matter of principle, all the autochthons of the villages are involved in the management of revenues from the sale of Prunus Africana barks. Organized in groups, they give their opinion on the projects developed in the community. It is at this level that the participation of women is really influential, because according to Mount Cameroon Prunus Management Group representatives, 70 percent of projects in villages mainly take into account the needs of women mentioned during consultations. Nevertheless, considering the low percentage of women involved in the activity and the

actual literacy men-women ratio which is stated at 0.88 [12](Employment and Growth Strategic Document, 2010), the opinion of these ones are stifled by the imposing number of the literate male actors.

4.3 STRATEGIC MEASURES TO CONSIDER

The analysis of value chain of the Prunus Africana collected in the Mount Cameroon Region shows that women do not effectively intervene in the valorisation of this product. How can women's participation and bargaining power in Prunus Africana value chain be improved? What kinds of platforms can supply timely market information and feedback to women? These two questions are the key points to boost the involvement of local women in the management of PA and restore fairness in the distribution of the profits from its exploitation. The gender mainstreaming strategy in the mount Cameroun region must start with the sensitization of women and men on the importance of equity in the sharing out of resources, and its impacts on the sustainable management of the Prunus Africana. This strategy has to be based on 3 factors: training and capacity building of the women, living the 29 villages members of Mount Cameroon Prunus Management Group, on the sustainable harvesting techniques (packaging, processing and regeneration); minimizing the arduous nature of efforts deployed to have access to the collection sites by promoting the domestication of Prunus Africana near villages; organizing the market at local level thereby limiting the involvement of intermediates.

Women should be encouraged to participate in training sessions on techniques of sustainable collection of Prunus Africana. The rural women's associations involved in the collection of other Non-Timber Forest Product should be invited to these trainings. During these training sessions, men and women have to be sensitized on the importance of women's involvement in this activity. Beyond the collection, this training should extend to methods of regeneration to encourage their actions for the domestication of this rare product near farms. In fact, the current methods of the bark exploitation are destructive, often leading to tree mortality and thus serious erode of the natural population of this specie [11]**(Tchoundjeu and al, 2002**). Most of the villages surrounding Mount Cameroon are located on high lands, which is conducive to the regeneration of the specie. This is particularly the case in the village of *Mapanja* and *Bokwango* where the domestication of Prunus Africana is carried out by an association of women in which there are two old harvesters. Plants of Prunus Africana from their site of origin have been replanted near farms and villages by these women in order to fit fully in the exploitation the Non Timber Forest Product. This initiative has as benefit the reduction of the hardship of the exploitation in areas which are located at far distances and significant altitudes that renders the activity very tedious. The implementation of these measures will contribute in diminishing the diagnosed disparities between men and women in the value chain of Prunus Africana.

A major challenge to the community based organization as Mount Cameroon Prunus Management Group is to access Prunus Africana barks markets abroad. Most of the barks exported from Cameroon to European markets are exported through long existing chain supply which is not profitable for the local community. In fact, while Prunus Africana is purchased from the local communities at 450 Francs cfa per Kilogram (0,99 US$) , it is resold 10 times more expensive to external corporations chartered for exportation. Such distribution of revenues marginalizes collectors who perceive not as much as the amount of effort they put into collecting the product. On the 450 francs cfa perceived by Mount Cameroon Prunus Management Group for the sale of one kilogram of Prunus Africana bark **(Awono, 2010)** the collectors earn 150 francs cfa per kilogram, of collected Prunus Africana. From the said sale, 50percent are proceeded to fund community development projects in the various villages [12]**(Tieguhong & Ndoye 2006)**. The bark collected in the region of Mount Cameroon is still marketed in a raw state, despite the participation of national export companies in the transformation of the bark. This transformation occurs in the coastal and central regions. The transformation initiative of Prunus Africana by women in the region of Mount Cameroon can contribute to the insertion a female dynamics in the value chain, increase of revenues for local women and restoration of equity in the management of the resource. For this purpose, regardless the space in which the barks are collected (community forest, national park of Mount Cameroon, domesticated Prunus Africana); they could be promoted at the local level by the women of the villages of Mount Cameroon. The acquisition of Prunus Africana community spaces can grant possibilities for the transformation of raw bark and communities can directly resell the semi-finished product to international pharmaceutical industries. Similar facilities are not locally found. This implies that a local based organization would stand in vantage position to collect and process bark harvested in the locality.

5 CONCLUSION

In general, the initial hypothesis about different practices in link with gender forestry work is that men mostly take part in the activities of big forestry companies, such as the felling of trees, meanwhile NTFPs consumed in households or sold in order to have a little income are mainly carried out by women. This is not the case for *Prunus Africana*, a Non Timber Forest Product which is sought after by international pharmaceutical industries and is flourishing in trade. Women in the region of

Mount Cameroon are particularly active in the exploitation of natural resources such as *Gnetum* and honey, yet the exploitation of *Prunus* is still labelled as a male activity. Thus, it is proved at the end of this study that gender issue is actually not a priority in Prunus Africana sustainable management policies. However, the current forestry issue requires the implementation of gender-specific measures to enforce the involvement the women of Mount Cameroon Region in the sustainable management of this resource, whose exploitation is protected at the international level for more efficiency. This initiative is currently in reflection among the actors involved in the management of *Prunus Africana* in the region of Mount Cameroon.

REFERENCES

[1] Manfre C, Rubin D., *Integrating gender into forestry research: A guide for CIFOR scientists and programme administrators*. Bogor, Indonesia, CIFOR, 2012.

[2] Lorena Aguilar, Daniel D.M.P. Shaw and al., *Forests and Gender*. Gland, Switzerland: UICN and New York, USA: WEDO, 2011.

[3] Gro Harlem Brundtland, *Notre avenir à tous*. Rapport de la Commission mondiale pour l'environnement et le développement, 1987.

[4] Lorena Aguilar, Daniel D.M.P. Shaw and al., *Forests and Gender*. Gland, Switzerland: UICN and New York, USA: WEDO, 2011.

[5] Institut National de la Statistique, *Enquête Camerounaise auprès des Ménages, Cameroun, 2008.*

[6] Ewusi, B. N., *The sustainable management of prunus africana in the mount cameroon region*. The World Bank/WBI‟s CBNRM Initiative/Mount Cameroon Project, 1998.

[7] Nfi, A. N., J. N. Mbanya, C. Ndi, A., "Ethnoveterinary Medicine in the Northern Provinces of Cameroon", *Veterinary Research Communications 25*, Number 1, p. 71-76, 2001.

[8] Glaser, BG, & Strauss, A.L., "Discovery of substantive theory: A basic strategy underlying qualitative research", *American Behavioral Scientist*, 8, 5-12, 1965.

[9] Cunningham A. B., Ayuk E., and al., *An economic evaluation of medicinal tree cultivation: Prunus Africana in Cameroon*. People and Plants working paper 10. UNESCO, Paris, 2002.

[10] Argawal Bina., "Common property institutions and sustainable governance of resources". *World Development*, vol 29.n°10 PP 1649-1672, 2001.

[11] Tchoundjeu Z., Kengue J. and Leakey R.R.B., "Domestication of Dacryodes edulis: State-of-the-art", For Trees Livelihoods 12: 3–14, 2002.

[12] Tieguhong Julius Chupezi, Ousseynou Ndoye*. Small-scale forestry and non-wood forest products enterprise development for poverty alleviation in Central Africa, 2006. [Online]* Available: www.fao.org/.../21889-066adebb9ed5b53854acbd0c. (February 12, 2014).

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Les Politiques Agricoles Communes et la Sécurité Alimentaire : le cas des pays de la Communauté Economique et Monétaire de l'Afrique Centrale

[The common agricultural policy and food security: the case of the Economic and Monetary Community of Central Africa's countries]

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ABSTRACT: Since hunger remains a big problem for families, increasing food security through improved agricultural production families remains a challenge for the public authorities. Thus, the object of this paper is to evaluate the effects of pooling of agricultural policies on food security in the CEMAC zone. In other hands, what is the influence of the `sharing of agricultural policies on food security in CEMAC countries? To answer this question, we made use of an existing literature review followed by a statistical analysis of data related to the availability and accessibility of food because of the free trade agreement signed between the Member States in the context of strengthening sub-regional economic integration. Following this analysis, we reached the following results:

- domestic prices are negatively related to food;
- domestic prices are positively influenced by agricultural investment and customs duties.

In conclusion, the pooling of agricultural policies positively influences food security in CEMAC. For the relief of conditions related to market access in the area, a factor of trade facilitation. Thus, the adoption of a common strategy for food production is a strategy for agricultural development in the area. This strategy reinforces the population, the opportunity to acquire in any place and at any time all the nutritious food they need.

KEYWORDS: integration, Strategy, trade liberalization food security, availability, accessibility.

RESUME: Puisque la faim demeure un grand problème pour les familles, l'augmentation de la sécurité alimentaire à travers une amélioration de la production agricole des familles reste un défi pour les autorités publiques. Ainsi, l'objet de ce papier est d'évaluer les effets de la mutualisation des politiques agricoles sur la sécurité alimentaire dans la CEMAC. En d'autres termes, quelle est l`influence de la mutualisation des politiques agricoles sur la sécurité alimentaire dans les pays de la CEMAC? Pour répondre à cette question, avons fait recours à une revue documentaire existante suivie d'une analyse statistique des données liées à la disponibilité et à l'accessibilité des produits alimentaires du fait de l'accord de libre-échange signé entre les Etats membre dans le cadre du renforcement de l'intégration économique sous régionale. Suite à cette analyse, nous sommes parvenus aux résultats suivant :

- les prix domestiques sont liés négativement aux produits alimentaires ;
- les prix domestiques sont positivement influencés par l'investissement agricole et les taxes douanières.

En conclusion, la mutualisation des politiques agricoles influence positivement la sécurité alimentaire dans la CEMAC. Car l'allégement des conditions liées à l'accès au marché de la zone, constitue un facteur de facilitation des échanges. Ainsi, l'adoption d'une stratégie commune, en matière de production alimentaire, est une stratégie de développement agricole

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dans la zone. Cette stratégie renforce, pour la population, la possibilité d'acquérir en tout lieu et à tout moment tous les aliments nutritifs dont elle a besoin.

MOTS-CLEFS: Stratégie, sécurité alimentaire, disponibilité, accessibilité, ouverture commerciale, intégration.

INTRODUCTION

La lutte contre la pauvreté et la faim sont au cœur des débats de politique économique. Ainsi, la sécurité alimentaire[1] est devenue une préoccupation majeure des autorités publiques ([1]). Parce que la faim demeure un grand problème pour les familles et l'humanité tout entière, l'augmentation de la sécurité alimentaire à travers une amélioration des conditions de production agricole des familles reste un défi pour les autorités publiques. La sécurité alimentaire reste alors, un des défis majeurs pour la communauté internationale et, plus particulièrement pour les décideurs politiques des pays en développement. L'un des objectifs clés des Objectifs du Millénaire pour le Développement (OMD) est de réduire de moitié, la proportion d'individus qui souffrent de la faim d'ici à 2015. L'atteinte de cet objectif permettra aux nombreuses familles de sortir de la pauvreté. Cependant, cet objectif risque de ne pas être atteint car le nombre de personnes sous-alimentées augmente de plus en plus ([1]). En 2012, près de 27% de la population d'Afrique subsaharienne (environs 234 millions de personnes) sont sous-alimentés dont 60% dans des pays en conflit. Cette région du monde est celle qui connait une croissance des cas de sous-alimentation (passant de 170 millions en 1990-92 à 234 millions en 2010-12) ([1]). Si en termes de prévalence, la population sous-alimentée a reculé de 6 points de pourcentage (passant de 32,8 en 1990-92 à 26,8 en 2010-12), cette baisse a tout de même été plus faible en comparaison avec d'autres régions du monde ayant presque le même niveau de prévalence entre 1990 et 1992. Pour faire face à ce problème, dans le cadre des négociations à l'OMC, les pays se sont penchés sur la question et ont consacré un accord au secteur agricole dénommé Accord sur l'Agriculture (AsA). Restant dans la même logique, la mutualisation des politiques relatives aux questions agricoles devient un impératif pour les différents pays engagés dans le processus d'intégration économique. A ce propos, la CEMAC n'est pas en reste. De ce fait, la politique agricole commune a vu le jour dans la CEMAC en 1999.

L'Afrique Centrale, notamment les pays de la CEMAC, regorge d'importantes ressources naturelles (minerais, bois, pétrole, etc.) et d'un sol extrêmement fertile ([2]). Cependant, le taux de pauvreté reste très élevé, soit 50,1% pour le Congo, 60% au Tchad, 42% au Cameroun, 46% au Gabon ([2]). Avec un PIB agricole allant de 3,5% pour le Gabon, 54,1% pour la Centrafrique à 43,8% pour le Cameroun ([3]) Pour limiter les effets de la pauvreté, les autorités politiques, réunis au sein de la CEMAC s'engagent dans une voie de recherche de solution commune à travers la création d'une stratégie de politique agricole commune. De ce fait, ils se sont inscrits dans une logique d'intégration économique centrée sur la libéralisation.

La libéralisation commerciale est le processus par lequel un pays ou un territoire douanier devient ouvert aux échanges commerciaux internationaux à travers une réduction et éventuellement une élimination systématique des droits de douane (barrières tarifaires) et d'autres barrières entre ses partenaires commerciaux ([4]). Le processus de libéralisation porte, entre autres, sur la réduction et l'élimination des barrières commerciales telles : *les droits de douane (les tarifs), les restrictions quantitatives (quotas d'importations et restrictions volontaires aux exportations), les licences d'importations et d'exportations, le contrôle de change, les taxes et subventions aux exportations, les entreprises publiques de commercialisation, les soutiens internes, les obstacles techniques au commerce, de même que toutes autres formes d'interventions qui pourraient constituer des entraves et limiter le commerce.* La libéralisation commerciale est motivée par le fait que les nations doivent se concentrer sur les produits dont elles disposent des avantages comparatifs ([4]). Cela leurs permettrait d'accroître les exportations, assortie d'une augmentation des revenus d'exportations qui pouvant être utilisés pour importer d'autres produits destinés à la consommation domestique. Au regard de l'enjeu que concède la libéralisation commerciale aux principaux acteurs, plusieurs questions mérites d'être élucidées afin de comprendre l'importance de l'adoption d'une politique agricole commune. A cet effet, quelle sera l'orientation des différents axes de cette politique ? Quels sont les enjeux de la mise en place d'une telle initiative ? Cette politique commune pourra-t-elle influer sur la sécurité

[1] *« La sécurité alimentaire est assurée quand toutes les personnes, en tout temps, ont économiquement, socialement et physiquement accès à une alimentation suffisante, sûre et nutritive qui satisfait leurs besoins nutritionnels et leurs préférences alimentaires pour leur permettre de mener une vie active et saine » ([1]).*

alimentaire ? En claire, dans quelle mesure l'initiative commune influera sur la production et la commercialisation agricole des familles ?

Parce que la situation alimentaire dans la CEMAC est, en général, caractérisée par une insécurité alimentaire, due à une sous-alimentation croissante des ménages à cause du niveau élevé de pauvreté et du déclin du secteur agricole ([4]), les responsables publics s'engagent dans une voix de recherche de solutions communes. Comptant en moyenne à 3,5 millions d'habitants, la CEMAC est composé de six (06) pays[2]. La Convention régissant l'Union Economique de l'Afrique Centrale (UEAC) attribue à la CEMAC la responsabilité de coordonner les politiques nationales y compris les politiques sectorielles. Elle a donc mandat de travailler sur les politiques agricoles, de développement rural et de sécurité alimentaire par le biais de la Conférence des Ministres chargés de l'Agriculture, des Eaux, Forêts et de la Chasse[3]. De ce point de vue, l'objectif de ce papier est d'examiner les effets de la mutualisation des politiques agricoles (politique agricole commune) sur la sécurité alimentaire dans la CEMAC.

Afin de mener à bien notre analyse, nous utilisons une stratégie à deux étapes pour évaluer le rôle de l'adoption d'une politique agricole commune sur la sécurité alimentaire. Cette méthodologie est inspirée de celle de ([5] pour évaluer l'impact indirect de la marginalisation politique sur la sécurité alimentaire dans quatre pays d'Afrique de l'Ouest (Benin, Ghana, Mali et Sénégal). Ce de point de vue, deux relations économiques vont être estimées : la relation les prix domestiques et les produits alimentaires d'une part, et la relation entre les prix domestiques des produits alimentaires et ses déterminants d'autre part. L'évaluation de ses relations sera faite à travers les questions relatives à la sécurité alimentaire dans les politiques sectorielles régionales de la CEMAC dans un premier temps. Et l'évaluation du mécanisme des effets de la politique agricole commune sur la sécurité alimentaire dans les pays de la CEMAC importateurs nets de produits alimentaires dans un second temps

1 LA SÉCURITÉ ALIMENTAIRE DANS LES POLITIQUES SECTORIELLES RÉGIONALES DE LA CMEAC

1.1 LA POLITIQUE AGRICOLE ET COMMERCIALE COMMUNE DE LA CEMAC ET SÉCURITÉ ALIMENTAIRE

1.1.1 LA POLITIQUE AGRICOLE COMMUNE : LES DISPOSITIONS ET LES DÉFIS MAJEURS AU DÉVELOPPEMENT DE LA PRODUCTION AGRICOLE DANS LA CEMAC

L'élaboration des lignes directrices de la stratégie agricole commune de la CEMAC répond à une disposition de la Convention régissant l'UEAC selon les dispositions de son article 35 qui préconise l'accroissement de la productivité de l'agriculture, de l'élevage et de la pêche etc. et la stabilité des marchés ([4]). Ce programme sous-régional tient compte des disparités structurelles entre les Etats et la nécessité d'opérer graduellement les ajustements opportuns. Il s'inscrit de ce fait, dans le cadre global du développement de la Communauté et doit en priorité s'attaquer aux grands défis de l'heure, notamment la sécurité alimentaire, la promotion d'une agriculture durable, l'accroissement de la productivité et la compétitivité des filières agricoles. C'est donc à ce titre que, nous présenterons les grandes lignes de la politique agricole commune et des défis majeurs à relever.

1.1.1.1 LES LIGNES DIRECTIVES DE LA POLITIQUE AGRICOLE COMMUNE

C'est en 1999, lors de la conférence des Chefs d'Etat tenue à Malabo que la stratégie agricole commune en Afrique centrale a été adoptée ([6]). Cette stratégie est basée sur l'harmonisation et la coordination des politiques agricoles des pays membres ([6]). Elle répond à cet égard, à cinq défis qui sont :

- L'amélioration des conditions de vie des producteurs par un accroissement de leurs revenus à travers la diversification des activités économiques, des réseaux financiers et l'accès à la technologie.

[2] *Le Cameroun, le Tchad, la République de Centre Afrique, le Congo, la Guinée équatoriale et le Gabon*

[3] *Dans le cadre des objectifs de l'Union Douanière et Economique de l'Afrique Centrale (UDEAC) relatifs au secteur agricole, le Conseil des Chefs d'Etat a adopté en 1990 l'Acte n° 8-509/90-UDEAC-CE-26 modifiant l'Acte n° 11/86-UDEAC-509 (annexe n°1)et créant la Conférence des Ministres chargés de l'Agriculture, des Eaux, Forêts et de la Chasse. Pour le bon fonctionnement de la Communauté Economique et Monétaire de l'Afrique centrale (CEMAC),*

- L'accroissement de la productivité agricole. Du fait de la faiblesse de la production agricole et alimentaire, les agriculteurs sont mis à rude épreuve à cause de l'explosion démographique que connaissent nos villes ([6]).
- Le développement des infrastructures pour faciliter l'accès aux marchés. En effet, l'enclavement de nombreux pays de la CEMAC et le mauvais état des infrastructures entrainent un accroissement des coûts de transport qui pénalisent la compétitivité.
- L'accroissement de la capacité de négociations commerciales à l'OMC sur l'agriculture et les accords de partenariat économique UE-ACP. Dans chacun de ces cas, la CEMAC doit se préparer au mieux, non seulement, pour parler d'une seule voix dans les négociations mais aussi pour obtenir des mesures d'accompagnement et de compensation avantageuses pour la région CEMAC ([5]).
- L'augmentation des budgets nationaux alloués au secteur agricole. Alors que l'agriculture est le secteur qui présente en Afrique les meilleures perspectives d'accumulation initiale de capital, de gain de productivité, de croissance et d'effet multiplicateur pour l'ensemble de l'économie, la dernière décennie est marquée par une réduction des crédits publics qui lui sont alloués.

Par le biais de ces conditions, une meilleure intégration régionale des marchés des produits agricoles représente un potentiel énorme en termes de gain que ces pays n'arrivent pas à capitaliser afin compenser leurs déficits alimentaires. Cette intégration sera d'autant plus facilitée que la libéralisation du commerce des produits vivriers, l'amélioration de la compétitivité des produits, les accords commerciaux sur les produits, offrent de nouvelles perspectives pour l'émergence de véritables marchés régionaux de produits vivriers et d'intrants agricoles. L'émergence de tels marchés, basés sur l'avantage comparatif auraient des effets sur les revenus, l'emploi et la sécurité alimentaire. En dépit des efforts fournis par les autorités, on assiste à une persistance de l'insécurité alimentaire dans la CEMAC. Il convient alors d'examiner d'autres conditions liées au développement du marché unique ([7)].

1.1.1.2 L'ACCÈS AU MARCHÉ : LES DÉFIS MAJEURS DU DÉVELOPPEMENT DE LA PRODUCTION AGRICOLE DANS LA CEMAC

La réussite de la politique agricole commune adoptée dans le cadre de l'organisation régionale africaine, nécessite que plusieurs contraintes soient levées aussi bien dans la participation institutionnelle que les tarifs douaniers, les échanges intra-régionaux et les négociations multilatérales en cours.

❖ ***Manque de fiabilité des statistiques et carence des structures étatiques.***

Dans la marche vers son émergence, la CEMAC fait face à de nombreuses contraintes. Une des contraintes est le manque de fiabilité des statistiques agricoles qui empêchent de cerner de manière quantitative les problèmes de sécurité alimentaire et d'évaluer les différents programmes et projets d'intérêt régional. Aussi, le manque de carence en matière de structures en charge du secteur agricole, et des questions de l'intégration régionale. Par ailleurs, ces structures ne prennent part aux réunions de prise de décisions régionales : le cas de l'adoption du tarif extérieur commun (TEC) dont les implications sur la production et la commercialisation des produits agricoles sont évidentes.

❖ ***Difficultés de réaliser l'intégration régionale des marchés***

Les organisations d'intégration régionale souffrent d'une série de déficiences qui retardent l'intégration africaine et qui atténuent les efforts menés en vue de mettre en place les politiques communes ([6]). Le bilan de l'intégration régionale qui a débuté depuis la décennie 60 est plutôt négatif au regard du niveau des échanges intra-régionaux et des difficultés d'instaurer une véritable zone de libre-échange. Or, l'analyse de l'évolution des échanges démontre que la valeur globale des échanges intracommunautaires est passée de 29 milliards en 1993 à 153 milliards de FCFA en 2003 soit une augmentation cumulative de 5,3 fois de la valeur initiale et 18,2% de hausse moyenne annuelle. Cette hausse a été favorisée par les effets de la dévaluation entre 1994 et 1998 avec une hausse moyenne annuelle de 29,5%. La seconde sous période s'est caractérisée par un accroissement moins rapide des exportations (7,8%). Malgré cette croissance rapide, les échanges intracommunautaires restent relativement faibles par rapport à la valeur globale des échanges de la Communauté. Le ratio annuel ne dépasse guère les 3%. Cette situation s'explique notamment par le fait que les exportations de la Communauté sont constituées essentiellement de matières premières qui ne sont le plus souvent utilisées que par les industries des pays

tiers[4]. Pour avoir une échelle de comparaison, ces mêmes échanges représentent plus de 75% du commerce au sein de l'Union européenne ([6]). Les échanges sont marqués par de fortes disparités. Le Cameroun concentre à lui seul 70% du commerce intra-régional. Les produits alimentaires échangés sont peu diversifiés sur le plan de leur composition et de leur destination. Il s'agit de l'huile de palme, le sucre raffiné, le tabac, les bières. En effet, les exportations camerounaises de ces produits s'orientent vers le Gabon pour 40%, vers le Congo pour 28%, la Guinée Equatoriale (14%), la RCA (10%) et le Tchad (8%) ([6]).

❖ **Le tarif extérieur commun (TEC) et autres taxes à l'importation de la CEMAC**

L'Union Economique a introduit de profondes modifications par rapport au traité de l'UDEAC qui avait pour principales missions la promotion d'une politique extérieure commune et la libre circulation des marchandises au sein d'un marché commun régional ([8]). En 1994, le dispositif mis en place par l'UDEAC est renforcé par la réforme fiscalo-douanière(RFD) ([8]) dont les articulations tournent autour de :

- L'institution d'un Tarif Extérieur Commun (TEC) visant à simplifier la panoplie des taux de droits et taxes applicables sur les produits à l'importation.
- La mise en place d'un Tarif Préférentiel Généralisé(TPG)
- L'institution d'une Taxe sur le Chiffre d'Affaires (TCA) transformée en 1999 en une Taxe sur la Valeur Ajoutée (TVA).
- L'introduction d'un Droit d'Accise ad valorem sur certains produits

Pour ce qui est du Tarif Extérieur Commun (TEC), quatre taux sont retenus comme le montre le tableau ci-dessous.

Tableau 1 : Répartition du TEC en fonction des produits importés

catégorie	taux	produits
1	5%	Biens de première nécessité
2	10%	Matières premières et bien d'équipement
3	20%	Biens intermédiaires et divers
4	30%	Biens de consommation courante

Sources ([8])

En plus de cette répartition soignée des différents biens devant faire l'objet d'imposition, il existe quelques biens (dont la liste est très limitée par pays) exonérés de tout paiement de taxe. Le TEC appliqué en ce moment, a fait l'objet de révision en 2001, puis mis en conformité avec le système harmonisé (version 2002) en 2003([8]).

Quant au Tarif Préférentiel Généralisé, il est institué par la réforme de 1994 sur les produits originaires d'un autre pays de la CEMAC. Le niveau de ce tarif a baissé progressivement pour aboutir à un marché libre en 1998, correspondant à un TPG à taux zéro. Le droit d'Accise n'est assujetti qu'à certains biens de consommation courante. Les pays ont la liberté d'en fixer la liste. En ce qui concerne la fiscalité intérieure, la TVA, en vigueur depuis 1999, est variable suivant les Etats. Les taux applicables sont de trois ordres :

- le taux nul pour les produits exonérés,
- le taux réduit et
- le taux normal.

Au principal, s'ajoute des centimes communaux de 10% du principal pour le Cameroun ([9]).

La TVA est une taxe déductible. Toute unité de production assujettie à cet impôt a la possibilité de déduire de la TVA qu'elle verse au Trésor Public la part qu'elle a eu à supporter lors de l'achat des biens de consommation intermédiaire ou des biens d'équipements. La déductibilité prend fin à la phase finale de consommation, c'est-à-dire lorsque le bien cesse d'être utilisé comme bien intermédiaire. La TVA s'applique sur la valeur imposable de la marchandise majorée du TEC et du Droit d'Accise ([8]).

[4] *http://www.cemac.int/de-la-cemac/commerce-intra-communautaire-de-la-cemac-faciliter-les-transports-et-le-transit consulté le 6 mai 2014*

Pour que soient réunies les conditions préalables à l'unification des marchés, il convient de rendre l'ensemble cohérent et de veiller à la mise en œuvre des mesures prescrites. Ce qui est loin d'être le cas. Car, les disparités d'application entre les Etats membres sont patentes : c'est le cas notamment de l'application du Tarif Extérieur Commun (TEC) et la gestion des exonérations sous-jacentes, de la valeur en douane, et concomitamment de la TCI ([8]). Toutes ces disparités liées à l'application du TEC et autres exonérations, constitue l'une des contraintes majeures qui limitent la réalisation de la production agricole commune et la commercialisation des produits. Ce tarif a été inspiré par les conceptions libérales visant à ouvrir grandement les marchés africains aux produits provenant des pays industrialisés et à réduire les taux de protection des productions locales.

La mise en place d'une faible taxation ne peut qu'encourager les importations de produits alimentaires. Ainsi, dans les pays de la CEMAC les produits dits de première nécessité comme le riz, sont taxés à 5%, favorisant ainsi les importations massives de produits alimentaires au détriment des productions locales de la sous-région. Ces tarifs ont été mis en place dans le cadre de la réforme fiscalo-douanière initiée par la Banque Mondiale et appliquée en 1994 ([9]). Face à des producteurs locaux mal organisés, et faibles du point de vue, de leur influence sur les économies nationales, cette réforme n'a pas connu une forte résistance de la part des agriculteurs et a été facilement appliquée. Aux disparités dans l'application du TEC par les Etats, il faut ajouter le contournement de catégories de produits, ou de déclassements tarifaires unilatéraux ([9]) et ([10]), Le tableau ci-dessous présente les différentes distorsions observées dans la pratique du TEC CEMAC.

Tableau 2 : Présentation des distorsions au commerce dans la CEMAC

pays	**Distorsions tarifaire Nombre de ligne arifaires)**	**Distorsion par rapport à la nomenclature**	
		Nombre de rubriques tarifaire à supprimer	Nombre de rubriques tarifaires à créer pour son alignement au TEC
Cameroun		609 (SH11)	
Centrafrique	7	434 (SH8)	35 (SH8)
Congo		329 (SH11)	56 (SH8
Gabon	103	168 (SH8)	63 (SH8)
Guinée Equatoriale	15		
Tchad		164 (SH8)	83 (SH8)

Source : ([7])

❖ **Faibles accès au marché et commercialisation des produits : une conséquence des franchises conditionnelles et exceptionnelles**

En Afrique Subsaharienne, les paysans rencontrent des difficultés pour vendre leurs produits agricoles et en tirer un revenu : manque de débouchés, prix peu élevés et volatils, rapports de force défavorables Pour autant, des paysans et leurs organisations paysannes (OP) s'organisent et développent des initiatives riches et variées pour améliorer les conditions de mise en marché, de négociation, de transaction, et ainsi pour mieux vivre de leurs activités. Malgré les dispositions prisent par les autorités et portant élaboration d'une politique agricole commune, la situation reste relativement stable ([11]). Cette stabilité est liée au fait qu'en pratique, les dispositions de la politique commerciale commune ne sont pas suivies. Aussi, ces politiques ont été soumises à de fortes contraintes macroéconomiques. Le non-respect des normes communautaires en matière de concurrence constitue une entrave au commerce. L'un des instruments majeurs de la politique communautaire de concurrence est bien la RFD, qui soutient la libéralisation des échanges des produits d'origine communautaire. La RFD ne discrimine pas les biens obtenus ou échangés dans l'espace communautaire, qui sont assujettis au principe de traitement national ([8]). Les produits du cru et tous les produits manufacturés dans l'espace communautaire respectant les critères d'origine circulent donc librement et sont assujettis au TPG nul.

Cependant, pour s'installer et produire, les entreprises sont toutes soumises à des lois et règlements nationaux ; les codes des investissements comportent souvent des mesures incitatives particulières et spécifiques, qui confèrent aux entreprises bénéficiaires autant d'avantages compétitifs par rapport aux autres entreprises qui n'en bénéficient pas. C'est pour éviter ces distorsions de compétitivité, promouvoir les investissements dans l'espace communautaire, et offrir un cadre homogène de travail aux entreprises, que la charte communautaire d'investissement a été élaborée ([8]). Les mesures d'ajustement

économique et l'élargissement des marchés ont fortement déterminé les politiques économiques et de ce fait, les politiques agricoles et de sécurité alimentaire ont dû s'adapter à ce nouveau contexte, alors que les instruments traditionnels de ces politiques comme les subventions, les restrictions aux importations, la protection du marché intérieur étaient difficilement acceptées dans le cadre de ces mesures ([7]), ([8]). Il est ainsi apparu, face aux contraintes macro-économiques, que la politique agricole n'est plus perçue comme une priorité budgétaire, ce qui limite considérablement le développement des infrastructures rurales, la recherche et la diffusion de technologies et l'appui/conseil aux producteurs[5]

1.1.2 LA POLITIQUE COMMERCIALE COMMUNE : LA SÉCURITÉ ALIMENTAIRE, LES CONDITIONS D'ACCÈS AU MARCHÉ ET LE DÉVELOPPEMENT AGRICOLE

❖ **La persistance de l'insécurité alimentaire**

La population de la CEMAC est estimée en 2013 à environ 75 745 815 habitants, dont 64,45% (56.630.000 habitants) vivent en milieu rural. Le taux moyen de croissance annuel est de 2,7%. ([12]). La population est très inégalement répartie tant entre les pays qu'à l'intérieur des Etats. La densité varie de 5 habitants au km2 en Centrafrique à 30 habitants au km^2 au Cameroun. Le taux moyen d'urbanisation reste soutenu (5 à 8%). Alors qu'en 1970 on comptait une personne vivant en zone urbaine pour 4 en zone rurale, en 2005 plus de 50% de la population était urbaine, soit 73% pour le Gabon était urbaine, dont près de 50% est concentrée à Libreville la capitale ([2]). Les statistiques de l'évolution de la population en Afrique Centrale sont consignées dans le tableau ci-dessous.

Tableau 3. Evolution des populations sous-alimentées des pays de la CEMAC 2003- 2012

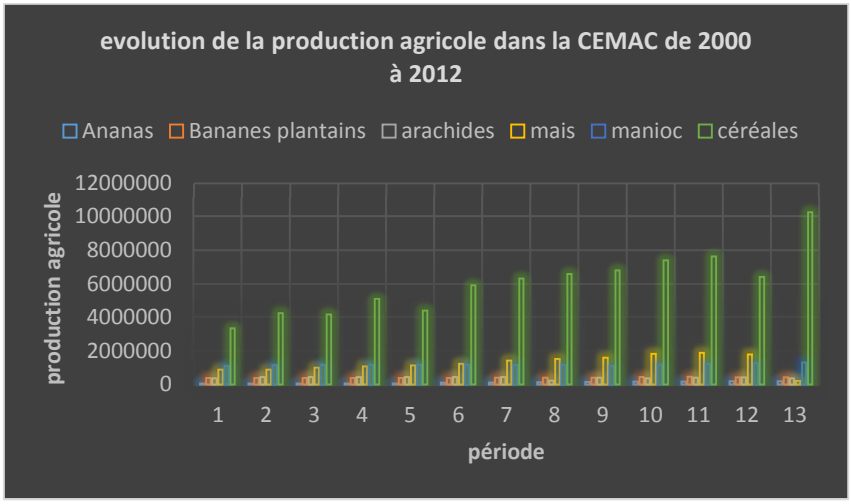
Années	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**1012**
Cameroun	4.10	3.90	3.70	3.60	3.30	3.20	2.90	2.90	2.70	2.70
Congo	0.90	1.10	1.10	1.20	1.30	1.30	1.40	1.40	1.40	1.40
Gabon	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Guinée Equatoriale	1.70	1.70	1.70	1.70	1.60	1.50	1.40	1.40	1.30	1.30
Tchad	3.60	3.60	3.70	3.80	4.00	4.20	4.10	3.90	3.60	3.50

Source : Auteur. ([13])

A l'observation du tableau, on constate que l'accroissement de la population urbaine comporte deux aspects contradictoires : le principal avantage est le fait que cette population constitue pour les producteurs agricoles un marché. Son accroissement devrait donc profiter aux ruraux qui doivent accroître la production et pour satisfaire les besoins des consommateurs urbains et répondre à la demande supplémentaire en denrées alimentaires. Par contre, l'urbanisation croissante se fait au détriment de la population rurale qui se voit privée de ses bras séculiers : les travailleurs du fait de l'exode rural de plus en plus alimenté. A la suite de cette analyse, nous présentons l'évolution de la production alimentaire de certains biens afin de mieux cerner la relation qui lie la population à la production. Le tableau ci-dessous, montre l'évolution de la production alimentaire de la zone période 2003 à 2012. De ce schéma, il ressort que de 2003 à 2012, la production des produits concernés notamment la banane plantain évolue en dent de scie mais à un taux relativement faible.

[5] *Programme régional de sécurité alimentaire (prsa) pour les pays membres de la communauté économique et monétaire de l'Afrique centrale (cemac) ; document prépare avec la collaboration de l'organisation des nations unies pour l'alimentation et l'agriculture (fao) mai 2002*

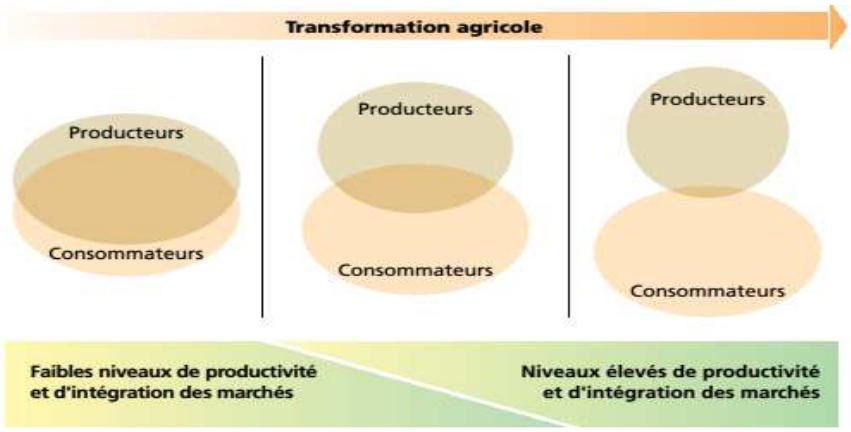
Schéma 1 : Evolution de la production agricole dans la CEMAC (2000-2012)



Source : auteur à partir des donnés ([13])

Partant de cette situation globale, les besoins de chaque pays membre en la matière restent élevés. Cette situation se confirme davantage avec le niveau d'imbrication des structures de production et de commercialisation ainsi que le montre les schéma et tableau ci-dessous

Schéma 1 : transformation du Système alimentaire



Source ([12])

Tableau 5 : Indicateurs de sécurité alimentaire dans les pays de la CEMAC (2003 à 2012)

pays	Valeurs d'accès à des services d'assainissement alimentaires (%) (2003/2011)								
périodes	2003	2004	2005	2006	2007	2008	2009	2010	2011
Cameroun	47.60	47.60	47.60	47.60	47.60	47.60	47.50	47.70	47.80
Congo	19.40	19.20	19.00	18.80	18.60	18.40	18.20	18.00	17.80
Gabon	34.60	34.20	33.70	33.30	32.80	32.90	32.90	32.90	32.90
Guinée Equatoriale	88.90	88.90	88.90	88.90					
Guinée Equatoriale	26.50	27.90	29.40	30.80	32.20	33.70	33.70	33.80	33.80
Tchad	10.30	10.40	10.60	10.80	11.00	11.20	11.40	11.50	11.70

Source ([14])

	Nombre de personnes sous-alimentées (millions) (moyenne sur 3 ans)									
années	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Cameroun	4.10	3.90	3.70	3.60	3.30	3.20	2.90	2.90	2.70	2.70
Congo	0.90	1.10	1.10	1.20	1.30	1.30	1.40	1.40	1.40	1.40
Gabon	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Guinée Equatoriale	1.70	1.70	1.70	1.70	1.60	1.50	1.40	1.40	1.30	1.30
Tchad	3.60	3.60	3.70	3.80	4.00	4.20	4.10	3.90	3.60	3.50

Source ([14])

	Variabilité des disponibilités alimentaires par habitant (Kcal/personne/jour)							
Années	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Cameroun	16.46	21.55	21.61	16.05	15.68	22.39	15.49	42.56
Congo	46.15	35.34	24.93	69.32	67.23	53.64	51.03	31.13
Gabon	37.46	40.79	32.86	20.81	21.55	12.31	34.51	38.08
Guinée Equatoriale	15.41	22.13	29.13	25.94	24.73	12.65	15.26	25.46
Tchad	57.59	32.91	27.31	23.46	19.10	5.33	5.45)	13.92

Source ([14])

Il ressort de ce tableau que la situation alimentaire de la CEMAC est préoccupante. La sous-alimentation se situe autour de 45% de la population totale, avec de fortes variations selon les pays. De plus, environ 10% de la population de la zone souffre d'un déficit alimentaire qualifié d'extrême (< à 300 kcal/personne/jour) ([13]). Cette situation résulte en partie de la faible accessibilité économique aux produits alimentaires, du fait du taux de pauvreté encore important dans la zone. Ce taux atteint par exemple 66% en RCA. La sous-alimentation résulte également d'une productivité agricole, non seulement faible mais en baisse continue depuis plusieurs années ([13]). Cette situation limite l'accessibilité physique aux produits alimentaires. Cette faible disponibilité de l'offre alimentaire contraste avec les conditions géo-climatiques de la zone, particulièrement favorables à l'intensification et à la diversification agricoles. Ce potentiel est peu exploité et l'agriculture est en réalité délaissée, notamment dans certains pays pétroliers. Ainsi, au Congo ou au Gabon, le secteur agricole ne représente respectivement que 5,4% et 3,5% du PIB, malgré les énormes potentialités ([13]). Le faible poids économique et la faible productivité agricole sont dus à plusieurs facteurs : exode rural réduisant la main d'œuvre agricole, faible utilisation des engrais (moins de 4 kg/ha), exploitation limitée des terres arables (<15%), insuffisance des investissements agricoles, troubles sociopolitiques, etc. Ces facteurs accentuent le déficit de l'offre alimentaire par rapport à la demande, et aggravent la dépendance des pays vis-à-vis des importations alimentaires massives ([13]). Ces importations restent ainsi élevées, autour de 16% du total des produits importés pour l'ensemble de la Communauté. Pour les céréales en particulier, les importations

nettes en kilogrammes sont supérieures à la production nationale pour tous les pays. Avec la hausse à tendance durable des prix des denrées alimentaires sur le marché international, le recours aux importations pour combler l'important déficit de production ne constitue plus une alternative durable ; cette situation risque d'accentuer le niveau d'insécurité alimentaire dans la sous-région. Des efforts importants devront donc être menés pour relancer la production agricole, afin d'améliorer de manière sensible la disponibilité de l'offre alimentaire et l'état nutritionnel des populations.

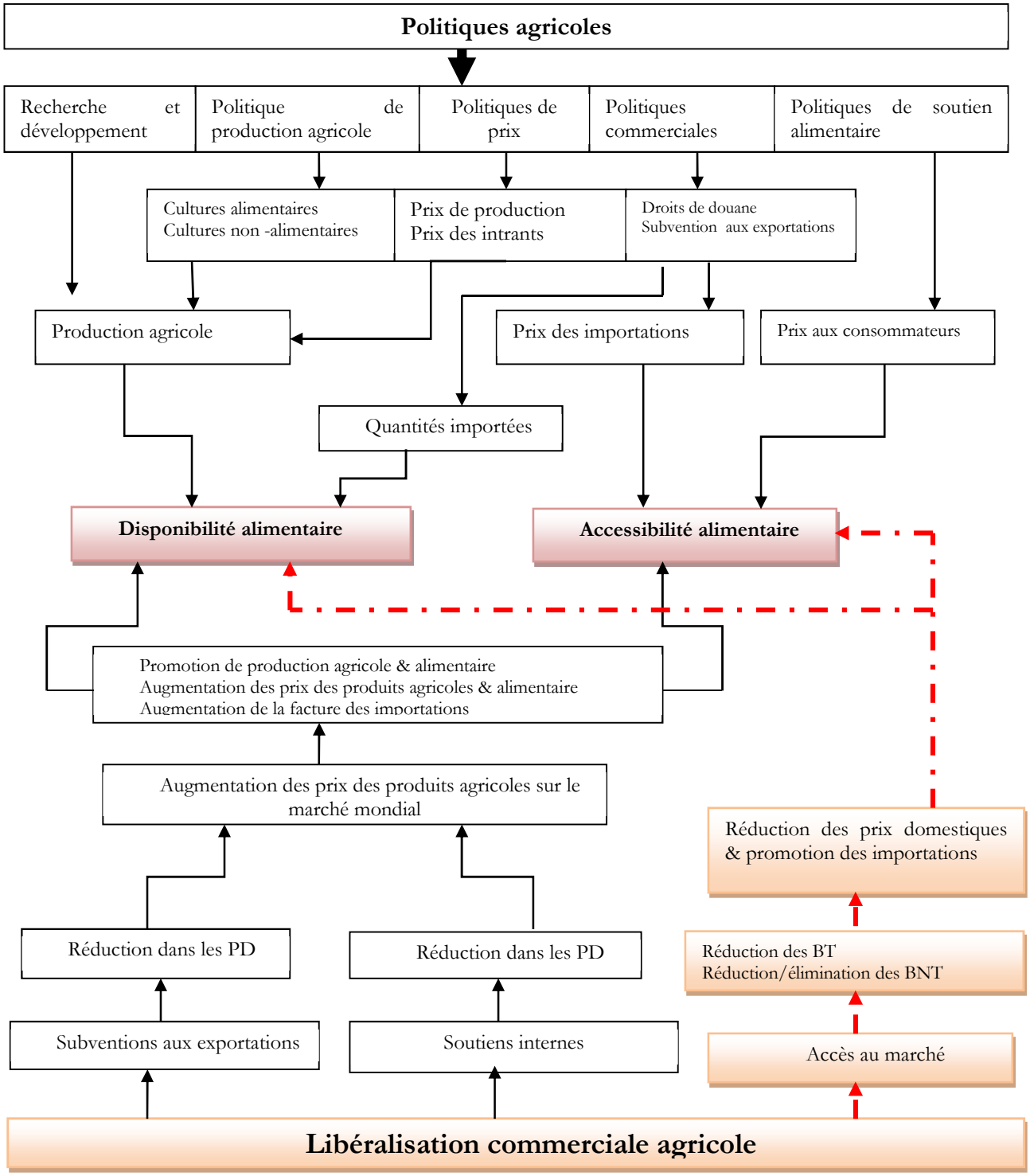
2 LE MÉCANISME DES EFFETS DE LA POLITIQUE AGRICOLE ET COMMERCIALE SUR LA SÉCURITÉ ALIMENTAIRE DANS LES PAYS DE LA CEMAC IMPORTATEURS NET DE PRODUITS ALIMENTAIRES

2.1 LES STRATÉGIES DE POLITIQUE AGRICOLE COMMUNE ET SÉCURITÉ ALIMENTAIRE : UNE CONTRIBUTION THÉORIQUE

2.1.1 UNE ILLUSTRATION GRAPHIQUE DU MÉCANISME DES EFFETS DE LA POLITIQUE AGRICOLE ET COMMERCIALE SUR LA SÉCURITÉ ALIMENTAIRE DANS LES PAYS DE LA CEMAC

Afin de mener à bien notre analyse, nous utilisons une stratégie à deux étapes pour évaluer le rôle de l'adoption d'une politique agricole et commerciale commune sur la sécurité alimentaire. Cette méthodologie est inspirée de celle de ([5]) pour évaluer l'impact indirect de la marginalisation politique sur la sécurité alimentaire dans quatre pays d'Afrique de l'Ouest (Benin, Ghana, Mali et Sénégal). Cette stratégie est appliquée au cadre méthodologique dérivé de ([15]) qui prend en compte le cadre conceptuel élaboré par la ([3]) pour établir les liens possibles entre la politique commerciale et la sécurité alimentaire. Dans tout le mécanisme représenté, notre analyse porte sur la relation en tirets rouge qui porte sur la levée des obstacles liés à l'accès au marché et la partie supérieur du graphique qui porte sur la politique agricole. Ces options sont choisies car elles portent sur des politiques maîtrisables par les pays. Nous allons donc évaluer l'impact indirect de la libéralisation commerciale sur la sécurité alimentaire à travers *l'effet sur le prix domestique des produits alimentaires* d'une part et l'impact de la politique agricole commune sur la sécurité alimentaire d'autre part. Nous commençons par établir le lien entre la sécurité alimentaire et la modification des prix domestiques ; et ensuite les liens entre la libéralisation commerciale et la modification de prix due à la levée des barrières tarifaires. Nous optons pour une évaluation économétrique à partir d'un modèle *ad hoc*, basé sur les différents liens identifiés à travers le cadre d'analyse adopté. De ce graphique, on comprend aisément que l'harmonisation de toutes les politiques centrées sur l'agriculture (politique de recherche développement, la politique commerciale, la politique de production et la politique de soutien alimentaire) vise la disponibilité de la production en quantité et leur accessibilité à travers le système des prix à l'importation et aux consommateurs ([15]).

Graphique 1 : Mécanisme des effets de la politique agricole et commerciale sur la sécurité alimentaire dans les pays en développement importateurs net de produits alimentaire



Source : adapté de ([15]).

2.2 L'ÉVALUATION EMPIRIQUE DU MÉCANISME DES EFFETS DE LA POLITIQUE AGRICOLE ET COMMERCIALE SUR LA SÉCURITÉ ALIMENTAIRE DANS LES PAYS DE LA CEMAC

2.2.1 PRÉSENTATION DU MODÈLE

Dans un premier temps, nous allons examiner la relation entre d'une part, la sécurité alimentaire et les prix domestiques des produits alimentaires à l'instar de ([15]) et. ([16]) selon l'équation suivante :

$$Y_{it} = \beta_1 Tradelibind_{it} + \beta_2 Indprixali_{it} + \lambda_i + \gamma X_{it} + \varepsilon_{it} \quad (1)$$

Dans cette équation, Y_{it} désigne l'indicateur de sécurité alimentaire du pays *i* à la période *t*, $Tradelibind_{it}$ désigne l'indice de libéralisation commerciale du pays i à la période t ; $Indprixali_{it}$ est l'indice de prix des produits alimentaires du pays i à la période t. λ_i est l'effet fixe qui inclut tous autres facteurs non observables pour le pays i ; X_{it} est une matrice de variables de contrôle et ε_{it} est le terme d'erreur. Si la sécurité alimentaire est directement affectée par la libéralisation commerciale, le coefficient β_1 sera significatif. De la même manière, si la sécurité alimentaire est influencée par la modification des prix des produits alimentaires, le coefficient β_2 sera positif et significatif. Le coefficient β_1 est supposé ne pas être significatif car selon la théorie économique, la politique commerciale a un effet indirect sur la sécurité alimentaire.

La seconde étape de notre démarche consiste à chercher les déterminants des prix domestiques des produits alimentaires tout en portant un intérêt sur l'indicateur de la libéralisation commerciale selon l'équation suivante :

$$Z_{it} = \alpha_1 Tradelibind_{it} + \delta_i + \alpha_2 X_{it} + \mu_{it} \quad (2)$$

Dans cette équation, Z_{it} est l'indice de prix des produits alimentaires du pays *i* à la période *t* ; $Tradelibind_{it}$ désigne l'indicateur de libéralisation commerciale du pays *i* à la période *t* ; δ_i est l'effet fixe qui inclut tous les autres facteurs non observables pour le pays *i* ; X_{it} est une matrice de variable de contrôle et μ_{it} est le terme d'erreur. Dans l'équation (2), nous espérons avoir le coefficient α_1 significatif puisque la politique commerciale est supposée influencer la sécurité alimentaire à travers son impact sur le prix domestique des produits alimentaires. Les deux équations seront estimées pour un panel de dix (06) pays de la CEMAC[6].

Tableau 6, Les variables de contrôles $\left(X_{it}\right)$ ***des différentes équations***

Équations	Variables dépendantes	Variables de contrôle
Sécurité alimentaire (1)	Disponibilité Énergétique Alimentaire Moyenne	valeur des importations alimentaires, profondeur du déficit alimentaire, indice de prix des produits alimentaires, production céréalière, formation brute de capital fixe dans le secteur agricole, terre agricole utilisée pour la production céréalière, surface agricole, rendement à l'hectare des céréales, densité de la population, population agricole[7], indice de production vivrière, indice de production du bétail.
Déterminants des prix domestiques des produits alimentaires (2)	Indice national de prix des produits alimentaire	valeur des importations alimentaires, volatilité du niveau de prix intérieure, indice de prix des produits alimentaires, production céréalière, formation brute de capital fixe dans le secteur agricole, surface agricole, rendement à l'hectare des céréales, densité de la population, population agricole, indice de production vivrière, indice de production du bétail.

Source ([15]) et ([16])

[6] *Le Cameroun, le Gabon, la Guinée Equatoriale, le Tchad, la RCA et le Congo Brazzaville.*
[7] *Définit selon la FAO*

2.2.2 LA PRÉSENTATION ET INTERPRÉTATION DES RÉSULTATS

2.2.2.1 DESCRIPTION DES VARIABLES DE CONTRÔLE

Tradelibind = indice de libéralisation commerciale : ce sont les tarifs appliqués aux produits agricoles.

importali = valeur des importations alimentaires.

indprixali = indice de prix domestique des produits alimentaires, utilisé comme indicateur d'accessibilité alimentaire.

adesa = Disponibilité Énergétique Alimentaire Moyenne mesurée en pourcentage du besoin énergétique alimentaire moyen dans le pays. Analysée avec la prévalence de la malnutrition, elle permet de discerner si la sous-alimentation est principalement due à l'insuffisance de l'approvisionnement en nourriture ou à une mauvaise répartition.

dfd = la profondeur du déficit alimentaire (kcal/caput/day). Cette variable indique le nombre de calories nécessaires pour que les individus sous alimentés quittent ce niveau.

dfpliv = la volatilité du niveau de prix alimentaire sur le marché intérieure. Elle est utilisée comme indicateur de mesure de la stabilité dans le temps et l'espace de l'accessibilité alimentaire.

lcerprod = le logarithme de la production céréalière en tonnes métriques. Les données sur la production céréalières portent sur les récoltes de grain sec uniquement

lfbcf =le logarithme de la formation brute de capital fixe dans le secteur agricole. Les valeurs de cette variable sont à prix constants de 2005 et exprimées en million de dollar américain. Elle est utilisée pour capter l'investissement agricole.

foodprdind = l'indice de production vivrière (2004 à 2006=100). Cet indice porte sur les cultures vivrières comestibles et qui contiennent des nutriments. Le café et le thé en sont exclus parce que même s'ils sont comestibles ils n'ont aucune valeur nutritive.

lvstprodind = l'indice de production de bétail (2004 à 2006=100). Il comprend la production de viande et de lait de toutes sources, les produits laitiers tels que le fromage, les œufs, le miel, la soie brute, la laine ainsi que les peaux et les cuirs.

popdens = la densité de la population en personnes par kilomètre carré de superficie des terres.

lpopag = le logarithme de la population agricole.

lrendcer = le logarithme du rendement à l'hectare des céréales en kilogrammes par hectare de terre récoltée.

L'usage du logarithme de certaines variables répond juste au problème d'échelle de mesure des variables qui n'ont pas la même unité.

2.2.2.2 DONNÉES

Les données utilisées sont des données secondaires extraites des Statistiques de la FAO (FAOSTAT), de World Integreted Trade Solution (WITS) pour les données commerciales et la construction des indicateurs de libéralisation commerciale. Les autres données sont issues de World Development Indicators (WDI) de la Banque Mondiale. Les données couvrent dix (06) pays de la CEMAC (le Cameroun, le Gabon, le Tchad, la RCA, le Congo et Guinée Equatoriale) sur la période 2001-2010. Le choix de ces pays et de la période d'étude est guidé par la disponibilité des données des pays.

2.2.2.3 LES RÉSULTATS ET INTERPRÉTATIONS

Les estimations des équations (1) et (2) décrites ci-dessus donnent les résultats présentés dans les tableaux 6 et 7 suivants.

Le tableau 6 suivant présente les résultats des estimations de l'équation (1). Le tableau montre que la libéralisation commerciale (par réduction tarifaire) a un impact direct sur la sécurité alimentaire matérialisée par la disponibilité alimentaire moyenne, puisque les coefficients pour l'estimation est positif et statistiquement significatifs au seuil retenu. Le coefficient est négatif, ce qui signifierait que la libéralisation tarifaire (baisse des tarifs), augmente la sécurité alimentaire. Par contre, l'indice national des prix alimentaires qui est un indicateur d'accessibilité alimentaire influence significativement (au seuil de 5%), la sécurité alimentaire. Le coefficient de cette variable est négativement relié à la sécurité alimentaire. Cela montre bien que le renforcement des capacités productives des différents pays, rendrait les produits alimentaires

accessibles. Mais le fait que le coefficient soit négatif traduit l'idée qu'une augmentation des prix des produits alimentaires entrainerait la baisse de la disponibilité alimentaire et en conséquence, réduire l'accessibilité des denrées alimentaires.

Tableau 6 : Résultats de régression de l'équation (1)

Variables	Coef,	z	P>|z|
Libéralisation commerciale	**-0,106**	0,0728	0,507
Profondeur du déficit alimentaire	-0,0894	0,0202	0,615
Indice de prix alimentaire	**-9,021**	2,115	0,000
Importation alimentaire	0,249	0,934	0,843
Terre utilisée pour production de céréales	-1,158	2,731	0,0096
Production de céréales	0,140	2,048	0,000
Surface agricole	12,98	7,568	0,000
Investissement agricole	9,912	6,129	0,003
Indice de production vivrière	0,00775	0,0338	0,207
Indice de production de bétail	0,0588	0,0296	0,327
Population agricole	12,25	6,463	0,015
Densité de la population	-0,0166	0,0611	0,1240
Constante	-168,9	71,80	0,000
Observations	**65**		
R-squared	**0.450**		
Nombre de Pays	**5**		

Note : la variable dépendante est la disponibilité énergétique alimentaire moyenne. Tous les modèles inclus des effets aléatoires pays. Random-effects GLS regression, STATA 12. Au seuil de 5%.

La sécurité alimentaire est significativement déterminée par la profondeur du déficit alimentaire et l'investissement agricole (matérialisé par la formation brute du capital fixe dans le secteur agricole). Les investissements agricoles sont significativement et positivement liés à la sécurité alimentaire. Un niveau élevé d'investissement dans le domaine agricole accroit la disponibilité énergétique alimentaire. Ce résultat est aussi cohérent puisque l'atteinte de la sécurité alimentaire requiert un niveau élevé d'investissement agricole. Toute chose qui peut être réglée par la mutualisation des politiques agricoles et donc une augmentation du budget des investissements agricole dans la zone.

D'autres variables comme la superficie agricole, la population agricole et l'indice de production vivrière influencent à leur tour la sécurité alimentaire. Ces dernières variables ajoutées à l'investissement agricole sont des variables qui peuvent être facilement influencées par la politique agricole.

En définitive, l'indice de prix des produits alimentaires est significativement lié à la sécurité alimentaire au seuil de 5%, et il apparait que la relation entre la sécurité alimentaire et libéralisation commerciale n'est pas directe. Ce résultat corrobore avec les travaux de ([17]) et ([18]) qui lient la sécurité alimentaire à l'instabilité des prix des produits alimentaires. Ainsi donc, l'atteinte de la sécurité alimentaire dans la CEMAC doit passer par une gestion de l'instabilité des prix.

Le tableau 7 suivant présente les résultats des estimations de l'équation (2) dans laquelle la variable dépendante est l'indice de prix alimentaire. Les quatre colonnes de ce tableau montrent que la libéralisation commerciale (une réduction tarifaire) est significativement liée à la sécurité alimentaire. Dans toutes les spécifications, la libéralisation commerciale influence négativement l'indice de prix alimentaire. Il y a donc une relation inverse entre la libéralisation commerciale et les prix alimentaires.

Tableau 7 : Résultats de régression de l'équation (2)

variables			
Indice national des prix alimentaire	Coef.	z	P>|z|
----------+--	----------	--------	---------
Lbéralisation commerciale (tarif)|	0,0373968	2,42	0,028
Lnsurface agricole	7,128758	3,85	0,000
Lproduction agrocole |	-847,1397	-3,69	0,000
Lpopulation agricole |	574,6463	3,65	0,000
densité_routière |	-0,05757	-5,77	0,000
var_prix_aimentairel |	0,00089	1,99	0,009
machines	-0,01213	-3,91	0,000
limport	0,16586	3,33	0,001
lrend |	-18,81037	-0,21	0,835
dficit_ali |	-0,0025	0,726	-,0164
indice_prod_agricole |	-0,0051	-3,02	0,003
indprod_animale |	0,0026	1,99	0,046
_cons |	742,14	3,68	0,000
Observations	**65**		
R-squared	**0.47**		
Nombre de Pays	**5**		

Note : la variable dépendante est l'indice de prix alimentaire. Tous les modèles inclus des effets aléatoires pays. Random-effects GLS regression, STATA 12

La réduction tarifaire due à la libéralisation se traduit par une baisse des prix des produits alimentaires. Des variables de contrôle comme la superficie agricole, la densité du réseau routier, l'indice de production animale et végétale, et la population agricole déterminent aussi selon les cas l'indice de prix alimentaire. Dans le cas de cette étude, cette variable est considérée comme l'indicateur d'accessibilité économique alimentaire. De plus, l'ensemble de ces variables relèvent du domaine de la politique agricole à l'exception du tarif douanier.

Ainsi, la libéralisation commerciale influence significativement l'indice de prix alimentaire. Cette hypothèse se confirme dans la mesure où le signe du coefficient est positif et conforme aux prédictions théoriques. L'observation des résultats du tableau 6 montre qu'une libéralisation commerciale à travers une réduction tarifaire conduit à une amélioration de la sécurité alimentaire dans les pays de la CEMAC. On peut donc conclure qu'elle a un effet positif. Ce résultat se classe en opposition des études qui aboutissent à des impacts négatifs comme celles de ([19]) dans le cas du Nigeria, ([20] et ([21]) dans le cas de la Chine.

3 LA CONCLUSION

Les politiques de lutte contre la pauvreté de la faim et celle de la sécurité alimentaire sont étroitement liées. Ainsi, les débats autour d'elles font légion dans le monde de la recherche en politique économique tant pour les chercheurs que pour les décideurs de politiques publiques. Puisque la faim demeure un grand problème pour les familles et l'humanité tout entière, l'augmentation de la sécurité alimentaire à travers une amélioration des conditions de production agricole des familles reste un défi pour les autorités publiques ([21]). Dans le cadre de ce travail, il s'est agi, d'examiner les effets de la mutualisation des politiques agricoles (politique agricole commune) sur la sécurité alimentaire dans la CEMAC. L'atteinte de cet objectif a été facilitée par l'usage des analyses statistique des données liées à la disponibilité des produits agricoles, l'accessibilité des produits alimentaires du fait de l'accord de libre-échange signé entre les Etats membres dans le cadre du renforcement de l'intégration économique sous régionale. Sur la base de l'estimation en données de panel du modèle économétrique issu des travaux de ([15]), deux relations économiques ont été estimées : la relation entre la sécurité alimentaire et les prix domestiques des produits alimentaires et la relation fixant les déterminants des prix domestiques des produits alimentaires en rapport avec l'indicateur de la libéralisation commerciale. Suite à cette analyse, nous sommes parvenus à la conclusion que la mutualisation des politiques agricoles influence positivement la sécurité alimentaire dans la CEMAC. C'est-à-dire, l'adoption et la mise en œuvre d'une politique agricole commune dans les pays de la CEMAC, permettra de venir à bout des problèmes liés à la faim et à augmenter le niveau de sécurité alimentaire par l'entremise d'une

augmentation du budget alloué au soutien de la production des denrées alimentaire dans les pays concernés. Ajouté à cette disposition, la baisse des tarifs douaniers, contribue à la baisse des prix alimentaires au niveau national. Ainsi, les questions liées à la disponibilité et à l'accessibilité des produits alimentaires, trouvent une solution dans la Communauté économique et monétaire de l'Afrique Centrale.

REFERENCES

[1] FAO (2012): The State of Food Insecurity in the World: *Economic growth is necessary but not sufficient to accelerate reduction of hunger and malnutrition.*

[2] Douya E., Hermelin B. et Rubier F. (2006), Impact sur l'agriculture de la CEMAC d'un Accord de Partenariat Economique, rapport, GRET.

[3] FAO. (2010) : Concept note. Symposium international sur la sécurité alimentaire et nutritionnelle: approches fondées sur les aliments pour l'amélioration du régime alimentaire et l'état nutritionnel, FAO, Rome, 7–9 décembre 2010. Rome.

[4] Boungou Jean-Christophe et Bazika (2005) : "Essai de définition et fonctionnalité de l'entreprise familiale dans une perspective africaine." *Revue internationale PME*18.3-4 (2005).

[5] Blimpo M. P., Harding R. and Wantchekon L. (2012): "*Food Security and Public Investment in Rural Infrastructure: Some Political Economy Considerations*" Paper prepared for the UNDP's first African Human Development Report.

[6] CEMAC (2004) :: Stratégie agricole commune des pays membres de la CEMAC, rapport povisoire, https://www.google.cm/url?sa=t&rct=j&q=&esrc=s&source=web&cd= 2&cad=rja&uact=8&ved=0CCwQFjAB&url=http%3A%2F%2Fpmb.sicac.org%2Fopaccss% 2Fdocnum.php%3Fexplnum_id%3D609&ei=esyWU83SLM-0wW5iICQDw&usg=AFQjCNHm APqvZMU4kbyIfR6nMlfM8MNJbw

[7] CEMAC (2009) : le tarif douanier des pays membres de la CEMAC Harmonisation, Tarif douanier CEMAC. http://www.sydonia.cemac.int/harmonisation/tarif.html

[8] Cretes (2008) : « Evaluation de l'impact fiscal net lié à la mise en œuvre de l'Accord de Partenariat Economique Afrique centrale/Union européenne et Elaboration d'un Mécanisme régional de compensation des pertes de recettes douanière » P 174, Rapport Provisoire, e-mail : cretesca@yahoo.fr

[9] Hoekman, Bernard and Marcelo Olarreaga (2007): Impacts and Implications of Global Trade Reform on Poverty Washington DC: Brookings Institution.

[10] Dufly, C., J. Puons, and M. Steenlandt (2002): "Vers l'union douanière en Afrique Centrale." Rapport pour la CEMAC à la demande de la Banque Mondiale, l'Union européenne et le Ministère français des affaires étrangères (2002).

[11] Gallezot J., Laborde D. (2007) : « L'Afrique centrale face au défi de l'accès au marché », liste d'exclusion, calendrier de démantèlement et coûts d'ajustement. Unité de gestion de projets APE : Projet 167/CEMAC. 148p.

[12] FAO. (2013) : Alimentación Escolar y las Posibilidades deCompra Directa de la Agricultura Familiar. http://www.fao.org/docrep/018/i3413s/i3413s.pdf

[13] FAO (2013 :. FAOSTAT statistical database (disponible à l'adresse: faostat.fao.org).

[14] FAO (2014) : FAOSTAT statistical database (disponible à l'adresse: faostat.fao.org).

[15] Jrad S, Nahas., Baghasa. (2010): "Food Security Models", National Agricultural Policy Center (NAPC) Policy Brief No 33, August.

[16] Golo yao (2013) : « Libéralisation commerciale et sécurité alimentaire en Afrique de l'Ouest », mémoire e de master / trapca/ lund University Novembre 2013

[17] Galtier F., (2009), « Comment gérer l'instabilité des prix alimentaires dans les pays en développement ? ». Working Paper Moisa N° 4/2009.

[18] Galtier F., (2012) : « Gérer l'instabilité des prix alimentaires dans les pays en développement : une analyse critique des stratégies et des instruments » http://www.afd.fr/webdav/site/afd/shared/PUBLICATIONS/RECHERCHE/Scientifiques/A-savoir/17-A-Savoir.pdf

[19] Abdullateef U, Ijaiya AT, (2010): "Agricultural trade liberalization and food security in Nigeria", Journal of Economics and International Finance.

[20] Chen CL, Duncan R, (2008): "Achieving food security in China: implications of World Trade Organization accession", Australian Centre for International Agricultural Research (ACIAR).

[21] FAO (2011): *Rural Poverty Report 2011: New realities, new challenges: New opportunities for tomorrow's generation*. Rome: International Fund for Agricultural Development. Retrieved from: http://www.ifad.org/rpr2011/report/e/rpr2011.pdf.

[22] Arestis P., & Caner, A. (2004): Financial liberalization and poverty: Channel and influence. Annandale-on-Hudson, NY: The Levy Economic Institute of Bard College. Retrieved from http://www.levyinstitute.org/pubs/wp411.pdf.

[23] Barrios S., Ouattara B., Strobl E. (2008): "The impact of climatic change on agricultural production: Is it different for Africa?" *Food Policy* 33 (2008) 287–298.
[24] Bezuneh M., Yiheyis Z., (2009): "Has trade liberalization improved food availability in developing countries? An empirical analysis", International Association of Agricultural Economists Conference, Beijing, China,16-22 August 2009.
[25] Chirwa E.W, Zakeyo C., (2006): « Malawi » in Trade-related reforms and food security: country case studies (Thomas H, ed.): 399-433, FAO.
[25] Claude Dufly et al (2003) : CEMAC Vers l'Union douanière, par, op.cit
[27] Diouf E. H. A. (2009) : « l'Afrique et le Droit à la Différence dans les Négociations Commerciales Internationales : OMC, APE, Intégration Régionale ».
[28] FAO. (2012) : Directives volontaires pour une gouvernance responsable des régimes fonciers applicables aux terres, aux pêches et aux forêts dans le contexte de la sécurité alimentaire nationale. http://www.fao.org/nr/tenure/voluntary-guidelines/es
[28] FAO, FIDA et PAM. (2012) : L'état de l'insécurité alimentaire dans le monde 2012: La croissance économique est nécessaire mais elle n'est pas suffisante pour accélérer la réduction de la faim et de la malnutrition. Rome.
[30] FAO (2013) : « la situation mondiale de l'alimentation et de l'agriculture », ISSN 0251-1460 Rome, 2013
[31] Fuller F, Beghin J, De Cara S, Fabiosa J, Cheng F, Matthey H, (2003):"China's accession to the World Trade Organization: what is at stake for agricultural markets?", Review of Agricultural Economics.
[32] Hailu M. B. (2010): "Food Security and Agricultural Trade Liberalization" Conference Paper, Society of International Economic Law (SIEL) Second Biennial Global Conference, July. http://www.ssrn.com/link/SIEL-2010-Barcelona-Conference.html.
[33] Hoekman, F. Ng et M. Olarreaga (2002): « Eliminating Tariff on Exports of Least Developed Countries». World Bank Economic Review, 16, pp. 1-21. (2002),
[34] Kaukab, R.S., & Chakravartti, S. (2011). Agricultural trade and development in five sub-Saharan countries: An overview. In Agriculture in development of select African countries: Linkages with trade, productivity, livelihood and food security. Geneva: CUTS International.
[35] McCorriston S., Hemming D. J., Lamontagne-Godwin J. D., Osborn J., Parr M. J., Roberts P. D., (2013): "What is the evidence of the impact of agricultural trade liberalization on food security in developing countries?" A systematic review. London: EPPI-Centre, Social Science Research Unit, Institute of Education, University of London.
[36] Nyangito H.O, Nzuma J, Ommeh H, Mbithi M (2006): "Kenya" in Trade-related reforms and food security: country case studies (Thomas H, ed.): 365-397, FAO.
[37] OCDE (2002): « The medium-term impacts of trade liberalization in OECD countries on the food security of non-member economies", OECD Joint Working Party on Agriculture and Trade, Working Paper.
[38] OMC, (2001) : « Déclaration ministérielle, conférence ministérielle » Quatrième session Doha, 9 - 14 novembre 2001, WT/MIN(01)/DEC/1.
[39] OMC, (2004) Programme de travail de Doha Décision adoptée par le Conseil général le 1er août 2004, WT/L/579.
[40] OMC, (2005) Programme de travail de Doha, conférence ministérielle Sixième session Hong Kong, 13 - 18 décembre 2005, WT/MIN(05)/DEC.
[41] OMC, (2008) Comité de l'agriculture, projet révisé de modalités concernant l'agriculture, Session extraordinaire TN/AG/W/4/Rev.4.
[42] Opolot J, Wandera A, Abdalla YA (2006), "Uganda" in Trade-related reforms and food security: country case studies (Thomas H, ed.): 587-615, FAO.
[43] Oyejide TA, Ogunkola EO, Alaba OB (2006) "Nigeria" in Trade-related reforms and food security: country case studies (Thomas H, ed.): 465-501, FAO.
[44] Pyakuryal B, Roy D, Thapa YB, (2010), "Trade liberalization and food security in Nepal" Food Policy, volume 35 pp. 1-43.
[45] UNECA (2007), Africa Review Report on Agriculture and Rural Development August 2007 *Economic Commission for Africa*.
[46] World Bank. (2008). *World Development Report 2008: Agriculture for development*. Washington, DC: World Bank.
[47] World Bank. (2010): "*Boom, bust and up again? Evolution, drivers and impact of commodity prices: Implications for Indonesia"*. Trade Policy Report. Jakarta: World Bank Office Jakarta. Retrieved from:http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/ 2011/01/07/000333037_20110107015936/Rendered/PDF/588310v1010WP01 sum1english112302010.pdf.

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Application of bubble column reactor in environmental engineering - future directions, future dimensions, visionary and deep comprehension

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ABSTRACT: History of environmental engineering science, visionary tools and their applications are moving towards a newer visionary scientific generation of science and technology. Zero discharge norms, environmental sustainability and the immense progress of engineering has brought human civilization from the brink of an immediate and imminent environmental disaster. These disasters are due to the tremendous industrialization of human civilization. Thus in such an encompassing disaster and a critical juncture of history and time , importance of environmental engineering science has predominant importance. The domain of environmental engineering is moving towards a new generation of scientific determination and scientific steadfastness. The challenges which lie before in the path of endeavour are crucial to scientific advancement. Environmental regulations and rigid restrictions stands today as an important issue in the path towards scientific progress and scientific pursuit. Here stands today the contribution of cutting edge technology and the vision to excel. Wastewater treatment and wastewater degradation stands today as a primordial issue in the history of mankind in the present day civilization. Cutting edge technologies such as application of bubble column reactor for wastewater treatment has an unquestioned hope and unquestioned vision. Bubble column reactors has become an effective tool in giving the environmental engineer and environmental scientist the standards and the basis of better wastewater degradation. Scientific advancement has immense answers and in such a crucial juncture of universal environmental sustainability, the world of unknown opens up new vistas and new doors of innovation in the path towards progress. This treatise emboldens the answers to immense questions of wastewater treatment, advanced oxidation processes and application of bubble column reactor.

KEYWORDS: environment, bubble, reactor, wastewater, reactor, engineering, wastewater, pollution.

1 INTRODUCTION

The domain of environmental engineering is witnessing drastic and far-reaching changes. Immense ecological damage and environmental disasters are destroying human habitat. In such a critical juncture of history of human mankind, industrial wastewater treatment needs to be reassessed and rejudged with the progress of civilization. Application of bubble column reactor stands as an important and primordial vision to the newly developed regime of industrial wastewater treatment. The world of challenges needs to be revamped and restructured in such a crucial juncture of history of human civilization. Mankind today stands in the midst of immense optimism , hope, scientific vision and scientific justification. Ecological imbalance is a boon to a greater environmental disaster of immense proportion in years to come. With this concept in mind, mankind should rejustify itself to a greater vision of application of novel separation processes, advanced oxidation processes and the improved application of tools of degradation such as bubble column reactor. Future directions, future dimensions and scientific understanding will enhance with improved implication in validating knowledge in the field of application of bubble column reactor.

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2 BUBBLE COLUMN REACTOR, ITS DEFINITIVE VISION AND ITS IMPROVED APPLICATION SCENARIO

Bubble column reactor and novel separation processes in today's scientific paradigm should have an umbilical cord which need not be severed. Its vision and improved application are the primordial issues of environmental engineering science. Industrial water pollution and ecological imbalance are the major parameters in the progress of science of environmental engineering. Global water shortage and drinking water shortage crisis has become an inevitable parameter to the immense growth of a developing country as well as a developed country.[1],[2],[3],[4]

Bubble column reactors owe their wide and versatile application area to a number of advantages they provide both in design and operation as compared to other reactors. First and foremost, they have excellent heat and mass transfer characteristics, meaning high heat and mass transfer coefficients. Little maintenance and low operating costs are required due to lack of moving parts and compactness. The durability of the catalyst or other packing material is high.[15],[16]

Recent research endeavour with bubble columns frequently focuses on the following topics: gas holdup studies, bubble characteristics , flow regime investigations and computational fluid dynamics studies , local and average heat transfer measurements and mass transfer studies. The effects of column dimensions, column internals design, operating conditions, i.e., pressure and temperature, the effect of superficial gas velocity, solid type and concentration are commonly investigated in these studies. Many experimental studies have been directed towards the quantification of the effects that operating conditions, slurry physical properties and column dimensions have on performance on bubble columns.[15],[16]

2.1 BUBBLE COLUMN REACTORS: CONCEPTS, DOCTRINES AND PUBLISHED WORK

As far as published studies are concerned, the main interest is concentrated on design and scale-up, fluid dynamics and regime analysis and characteristics parameters, especially gas-holdup, bubble characteristics, mass transfer coefficient and heat transfer coefficient

The design and scale-up of bubble columns have gained considerable attention in recent years due to complex hydrodynamics and its influence on transport characteristics. Although the construction of bubble columns is simple, accurate and successful design and scale-up require an improved understanding of multiphase fluid dynamics and its influences. Industrial bubble columns usually operate with a length-to-diameter ratio, or aspect ratio of at least 5. In biochemical applications this value usually varies between 2 and 5. The effects brought about by the selection of column dimensions have found interest in bubble column reactor design. First and foremost , the use of large diameter reactors is desired because large gas throughputs are involved. Additionally large reactor heights are required to obtain large conversion levels. However , there are also disadvantages brought about by the use of large diameter and tall columns in terms of ease of operation. As a result it is necessary to talk about an optimization process for best output.[16]

3 ENVIRONMENTAL ENGINEERING SCIENCE, VISIONARY TOOLS AND FAR-REACHING APPLICATIONS

Visionary applications of bubble column reactor in enviromental engineering science are immense, wide and ground-breaking. Environmental engineering is moving briskly surpassing one visionary frontier over another. The greatness of human civilization needs to be reshaped and reassessed. In today's world and today's generation, heavy metal groundwater remediation remain a formidable challenge. Bioremediation , bioadsorption and bio-ozonation stands today as a primordial alternative to this vicious challenge. In view of an inevitable global water shortage and industrial water pollution, the importance of novel separation processes and application of bubble column reactors stands high in the midst of immense optimism and steadfastness.[5],[6],[7],[8]

4 BUBBLE COLUMN REACTOR, VISIONARY CHALLENGES AND THE EFFECTIVE THRUST AREAS OF TECHNOLOGY

The path to excel in the field of environmental engineering is wide, versatile and unsurpassed. Progress of technology is visionary at every turn of decade. Hindrance, hurdles and barriers are standing in the path to progress of human mankind but visionary implications are many. Environmental regulations and restrictions has brought the human civilization out of the brink of immense catastrophe. Zero discharge norms have plunged the scientific community to immense optimism, scientific hope and scientific vision. Progress of science and technology has cogent and insightful parameters-the urge to drive scientific optimism forward. In such a scenario, the application of bubble column reactor is a boon to the purposeful and definitive vision for the future.[9],[10],[11],[12]

5 BUBBLE COLUMN REACTOR, ITS APPLICATION , PURPOSEFUL AND IMPROVED VISION

Bubble column reactor and its purposeful and improved vision are widening the colossal scientific achievements and bringing in new optimism in effectivity of environmental engineering techniques. Environmental engineering today stands in the midst of absolute optimism and unhindered progress. Environmental engineering, application of bubble column reactor and membrane separation process are interrelated domains of scientific research pursuit. Newer optimism, immense hope and scientific vision are the order of today's scientific civilization.

6 SCIENTIFIC SAGACITY, SCIENTIFIC VISION AND THE IMMEDIATE FUTURE OF APPLICATION OF BUBBLE COLUMN

Scientific sagacity and visionary path of progress are opening up new dimensions in the application areas of bubble column reactor. Progeny of the application areas of bubble column reactor are wide, versatile and visionary. History of environmental engineering, its visionary implications and immense possibilities has helped civilization out of the brinks of disaster.

7 GLOBAL WATER SHORTAGE CRISIS, INDUSTRIAL WASTEWATER TREATMENT AND THE AVENUE TO PROGRESS

Global water shortage has today plunged human mankind to the depths of infinite disaster. Drinking water provision has emerged as a primordial thrust area in a nation's growth. Man's vision is hugely enhanced and the future scientific endeavour is reshaped and rejustified. Man's as well as a scientist's path to progress is surpassing many visionary boundaries. History of science and technology will be a definitive witness to the scientific ordeals of time. Global water shortage crisis and industrial pollution stands today in the midst of immense optimism and hope. Bubble column reactor is a visionary tool whose efficacy is unlimited. Textile wastewater treatment and industrial pollution control are the backbones of its immense application domain.

The scenario of global water availability is grave and is of utmost and immediate concern to human society. Growth and progress of human civilization have an umbilical cord with the global water shortage. The path to progress in solving intricacies of industrial pollution control and environmental engineering science needs to be reassessed. History of human civilization today is in the avenue of brisk and infinite vision. That vision should alter the course of scientific understanding and scientific thought.

8 ENVIRONMENTAL AND ENERGY SUSTAINABILITY – THE SCIENTIFIC VISION FOR THE IMMEDIATE FUTURE

Environmental sustainability is the formidable issue of the present day human society and present day human generation. Scientific vision, scientific justification and scientific hope today stands in the midst of devil and the deep sea. The immediate future stands bright and visionary at the distant scientific horizon. Environmental and ecological imbalance has brought the human civilization today in deep peril. Scientific advancements has to be reassessed and revamped with the march and progress of science and technology. Energy sustainability in the same vein today stands in the midst of immense optimism in today's human civilization. The scientific vision of energy as well as environmental sustainability has to be targeted towards the needs of human development and human scientific advancement. Human society and the march of science and technology regenerates itself each turn of a decade and century. Environmental and energy sustainability stands in the midst of unbridled hope and deep insight.[13],[14],[15],[16]

9 ADVANCED OXIDATION PROCESS AND ITS VISIONARY APPLICATION IN THE DOMAIN OF INDUSTRIAL WASTEWATER TREATMENT

Advanced oxidation processes and novel separation processes today stands as a primordial backbone and a visionary tool towards effective remediation of contaminated drinking water and contaminated groundwater. History of science and technology needs to be revamped at the immediate need of human society and the scientific advancements of present day civilization. The effectivity of advanced oxidation processes and ozonation in particular are versatile, visionary and proven. The holistic approach of the application of bubble column reactor needs to be readjudicated and revamped. The challenges will loom large over the distant scientific horizon but visionary ideals will eventually surpass these inimitable barriers.

10 NOVEL SEPARATION PROCESS, MEMBRANE SCIENCE AND THE SCIENCTIFIC URGE TO EXCEL:

Novel separation processes and membrane science has visionary implication to the future progress of environmental engineering science. The scientific urge to excel has surpassed human scientific boundaries. Excellence and brilliance in scientific pursuit in today's world needs a wholesome and holistic regeneration and scientific revamping. Novel separation processes and membrane science are the backbones of environmental engineering research pursuit in today's visionary path to progress, success and immense optimism. The scientific urge to excel has been proven over the four decades in the environmental engineering pursuits. History of membrane science and environmental engineering endeavours will surely open up new doors of immense innovation and scientific intuition in years to come.

11 HUMAN MANKIND'S PROGRESS IN THE DOMAIN OF ENVIRONMENTAL ENGINEERING

Mankind's progress and thrust in scientific understanding and scientific vision is inspiring as well as path enhancing. Ecological imbalance and environmental disasters has brought the present day civilization to the brink of inimitable disaster. Thus environmental engineering is the mainstay for future generations. The hurdles, barriers and frontiers of challenges are wide and immense. Environmental sustainability is the need of the hour. Scientific reassessment of environmental engineering has to be more definitive. Progress in this area of science has to parallely move with the virtues and fruits of engineering. Civil society, governmental regulations, environmental restrictions and visionary optimization are the primordial issues of present and future generations.

Human mankind and the progress of civilization today stands in the midst of immense optimism and hope. In such a respect, environmental regulations and ecological imbalance stands steadfast and firm. The tools of environmental engineering such as bubble column reactor, advanced oxidation processes or novel separation processes will surely open up doors of immense imagination and windows of innovation for the future perspective and the future paradigm.

12 VISION OF MANKIND AND VISION OF ENVIRONMENTAL ENGINEERING FOR THE IMMEDIATE FUTURE

Vision of mankind and human civilization is poised for immense growth and immense optimism. The immediate future for environmental engineering has opened up new vistas of human growth and newer scientific vision. The vision for the future in the domain of environmental engineering is progressive and definitive. The challenges to the application needs to be surpassed with extreme steadfastness and firmness. Mass and heat transfer effects needs to be addressed vehemently and briskly. History of environmental engineering science will witness a new dawn with the slow and brisk progress of time.

The immediate future in the progress towards zero-discharge norms is inspiring and of definitive vision. Civil society, governmental decisions and environmental restrictions will go a long way in unraveling the definite truth behind environmental engineering endeavours.

13 VISION OF APPLICATION OF BUBBLE COLUMN REACTOR AND ITS IMPROVED EFFICACY

Bubble column reactors are the tools of engineering for the future. Hydrodynamics, heat and mass transfer phenomenon are the primordial issues for the future of the application of bubble column reactors. Improved technologies and definitive vision will lead the scientific endeavour to a newer generation. Improved efficacy and visionary implications will open up new doors of innovation.

14 BUBBLE COLUMN REACTOR , ADVANCED OXIDATION PROCESSES AND ITS IMMEDIATE VISION

The immediate vision in the application of bubble column reactor needs to be surpassed. History of science and engineering, the vision for future and the immense scientific optimism are the flagbearers of the greater objective of the application of this domain. The effectiveness and efficiency of the application of bubble column reactor is the backbone of scientific truth and immense scientific understanding.

15 IMPROVED HYDRODYNAMICS, IMPROVED HEAT AND MASS TRANSFER CHARACTERISTICS AND THE DEFINITIVE VISION

Bubble column reactors are intensively used as multiphase contactors and reactors in chemical, biochemical and petrochemical industries. This progressive vision in its application needs to be reassessed. They provide several advantages during operation and maintenance such as high heat and mass transfer rates , compactness and low operating and

maintenance costs. Three phase bubble column reactors are widely employed in reaction engineering , i.e., in the presence of a catalyst and in biochemical applications where microorganisms are utilized as solid suspensions in order to manufacture industrially valuable bioproducts. The design and scale-up of bubble column reactors generally depend on the quantification of three main phenomena:i)heat and mass transfer characteristics ; ii) mixing characteristics and iii) chemical kinetics of the reacting system. Thus the reported studies emphasize the requirement of improved understanding of the multiphase fluid dynamics and its influence on phase hold ups, mixing and transport properties.

16 NANOFILTRATION, APPLICATION OF BUBBLE COLUMN REACTOR AND ITS PROGRESSIVE VISION

Nanofiltration and application of nanotechnology today stands as a major thrust area in the march of environmental engineering science. Mankind's boon of science, scientific vision and progressive thoughts and vision are all interrelated. Application of bubble column reactor is the focal point of the current ongoing research thrust and the primordial backbone of tomorrow's scientific application.

17 FUTURE OF DOCTRINE OF APPLICATION AREAS OF BUBBLE COLUMN REACTOR

Doctrine of application areas of bubble column reactor is wide, varied , ever inspiring and path-breaking. History of mankind is a visionary witness to the winds of immense changes and upheavals. Bubble column reactors has shown its efficacy and its wide importance.The doctrine of applications has improved the definitive and futuristic vision of bubble column reactor. Environmental engineering science and application of bubble column reactor have an umbilical cord which cannot be surpassed. Progress, application and improved performance stands today as a major thrust area of the definitive vision of bubble column reactor. History of science, progressive vision and improved effectivity will surely help to enhance the doctrine of the application domain of bubble column reactor.

18 PROGRESS OF SCIENCE AND TECHNOLOGY AND THRUST AREAS OF ENVIRONMENTAL ENGINEERING

Science, engineering and technology are the pallbearers of the next generation human endeavour. The thrust areas needs to be reassessed and rejudged. The frontiers of application areas of environmental engineering are vehemently surpassed and the jargons of application areas and techniques of environmental engineering are resolved with immense scientific acuity. Progress in science in today's scientific world should be targeted towards definitive vision and purposeful scientific attitude. [13],[14]

19 HISTORY OF SCIENCE AND ENGINEERING, SURGE TOWARDS A NEWER VISION AND THE IMMENSE CHALLENGES IN ENVIRONMENTAL ENGINEERING SCIENCE

History of technology and science, scientific truth and scientific vision are the focal points of future human generations. The challenges towards the application of scientific visionary tools needs to be redrafted and revamped. Water shortage crisis, zero discharge norms and the scientific conclusions of environmental engineering science are the immense boons to the future of human mankind. Environmental engineering paradigm in today's world needs to be reassessed and revamped with a view to zero-discharge norms. Optimism, hope and immense scientific steadfastness will go a long way in determining human mankind's development parameter.

20 FUTURE DIRECTION, FUTURE VISIONARY THOUGHT AND THE STRIVING TOWARDS A NEWER SCIENTIFIC HOPE AND SCIENTIFIC OPTIMISM

Future direction and future dimensions in the field of application of bubble column reactors are ground-breaking and vision-surpassing. History of mankind needs to be readjudged and reassessed with the turn of each decade and each century. Future visionary thoughts will surely be targeted towards a definitive mission and purposeful goal. New scientific sagacity and scientific vision will surely pull our fragmented civilization out of the impending water shortage crisis.

21 FUTURE DIMENSION OF APPLICATION OF VARIOUS ENVIRONMENTAL ENGINEERING TECHNIQUES

Man's as well as a scientist's vision are immensely path-breaking, far-reaching and imaginative. History will visibly repeat itself with deep insight. Environmental engineering techniques, visionary implications and the progress of science and

technology are the inevitable parameters of the development and growth of a nation. Future dimensions with regards to environmental engineering techniques needs a thorough assessment and a poignant and incisive insight. In view of the ecological imbalance , the question of application of tools of environmental engineering will surely bring in a new era of scientific hope and scientific justification.

22 FUTURE VISION, PROGRESS OF ENVIRONMENTAL ENGINEERING AND THE FUTURE PATH TO PROGRESS

Future vision in the field of environmental engineering needs to be restructured and revamped. The future path to progress is wide and exceedingly imaginative. Mankind's history needs to follow a new path of environmental engineering endeavour. Zero discharge norms, effective visionary techniques and the wider vision of industrial pollution control are the parameters of future progress. History of civilization today stands in the brink of immense disaster and unsurpassed catastrophe. The jargons of human science in today's world are obliterated and the vision of tomorrow in the field of scientific vision and scientific judgement has been inspiring. Challenges, difficulties and barriers of human endeavour are immense and unsurpassed till today but the visionary implications are opening new vistas of pursuit for enhancing the scientific vision of tomorrow.

23 CONCLUSION

Bubble column reactors are one of the major environmental engineering tools for the future. Future dimensions, future progress and future vision needs to be realigned with the view of immediate need of zero-discharge norms. Environmental regulations and environmental restrictions has brought human civilization out of immediate disaster. Newer techniques, novel separation processes and effective tools such as bubble column reactors are ushering in a new scientific generation of renewed hope , intuition and perfect vision. Bubble column reactors with its enhanced scientific understanding and scientific truth are the world of vision of tomorrow. Enhanced heat and mass transfer characteristics, improved hydrodynamic applications and progressive scientific vision will be leading human vision and scientific steadfastness to a newer future generation.

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REFERENCES

(1) Kepa.U.,Stanczyk-Mazanek.E.,Stepniak.L.,The use of advanced oxidation process in the ozone+ hydrogen peroxide system for the removal of cyanide from water.,Desalination,2008, (223)187-193
(2) Zhou.H.,Smith.D.W.,, Advanced technologies in water and wastewater treatment,Journal of Environmental Engineering Science,2002,1:247-264.
(3) Al-Kdasi,Idris.A.,Saed.K.,Guan.C.T.,Treatment of textile wastewater by advanced oxidation processes:a review, Global Nest, The International journal,2004, Vol.6, No.3, Page 222-230
(4) Palit.S.,,Membrane separation processes and advanced oxidation processes of dyes in bubble column reactor-a keen and far reaching overview,International Journal of Chem Tech Research, 2012,Vol.4, No.3,pp862-866
(4) Gogate.P.R.,Pandit.A.B.,A review of imperative technologies for wastewater treatment I:oxidation technologies at ambient conditions, Advances in Environmental Research 2004,8,500-551
(5) Chiron.S.,Fernandez-Alba.A.,Rodriguez.A.,Garcia-Calvo.E.,Pesticide Chemical Oxidation: State of the Art., Water Research, 2000,Vol.34,No.2,pp366-377.
(6) Kos.L.,Perkowski.J.,,Decolouration of real textile wastewater with advanced oxidation processes,Fibres and textiles in Eastern Europe., October/ December,2003,Vol.11,No.4,43.
(7) Suty.H.,De Traversay.C.,Cost.M.,,Applications of advanced oxidation processes: present and future, Water Science and Technology, 2004,Vol.49,No.4,pp227-233
(8) Stasinakis.A.S., Use of selected advanced oxidation processes(AOPs) for wastewater treatment-a mini-review, Global NEST Journal,2008, Vol. 10, No.3, pp376-385

(9) Joseph .C.G.,Puma.G.L.,Bono.A.,Krishnaiah.D.,Sonophotocatalysis in advanced oxidation process: A short review, Ultrasonics Sonochemistry, 2009, 16,583-589
(10) Huber.M.M.,Canonica.S.,Park.G.Y.,Gunten.U.V., Oxidation of pharmaceuticals during ozonation and advanced oxidation processes ,Environmental Science and Technology,2003, 37, 1016-1024
(11) Esplugas.S.,Bila.D.M.,Krause.L.G.T.,Dezotti.M.,Ozonation and advanced oxidation technologies to remove endocrine disrupting chemicals (EDCs) and pharmaceuticals and personal care products (PPCPs)in water effluents, Journal of Hazardous Materials ,2007,149,631-642
(12) Palit Sukanchan, Progress in membrane separation processes, ozonation and other advanced oxidation processes- A review, International Journal of Chemical and Analytical Science , 2012, 3(1) , 1290-1292.
(13) Palit Sukanchan, Ozone treatment as an effective advanced oxidation process for the degradation of textile dye-effluents. , International Journal of Chemical and Analytical Science, 2012, 3(1), 1293-1295
(14) Palit Sukanchan, Ozonation of Direct Red – 23 dye in a fixed bed batch bubble column reactor, Indian Journal of Science and Technology,2009, Vol.2 , No.10,Oct.
(15) Palit Sukanchan,Ozonation associated with nanofiltration as an effective procedure in treating dye effluents from textile industries with the help of a bubble column:A review, International Journal of Chemistry and Chemical Engineering, 2011,Vol 1, Number 1, pp 53-60
(16) Kantarci.N.,Borak.F.,Ulgen.K.O.,Bubble Column Reactors,Process Biochemistry,2005, 40,2263-2283

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Design and Estimation of Low Cost Floating House

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ABSTRACT: An attempt was made to design a low cost floating house suitable for people in low lying areas such as Bangladesh. The prototype house considered for the present study has the carrying capacity of 1850 kg loads with sufficient freeboard of 30% excluding the self weights of the supporting ten airtight empty steel drums in water and having a floor area of 120 ft^2. These steel drums that are locally available and provide an atmosphere to live in without the fear of losing possession during flood. The value of metacentric height (10.22 ft) of the designed house was found to be positive indicating its stability at floating condition. The angular displacement of the house due to wind action was also calculated and this floating structure would be stable up to the wind speed of about 160 km/hr. To provide sanitation a floating toilet can be hinged with the structure. It would definitely give an eco-friendly out look to the structure. For variable fencing, flooring, roofing and floating elements costs were estimated to determine the most economic feasibility. The most economic house was supposed to be made of locally available materials such as chhon and golpata. But from the engineering point of view the most stable and durable house was found to be CI- sheet and angle bar. Above all, the house made of Bamboo could be used on the basis of availability and durability. This house could be used all the round year as a permanent address for landless people and gypsies.

KEYWORDS: Floating House, Metacentric Height, Moment of Inertia, Low cost House.

INTRODUCTION

Floating house is a unique mechanism of living on a buoyant platform without the fear of sinking and get afloat with the rising ups and downs according to the water level. It is not a house boat, but an actual house that's designed to float. The concept of these types of house developed to get rid of the debilitating and expensive damage due to floodwater incursion in low lying areas around the world. Different types of modern constructional materials are used in modernize floating structure and providing all the amenities required in this house. Two types of floating house are basically designed. One sits permanently on water as boat and another is an amphibious house that stand on dry land but in the event of flood able to rise with water**.** The Dutch technology consists of a floating concrete container that can be used as a lower level or cellar. The Canadian technology consists of a square container turned upside down and filled with polystyrene, an unsinkable structure. Switzerland architects design floating house on a catamaran pontoon which consists of 98% plywood from locally sourced birch. Ali (1995) and Suman (2007) had developed floating poultry house for flood-hit areas which may also used as flood

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shelter. They used local available material for the construction of this house. Abul Hasanat Mohammed Rezwan (URL) introduced solar-powered floating or boat school in 2002 for children with library, heath and extension work facilities. Bangladesh is located in the deltaic region of three enormous rivers. As the sea level is rising, the water from the floods is no longer being quickly pulled down towards the ocean. Tidal flow are most common scenario in the southern region of the basin area of Bangladesh and every year it appeared as havoc and made millions of people victims by losing their possessions and lives. So a vast area remains under water all round the year. However, floating people may sort out their dwelling problems using country boats of different types. But the costs of large boats are high which cannot be afforded by rural people. There are lacks of sanitation facilities in boats. Inadequate supply of well finished timber in the market is also a reason of choosing floating device other than boats. About half of the total population in the country is landless and lead a miserable floating life. Considering the reasons above an attempt was taken to make a low cost floating house that would be stable and durable.

Hence the present study was conducted with a view to address the following objectives:

- To design a floating house suitable for all the year round in flood affected area and used as a flood shelter.
- To analyze the stability of the designed house against the wind action at floating condition.
- To estimate the cost of floating houses made of different constructional materials for economic viability.

METHODOLOGY

An amphibious floating structure was designed to use it as a flood shelter with all the amenities so that one can meet their natural need during flood. To float the structure an assumption was made that drums should be provided in such a way that it will remain in complete balance. However, local materials were selected to design the floating house. In the present study a 'Middle class' family was considered as the family in the rural areas who has enough earnings to run the family easily for the whole year. Mostly its source of income is from agricultural products. The family was considered of five member's family. It consists of father, mother and three children. For design consideration their approximate body weights were considered as 60 kg, 55 kg, 40Kg, 15 kg and 10kg i.e. the total is 180 kg. To provide sanitation facilities a floating toilet must be hinged in such a way that stability of the floating structure does not hindered.

Considerable incoming loads in the house

For design purpose the weights are considered as given below:

The total weight of the family members	= 180 kg
Weight of food (one month)	= 250kg
Weight of seed of different crops	= 200kg
Self weight of the structure	= 900 kg
Weight of stored drinking water	= 80kg
Weight of the utensils, cloth and others	= 200 kg
Total weights	= 1810Kg

Design consideration

In designing the floating body 30% of drum diameter was maintained as free board above water surface (Garg, 2003).So, the total buoyant force was calculated as following:

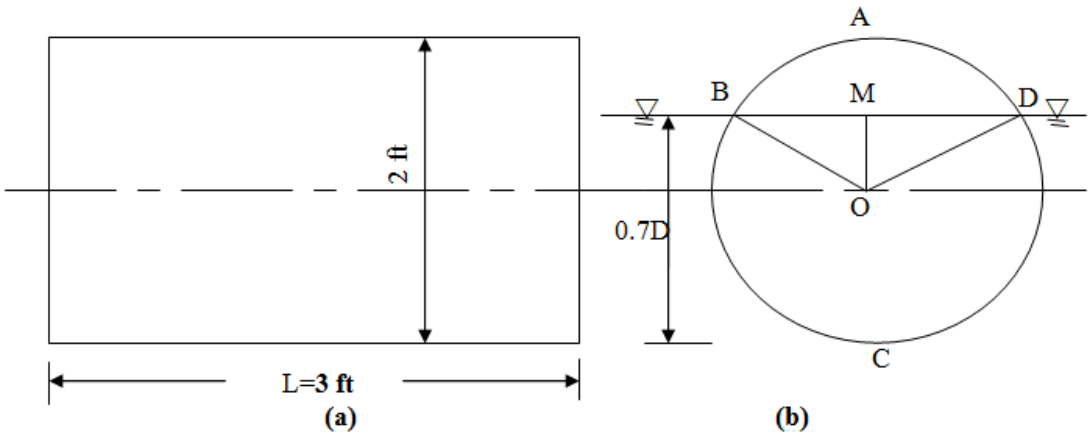


Fig.1 Front view and cross sectional view of a drum

The number of drums required to construct floating house are calculated from the ratio of total weight of structure and the net buoyant force developed by a drum (Suman *et al*, 2008).

Determination of center of gravity of the floating body (G)

Since, the whole floating body dealt in this experiment consists of different segment having different weight and shape, so center of gravity is to be determined following the law of composite body.

Now, the centroid distance of ABCDEF is Z_1 ft from the drum base (Meriam & Kraige, 1987), then Z_1 was calculated from the equation (1) and (2)

Z_1*ABCDEF=6*(8*12)+12*(4*12) (1)

Z_2 * 1900 = 1*50 + 8*900 + 5* 950) (2)

Determination of center of Buoyancy (B)

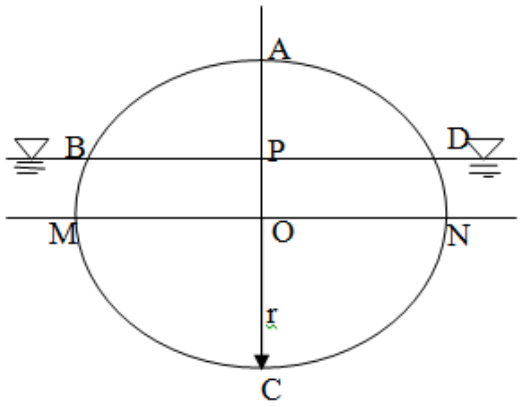


Fig.2 Determination of center of buoyancy

The distance of centroid of the BCD portion is Z_3 from base of the drum was (Ferdinand & Russell, 1978); **(**Fig.2).

Z_3 * area of BMCND = ($\frac{3\pi r - 4r}{3\pi}$) * area of semicircle + ($\frac{op}{2}$ +r)* BMND (3)

Determination of Moment of inertia (I)

In this experiment, only drums are in submerged condition, that's why the moment of inertia will be the combination of four water line sectional area of those drum. The plan view of water section area for four drum is given in Fig. 3.

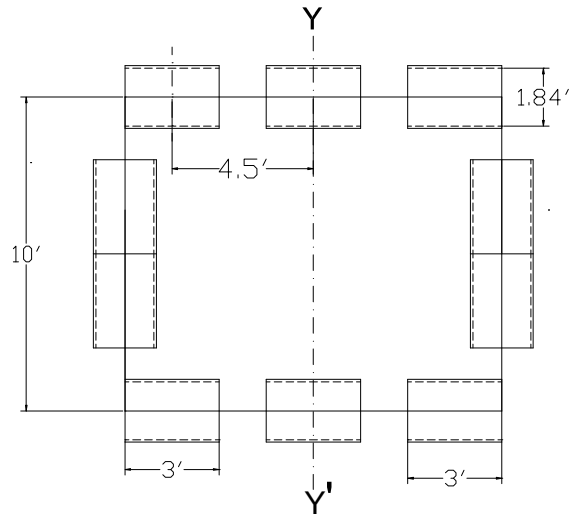


Fig.3 Determination of Moment of inertia

Moment of inertia for any drum along its center line (Meriam & Kraige, 1987), was calculated from equation(4)

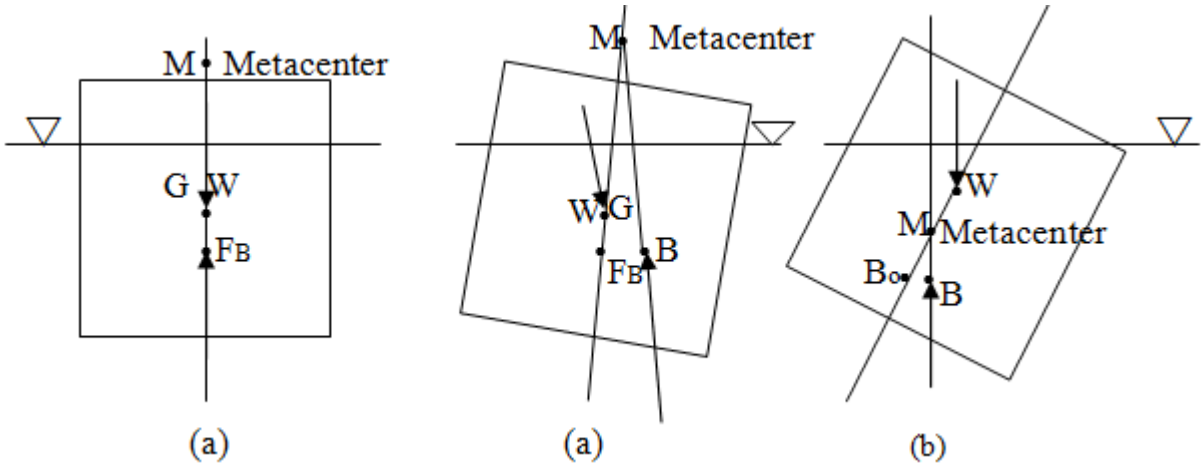
$I_1 = \frac{1}{2}$ *actual diameter of drum*(Lengh of drum)^3 **(4)**

and moment of inertia for any drum With respect to Y-Y axis,

$I = I_1 + 4.5^2$ * (actual diameter of drum * Lengh of drum) **(5)**

Stability analysis

A floating body is said to be stable if it comes back to its original position after slight disturbance (Bansal, 2005).Two alternate moments may act on the floating body depending on the relative position of center of gravity (G) and center of buoyancy (B) as shown in Fig. 4.



(a) Stable equilibrium, M is above G (b) Unstable equilibrium M is below G

Fig. 4 Stable equilibrium and unstable equilibrium of a floating body

The point M is known as the metacenter and its distance GM from the center of gravity is termed as metacentric height and was calculated by **,GM = MB_o - GB_o** **(6)**

For stable condition, GM must be positive (King *et al.,* 1963; Khurmi, 1998).

For small disturbance (Angle should be $<5^0$), **MBo =** $\frac{I}{V}$ **(7)**

where,

I = Moment of inertia of the water line section about the longitudinal axis through central point.

V = Volume of water displaced by submerged body.

Wind Force

Wind force was calculated by resolving θ from the Fig. 5. Also, a computer program was developed for calculating angular displacement of floating structure at different wind forces.

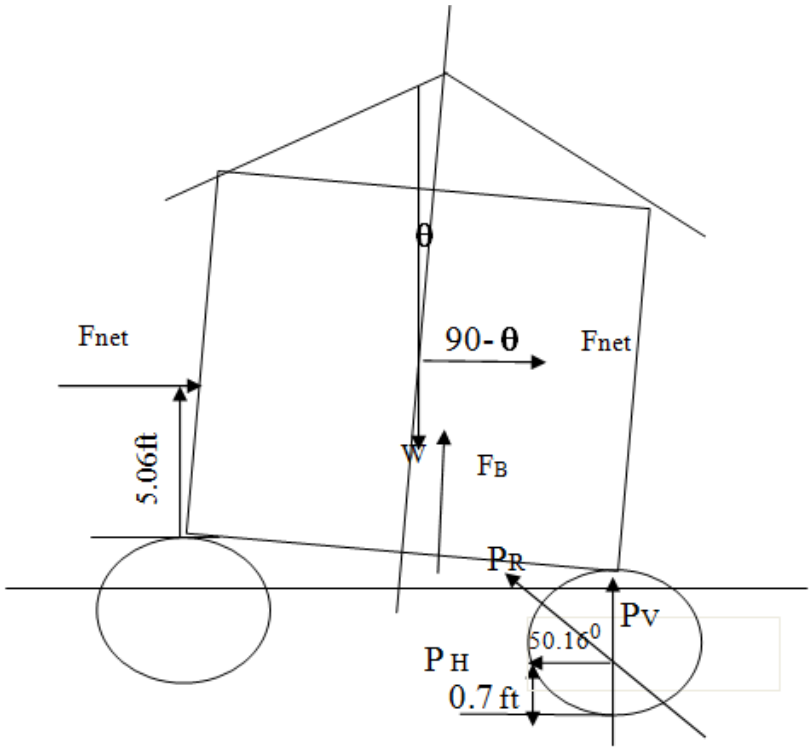


Fig. 5 Determination of resistance force of water

Considerations for sanitation

To provide sanitation a floating toilet was hinged with the main structure without disruption of the stability of the structure. A single drum will provide as septic tank with the capacity of holding sewage for three days. It also worked as a floating body for the toilet structure. After three days the drum will conveyed to the bank of the river and for exodus of sewage, a pit would dig at the bank of the river. For increasing capacity of holding sewage the drums can be used which are attached with the side wall of the main structure.

Estimation of Cost

With the consideration of locally available material, durability of the constructional materials and stability the structure, different types of materials are chosen for the estimation of the cost of design floating house. Different types of floating body such as drums, tires and boat are considered for estimating the cost and to find out the most economic and durable structure.

RESULTS AND DISCUSSION

The floating was designed by taking a dimension of 10′×12′ where a family with five members reside on it. The height of the house was considered 8 ft. The house will float on water during flood or any time as it is used. It required 10 steel drums of size 2 ft diameter and 3 ft long. The house then able to carry 1850 kg loads sufficiently with 30% free board excluding self weight of the drum.

Stability Analysis

Since, during flood or rising in water level there is possibility of tilting the house, so a details stability analysis was made with light of fluid mechanics. It was found that the combined center of gravity of whole floating body with loads in at 7 ft above the base of floating drum and the center of buoyancy was 0.78 ft above the base of the drum. The combined moment of inertia was found as 1159.2 ft^4**.** The metacentric height (GM), the principle criterion of the stability of the floating body was found as **10.22ft.** The positive value of GM indicates that the floating house able to gain its stable condition, if small angular displacement (<5°) is given in that structure. The net force is responsible for tilting of the house which was 8 kg at a wind speed of 85 mph. The tilting angel was calculated from the balance equation of righting moment of buoyancy and overturning moment for the net force which was found as 0.15^0. This value ensured the condition of small angular displacement, which was considered in calculating the metacentric height. It was found that from the computer program the floating structure would be stable up to the wind speed about 160km/hr.

Estimate of cost

Considering the economic condition of floating people an investigation was carried out to find a suitable building material which has economic viability and durability. So that, variable fencing, roofing and floating materials were considered to validate the cost. Estimated cost for a Bamboo Fenced floating house is shown in Table.1.

Table.1.Estimated Cost for Bamboo Fenced Floating House

Sl. No.	Materials	Quantity	Rate	Price (Taka)
1.	Fencing			
	a) Bamboo pillar	3 pieces	Tk.167.67/Pieces	503.00
	b) Bamboo wire	6 pieces	Tk. 50/Pieces	300.00
	c) Bamboo Mat	6 Nos.(5'×8')	Tk. 50/chatai	300.00
	d)Timber for door(2) and window(2)	1.5 cft	Tk.1200/cft	1800.00
	e) Nails	1.5 kg	Tk.60/kg	90.00
	f) G.I. wire	1.5 kg	Tk.60/kg	90.00
2.	Roofing			
	a) Wood frame and rafter	2.3 cft	Tk.1400/cft	3220.00
	b) Bamboo purlin	3 pieces	Tk. 50/Pieces	150.00
	c) Screw	1 kg	Tk.100/kg	100.00
	d) CI-sheet	1.2 ban	Tk.4000/ban	4800.00

Table.1.Estimated Cost for Bamboo Fenced Floating House

Sl. No.	Materials	Quantity	Rate	Price (Taka)
3.	a) Ceiling	1 No. (12'×10')	Tk. 80/chatai	80.00
	b) G.I Wire	1 kg	Tk.60/kg	60.00
4.	Flooring			
	a)Wooden Frame	2.3 cft	Tk.1400/cft	3220.00
	b) Bottom frame of bamboo mat	3 pieces	Tk.167.67/Pieces	503.00
	c) bamboo mat	1 No.((12'×10')	Tk. 80/chatai	80.00
	d)Nails	1.5 kg	Tk.60/kg	90.00
	e)G.I. wire	0.5 kg	Tk.60/kg	30.00
5.	Float			
	a)Drum	10 Nos	Tk.1000/Drum	10000.00
	b)Weilding	20 bars	Tk. 30/bar	600.00
6.	Labour cost	a) 1 labour/day(4 days)	Tk. 200/day	800.00
		b) 1 carpenter/day(3 days	Tk. 250/day	750.00
7.	Transportation cost			500.00
8.	Miscellaneous cost			850.00
9.	Subtotal cost			**28916.00**
10.	Floating Toilet			2500.00
			Grand Total =	Tk.31416.00

The cost of a bamboo fenced house with CI-sheet roofing above on drum was estimated to Tk. 31416 where as the cost varied to Tk.**44880** for CI-sheet fenced house with angle bar. But the stability and durability of CI-sheet structure was more than the bamboo fenced structure. For a middle class farmer's family this type of shelter reduced the misery and damage of food, seeds and livestock during flood. If the fencing, flooring and roofing(i.e. chhon, golpata, kanchi and hard board) materials are changed by the locally available cheap resources than the cost would reduced to Tk. 25820 to Tk. 29631. Variation in estimated cost for different floating house is shown in bar chart (Fig.6).

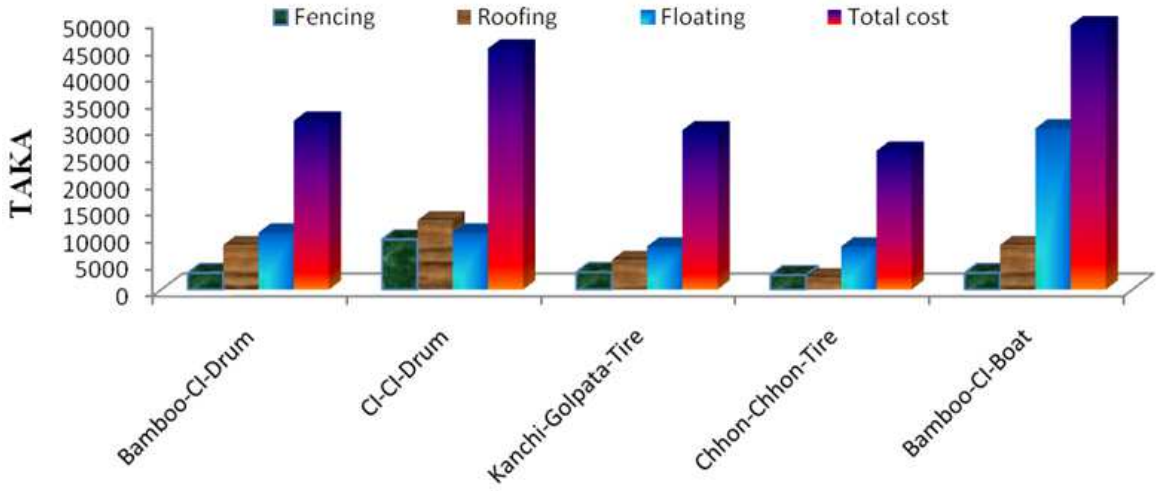


Fig. 6 Variation in Estimated Cost for Different Floating House

For landless poor community, gypsies and bede community people, this type of house may be a permanent shelter for themselves with low cost. People can use this type of house for transportation. One can easily choose their type of house for themselves with variation in fencing, flooring, roofing and floating elements which would results in fluctuation in cost. Hence the real cost of construction of such type of house would be reduced substantially.

CONCLUSIONS AND RECOMMENDATIONS

The designed floating house had been found stable from engineering point of view and it had been found economically viable if the house was constructed by locally available materials. This house has the capacity of accommodating the family members of the owner including all necessary commodities they need to live with sufficient safety and comfort during flood with internal space arrangements. If this house was constructed practically then the merits and demerits of this house may come out more basically. The designed floating house is suitable for the flood-hit areas and providing a permanent address for dwelling in a home like environment to the landless people and gypsies. Instead of drum, airtight plastic cylinder may be used to increase the durability. To rear the poultry and livestock another floating house would be made hinge with the main structure. The sanitation facility can be improved by the use of honey pot with pump and the hose pipe connects to the nearest sewage line or the nearest pit. For low costing the single drum may be used as septic with three days capacity. Then it will distinguish as an eco-friendly structure. With the provision of solar power the house may enjoy the electricity and it would definitely change their life style. The information and the design facts of such floating house should reach to the concerned communities through different media towards fostering them to use this functional live saving invention.

REFERENCES

[1] Ali, M.S.Y. 1995. Design and modelling of a poultry house to be used as flood shelter. Undergraudate project report. Department of Farm Structure, BAU, Mymensigh.

[2] Bansal, R. K. 2005. A Text Book of Fluid Mechanichs and Hydraulic Machines, Nineth edition, Published by Laxmi Publications (P) Ltd., New Delhi-110006, India.

[3] Ferdinand, P. Beer and E. Jr. Russell. 1978. Mechanics for Engineers, Statics and Dynamics, Third Edition. Published by Mc. Graw Hill Book . Co. New York, USA.

[4] Garg, S. K. 2003. Irrigation Engineering and Hydraulic Structures. 17 th Edition Published by Khanna publishers.2-B Nathmarket, Nai Sarak, New Delhi-110006,India.

[5] Khurmi, R. S. 1998. A text book of Hydraulics, Fluid mechanics and Hydraulic machine (SI unit). Published by S. Chand and Company Ltd. Ram Nagar, New Delhi-110055.

[6] King, H. W., C. O. Wisler and J. Wodburn, 1963. Hydraulics 5 th edition. Published by John Wiley and Sons, inc.,New York and London.

[7] Meriam, J. L. and L. G. Kraige, 1987. Engineering Mechanics, Volume -1, Statics, 2 nd edition. Published by John Wiley and Sons, inc.,New York and London.

[8] Suman, A.2007. Design and development of a floating poultry house for flood-hit area. M.S. Thesis. Department of Farm Structure, BAU, Mymensigh.
[9] Suman, A., Hoque, M. N., Abedin, M. Z. and Rahman, M. M., 2008. Use of floating poultry house in flood-prone areas: a new approach in poultry business. Intl. J. BioRes 4(4):6-11.
[10] Suman, A., Hoque, M. N., Abedin, M. Z. and Rahman, M. M., 2008. Design and development of floating poultry house for flood-hit area. Int. J. Sustain. Agril. Tech. 4(4): 55-61.
[11] http://www.irinnews.org/Report.aspx?ReportId=81044 (Retrieve on January 25th, 2009)

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Antiparasitic activity of Natural Plant *Carica papaya* Seed Extract against Gastrointestinal Parasite *Entamoeba histolytica*

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ABSTRACT: The principal objective for our study was to evaluate the efficacy of *Carica papaya* seeds against *Entamoeba histolytica* infection compared with metronidazole by using mice models. A single oral dose of *Caricapapaya* seeds water extracts of up to (0.1ml /mice/day) reduced parasite appearance in feces and disappear completely atthe 8th day compared with metronidazole the cysts parasite continued till 10th day. The histomorphological study findings showed in the group which was given *Carica papaya* seeds the majority of tissue intestine return to normalshape. These finding indicated that *Carica papaya* seeds may be effective in treating *Entamoeba histolytica*.

KEYWORDS: *Entamoeba histolytica*, *Carica papaya*, seeds water extract, metronidazole, intestinal tissue.

1 INTRODUCTION

Amoebiasis is caused by *Entamoeba histolytica,* a protozoan parasite of humans and the causative agent of intestinal amoebiasis. This disease is a major health problem in developing countries [1]. Although it is asymptomatic in 90% of cases, about 50 million people are estimated to suffer from symptoms associated with amoebiasis, such as hemorrhagic colitis and amoebic liver abscess [2]. Several means of transmitting *E. histolytica* are known, ingestion of the infective cyst occur in contaminated food and water and it may also be transferred via homosexual men [3].

In developing countries, medicinal plants are popular because their products are safe and widely available at low cost. Some compounds extracted from medicinal plants already play an important role against infectious disease[4]. *Carica papaya* Linn. (family: Caricaceae) is a tropical tree which is native to the tropics of the Americas but now widely cultivated in other tropical regions of the world[5]. Previous studies on biological activities of *Carica papaya* parts, extracts and isolated compounds showed that the latex and root extracts inhibited *Candida albicans* while extracts of pulp and seeds showed bacteriostatic properties against *Staphylococcus aureus*, *Escherichia coli*, *Salmonella typhi*, *Bacillus subtilis*, and *Entamoeba histolytica*[6], its root aqueous extract has equally been shown to have purgative effect [7]. Also these parts are known to be analgesic, cardiotonic, cholagogue, digestive, emenagogue, febrifuge, hypotensive, laxative, pectoral, stomachic and vermifugic[8].

Only limited numbers of drugs are available for the treatment of amoebiasis. Among them metronidazole is used for many years. But indiscriminate use may cause drug resistance in future[9]. The most frequently reported side effects of metronidazole are vaginal discharge, symptomatic candidiasis, and vulvovaginal irritation; following oral metronidazole therapy, the side effects are gastrointestinal disorders, nausea, and metallic taste [10]. This study aimed to compare the therapeutic effects of *C.papaya* seeds extract with metronidazole on *E. histolytica*.

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2 MATERIALS AND METHODS

2.1 FECES SAMPLES

This study included the collection of 60 stool samples from people suffering from diarrhea and samples were collected from various areas of civil laboratories in Baghdad. Has slides were prepared by direct smear and after confirming the presence of E. histolytic at the samples behaved. The refrigerated and transported to the laboratory at university of AL-Mustansiriya.

2.2 PARASITIC PURIFICATION

Robert and Thombson [11] method was used to isolate the Parasite then (cysts &Trophozoites) were suspended in phosphate buffer saline (PBS-7.2) and the final concentration was attended by rate 1×10^3celles/0.1 ml.

2.3 PREPARATION OF THE C.PAPAYA SEEDS EXTRACT

The seeds were collected freshly from the market of Maskat / Oman,Fig(1). Washed with clean water to remove dirt. The seeds were sundried and later grinded into powdery forms. The *C.papaya* seed powders were weighed (50g), and blended into liquefaction in 120ml of distilled water, the mixture was then centrifuged at 1500rpm. The supernatant was filtered through sterile filter papers into conical flask as the study extract. One milliliter of the filtrate is expected to contain 0.3g (300mg /ml).



Fig. 1. Dried seeds of C.papaya collected freshly from the market of Maskat / Oman

2.4 ANIMALS

In this experimental used male Swiss albino mouse about 14-15 weeks old, weighing 15-20g were obtained from the Animal house in college of medicine Baghdad University were housed under standard condition. Has feces of mice were examined to ensure that they are free from parasitic infection before starting the experiment. Then the mice were immunosuppressed by which injection with (0.01 ml/ mice/ day) with dexamethasone according to Regh [12].

2.5 EXPERIMENTAL DESIGN

Thirty mouse was inoculated orally with (0.1ml) contain 1×10^3 cell from E. histolytic, day after dosing each mice were examined prepare direct smear and after confirmation of infection get infected into four groups and each group of (10) mice was inoculated as follow:

Group 1: Given orally 0.1 from papay extraction once a day [13].

Group 2: Given (0.1 ml) of metronidazole (30mg/kg/day) orally at a single dose per day.

Group 3: Given only (0.1 ml) of normal saline and promised as appositive group.

Group 4: This group intact mice and non-infected with parasite and were given orally (0.1 ml) of PBS pH 7.2 and promised as a negative control group.

2.6 ENUMERATION OF *E.HISTOLYTICA*

Cysts &trophozote in faces were enumerated as Shukla *et al* [14]. Briefly mice feces were collected first three groups daily from each mouse, one gram of fecal sample was dissolved in 10 ml of normal saline, homogenized then counted every day by suing hemocytometer.

2.7 HISTOPATHOLOGICAL STUDY

After the end of experimental period the mice in [G1; G2 G3 and G4] were sacrificed and small intestine was removed fixed in 10% buffered formalin processed stained with hematoxylin and eosin for study histopathological changes.

2.8 STATISTICAL ANALYSIS

Data are reported as mean± standard deviation and the inter group variation performed by t-test.

3 RESULT AND DISCUSSION

In this study we compare the efficacy of the *Carica papaya* seed extract with metronidazole in mice with acute cause by the results in fig(2) . Showed that the numbers of *Entamoeba histolytica* in G1was reach to 2.66 cyst/gm at first day ,not like in positive control G3 3.66 cyst/gm while reach to 5.33 and 4 cyst/gm at second and third day respectively but at the 5th day the number of parasite was similar to the first day then start to decrease in 5th and 6th days till reach zero in the 8th day ,in compare with G3 that reach to 14.33 cyst/gm in 7th day and decrease to 12 cyst /gm in 14th day ,moreover when we compare the results G2 we saw increasing number of parasite on days (2,3,4,5) then start decrease in days (6,7,8) till reach zero at10 th day.

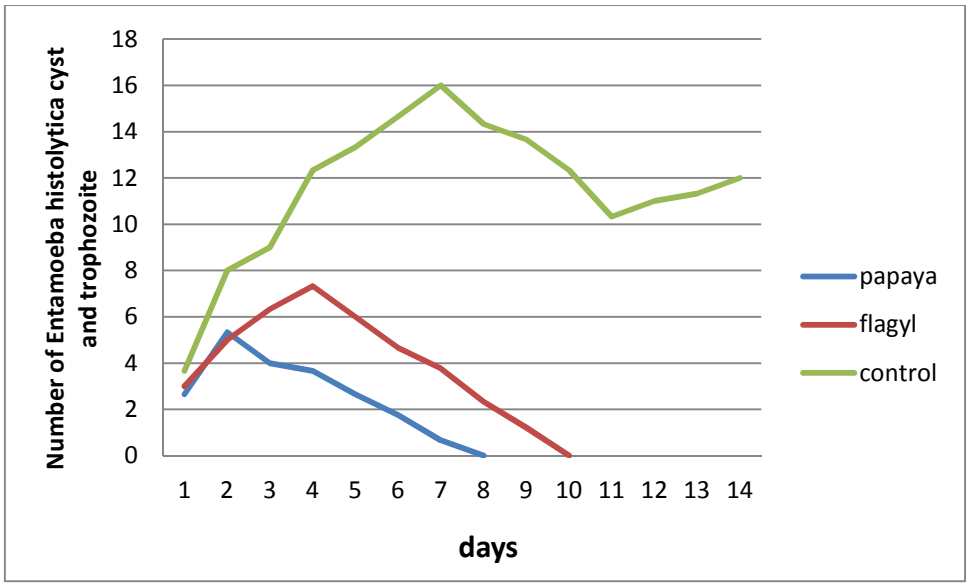


Fig. 2. Number of Entamoeba histolytica parasites in treatment and control groups.

The histological study showed that *C.papaya* plant was able to re-structure of intestinal tissue Fig (5) has been able to bring along the length of the villa to normal when compared with control mice Fig (3), after it suffered from the palace because of parasite which lead to causes necrosis in tissue intestine Fig (4).

Also the metronidazole drug reappeared the tissue but not completely still some of some necrosis and infiltration of lymphocytes fig (6).

The aqueous extracts administered in this study caused significant reduction the parasite burden of the mice. the reduction of parasite loads observed with aqueous extracts of *C.papaya* may be attributed to the presence of papain in capable of digesting bacteria and parasitic cells, hence its use an anthelmintic and antibiotics[15]. Adu *et al* [16] reported that *C. papaya* has certain chemical components that are of high anthelminthic attributes in poultry with satisfactory efficacy at the dosage of 1200mg／bird.

Sarker *et al* [17] reported that the mature seeds of *C. papaya* have antiamoebic effect but less pronounced than metronidazole. The mechanism of action of the efficacious plant cysteine proteinases (papaya) is similar and probably identical involving digesting and removal of the cuticle.

Our results support previous studies [18] suggesting that papaya may have potential as an anthelmintic against nematode parasites and too define the mechanisms of its antiparasitic action.

Hiramoto *et al* [19] reported that the oral administration of the fermented papaya preparation to mice may have a therapeutic potential for the prevention of contact hypersensitive immuno-response, also Melissa *et al* [20] found no morphological alteration in the integrity of the intestine mucosa after 3months administrated for Wister rats.

The use of plant material for the management of nematode population is apparently effective and environmentally friendly compared to synthetic nematicides. The tropical fruit *Carica papaya* and its seeds have proven antihelminthic and anti-amoebic activities. To determine the effectiveness of air-dried C. papaya seeds on human intestinal parasitosis, 60 asymptomatic Nigerian children with stool microscopic evidence of intestinal parasites received immediate doses (20 mL) of either an elixir composed with air-dried C. papaya seeds and honey (CPH) or honey alone (placebo) in two randomized treatment groups, there were no harmful effects and the stool clearance rate for the various types of parasites encountered was between 71.4% and 100% following CPH elixir treatment compared with 0-15.4% with honey. Thus, air-dried C. papaya seeds are efficacious in treating human intestinal parasites and without significant side effects. Their consumption offers a cheap, natural, harmless, readily available mono therapy and preventive strategy against intestinal parasitosis, especially in tropical communities. Further and large-scale intervention studies to compare C. papaya with standard antiparasitic preparation are desirous [21].Sujit *etal* [22] suggests that the mature seeds of C. papays have antiamoebic effect but less pronounced than meteronidazole.*C papay* contain many biologically active compounds in its different parts, a many the compound carpaine and benzylisothiocyanate found mainly in seeds, antiamoebic activity's of papay a seeds may be occurred due to these compounds but further study is required for validation form the study.

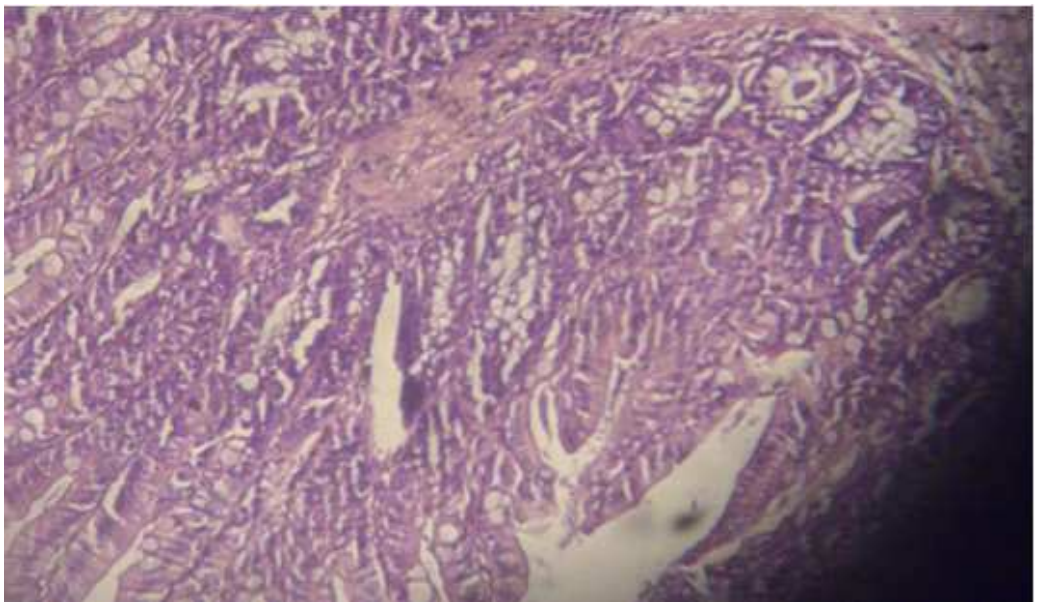


Fig. 3. Normal tissue structure for control mice intestine.4x

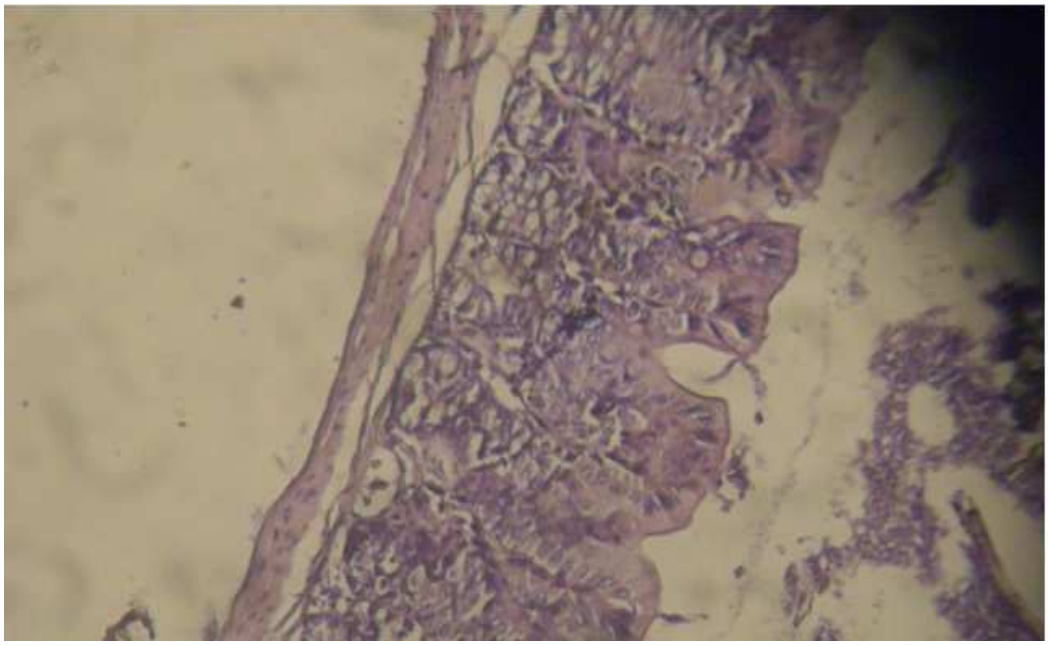


Fig. 4. Necrosis accrue in tissue intestine which a results of parasites infection (control positive).4x

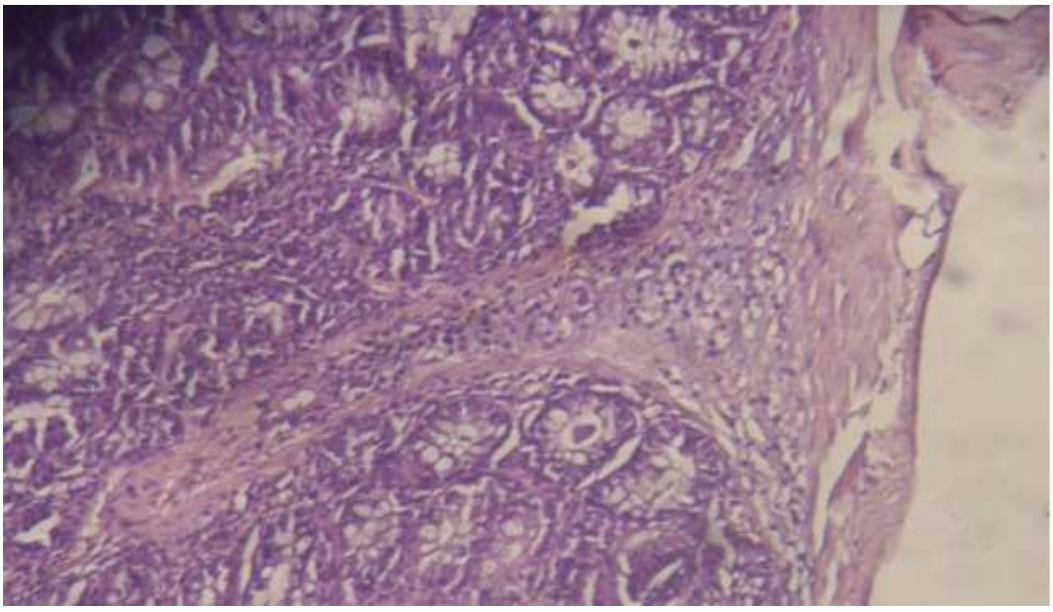


Fig. 5. Retune the intestinal tissue to normal structure after treated with C.papaya.4x

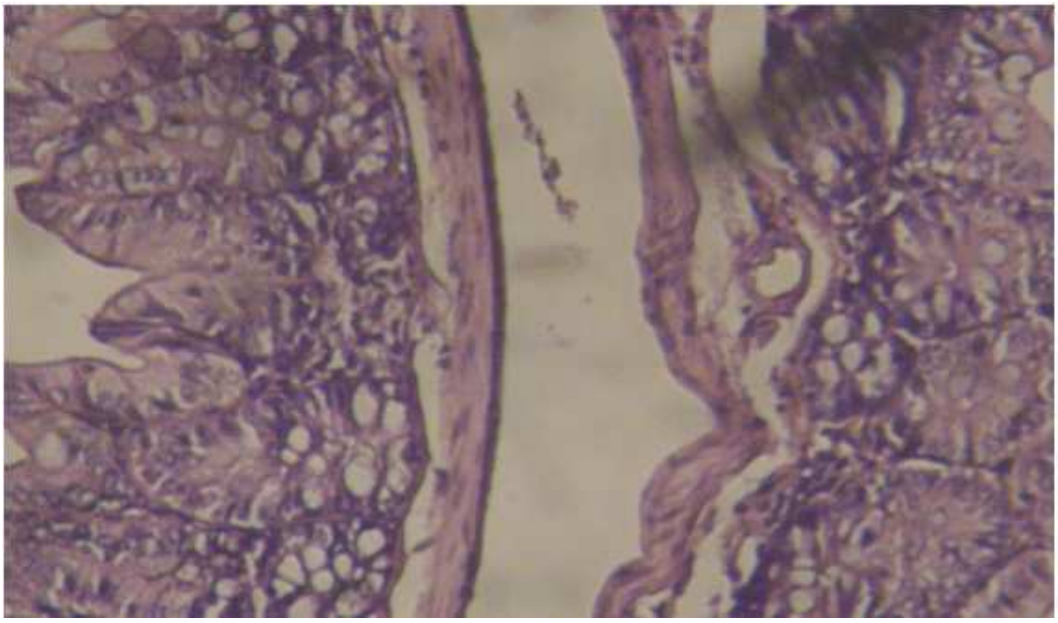


Fig. 6. Still of some necrosis and infiltration of lymphocytes in tissue intestine of mice treated with meteronidazole. 4x

4 CONCLUSIONS

We conclude that *C. papaya* seeds could be beneficial in the treatment and plausibly prevention of intestinal parasites, more so being readily available, harmless, and cheap. We therefore recommend their consumption for not only for their nutritive but their medicinal value.

5 RECOMMENDATION

1-Study the effect of C. papaya seeds on E.histolytica In vitro .
2- Study the effect of immature *C. papaya* seeds on the parasites.
3-Try to extract active materials and use it.
4-study the effect of fruit,leaf,and roots for C. papaya .

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REFERENCES

[1] Stanley SL Amoebiasis. Lancet 361:1025-1034. Tabanca NE, Bedir N, Kirmer KH, Baser SI, Khan MR, Jacob, Khan IA. Antimicrobial compounds from *Pimpinella* species growing in Turkey. Planta Med. 69:933-938, 2003.
[2] Ravdin JI. State of the art clinical article. Clin. Infect. Dis. 20:1453-1466,1995.
[3] Tanyuksel, M. & Petri, W.A.. Laboratory Diagnosis of Amoebiasis. Clin. Microbiol. Rev.16: 713-729, 2003.
[4] Quiñones-Gutiérrez Y.,Verde-Star M. J., Rivas-Morales C., Oranday-Cárdenas A., Mercado-Hernández R.,Chávez-Montes A. and Barrón-González M. P In vitro study of antiamoebic activity of methanol extract of fruit of Pimpinella anisum on trophozoites of Entamoeba histolytica HM1-IMSS. African Journal of Biotechnology Vol.12(16), pp. 2065-2068,2013 .
[5] Banerjee A, Vaghasiya R, Shrivastava N, Padh H, Nivsarkar M, Antihyperlipidemic effect of *Carica papaya* L. in Sprague Dawley rats. Nigerian Journal of Natural Products and Medicine, 10: 69-72, 2006
[6] Emeruwa A. C. Antibacterial substance from *Carica papaya* fruit extract. *Journal of Natural Products*, 45 (2): 123-127, 1982.
[7] Akah P. A., Oli A. N, Enwerem N. M. and Gamaniel K. Preliminary studies on purgative effect of *Carica papaya* root extract, 1997.

[8] Anibijuwon, I. and A. Udeze."Antimicrobial activity of Carica papaya (pawpaw leaf) on some pathogenic organisms of clinical origin from South-Western Nigeria." *Ethnobotanical Leaflets,* (7): 4, 2009.
[9] Bansal D, Sehgal R, Chawla Y, Malla N**,** Mahajan RC. Multidrug resistance in amoebiasis patient. Indian J Med Res.124: 189-94, 2006.
[10] Wain, A.M.. Metronidazole vaginal gel 0.75% (Metrogel- vaginal): a brief review. Infect. Dis. Obstet. Gynecol. 6, 3–7, 1998.
[11] Roberts-Thompson, I.C.; Stevens, D.P.; Mahmoud, A.A.F. and warren, K. Giardiasis in the mouse: an animal model. Gastroenterology; 71:57-61, 1976.
[12] Regh, J.E. (1996). Effect of interferony ion ecperimental C. parvum infection .J. Infect. Pis. 174: 22-32.
[13] Savas-Erdevc, S.; Gökay, S, Dallar, Y. Efficacy and satetyof *Saccharomycesboulardii* in amebiasis associated diarrhea in children. Turkish. J. Pediatrics;. 51:220-224, 2000.
[14] Shukla, G.; Dev, P. and Sehga, I.R. effect of Lactobacillus casi as a probiotic modulation of giardiasis, Digestive Disease and Science. 53(10):2671-2679, 2008.
[15] Fajimi, A. K.; Taiwo, A. A., *Herbal remedies* in *animal parasitic diseases* in*Nigeria*: a *review*. African Journal of Biotechnology; 4(4): 303-307, 2005.
[16] Adu OA,Akingboy KA,Akinfemi A. Potency of pawpaw (*Carica papaya*) latex as an anthelmintic in poultry production. *Bot. Res. Int.* 2:139–142,2009.
[17] Sujit Kumar Sarker, Nilufar Begum, Dinesh Mondal, Md. Abdullah Siddique and Mohammad A. Rashid. *In vitro* study of antiamoebic effect of methanol extract of mature seeds of *Carica papaya* on trophozoites of *Entamoeba histolytica*. Bangladesh J Pharmacol; 5: 45-47, 2010.
[18] Mursof, E.P. & He**, S.** Apotential role of *Papaya latex* as an anthelmintic against patent *Ascaridia galli* in chicken. *Heamara Zoa*,; 74: 1-5, 1991.
[19] Hiramoto K, Imao M, Sato EF, et al. Effect of fermented papaya preparation on dermal and intestinal mucosal immunity and allergic inflammations. Journal of the Science of Food and Agriculture. Volume 88, Issue 7 , Pages 1151 – 1157
[20] Melissa P.; Andrew O. W.; Felix O.; Helen N. A.; Nadia P. W.; Paula F. T**.** Comparative effects of dietary administered transgenic and conventional papaya on selected intestinal parameters in rat models. Transgenic Res.; 19(3):511-8, 2010.
[21] Okeniyi JA , Ogunlesi TA, Oyelami OA, Adeyemi LA. Effectiveness of dried Carica papaya seeds against human intestinal parasitosis: a pilot study. J Med Food. Mar;10(1):194-6, 2007**.**
[22] Sujit K S, Nilufar B, Dinesh M and Mohammad A R.*In vitro* study of antiamoebic effect of methanol extract of mature seeds of*Carica papaya* on trophozoites of *Entamoeba histolytica*. Bangladesh J Pharmacol; 5: 45-47, 2010.

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Identification and mapping of some potential transmission foci of schistosomasis in Maroua, Far North Region, Cameroon

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ABSTRACT: Like many African cities affected by urban schistosomiasis, Maroua in the Far North Region of Cameroon has a moderate level of schistosomiasis transmission, as indicated by human infections. This study was designed to identify and map some potential transmission sites of schistosomiasis in Maroua. Water ponds were surveyed for snail intermediate host of schistosome and mapped using a handheld Global Positioning Systems (GPS). Snail status was assessed via cercaria shedding procedure. The vegetation cover, human water contact activities and some physico-chemical characteristics of the water including pH, temperature, salinity, total dissolve solute (TDS) were measured and documented. Twenty two water ponds were surveyed and 21 of them were found to have at least one of the two identified schistosome snail host species. A total of 658 specimens of snails were collected: 57.45% *B. senegalensis* and 42.55% *B. globosus*. Eleven water ponds were found to have both snail host and the 10 other have single species (8 with *B. senegalensis* and 2 with *B. globosus*). Ten (1.56%) of the 642 snails were found to shed *Schistosoma* cercariae: 2.21% in *B. senegalensis* and 0.71% in B*. globosus* and they were not significantly different (χ^2 = 1.431, p= 0.232). The presence of *B. senegalensis* and *B. globosus* (two known intermediate snail host of *S. haematobium*) snail and their infections with *Schistosoma* suggest possible local transmission of human schistosomiasis in Maroua. Exposure to these water environments may pose infection risk to general population, in particular children who seem to have greater water contact.

KEYWORDS: Mapping, *Bulinus senegalensis*, *Bulinus globosus*, schistosomiasis, Maroua, urban area.

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1 BACKGROUND

Schistosomiasis, a water-associated parasitic disease and part of neglected tropical diseases, still poses a significant public health threat to many parts of developing countries [1]. More than 90% of infected cases are from sub-Saharan Africa [2]. Of the six species of *Schistosoma* affecting humans, four are known to occur in Africa: *Schistosoma haematobium* that causes urinary schistosomiasis, *S. mansoni*, *S. intercalatum* and *S. guineensis* (formerly *S. intercalatum* [3]**,** [4]) which cause intestinal schistosoimiasis. People become infected when they contact freshwater containing *Schistosoma* cercariae, shed by infected intermediate host snails, which in Africa are fresh water pulmonate snails belonging to the family Planorbidae [5]. The species belong to two genera, *Biomphalaria* (host of *S*. *mansoni*) and *Bulinus* (host of *S. h*aematobium, *S. intercalatum* and *S. guineensis*). Transmission can take place both in natural and man-made water bodies and it may occur in almost any type of habitat from large lakes to the small seasonal ponds or streams [6].

Infections with schistosomes are particularly abundant among people living in rural or deprived urban settings with low socio-economic status, such as lack of clean water and poor sanitation [7]**.** Urban foci of schistosomiasis in tropical areas are generally given little attention by control programs, largely due to that transmission is less intense in urban settings than in surrounding rural areas. Cases of urban schistosomiasis have been reported in several areas of Africa, e.g. Nigeria [8], Mali [9] as well as Zambia [10].

In Cameroon schistosomiasis is an important public health problem particularly in the northern tropical climatic zone of the country where the highest transmission levels of schistosomiasis have been reported [11]. The country has also faced urban schistosomiasis, particularly in the town of Yaoundé where the transmission of *S. mansoni* has extended beyond its former transmission points of Melen and Nkolbisson [12] to reach other quarters such as Mballa1 – Dragage and Obobogo, partially as consequences of poor sanitation ([13], Tchuem Tchuenté, personal communication). The town of Maroua in the Far North Region is also concerned with urban schistosomiasis. Indeed, a parasitological survey for urinary schistosomiasis conducted on schoolchildren of Maroua town showed that about 22.90% of them have *S. haematobium* eggs in urine [14]. However, nothing was done to identify potential schistosomiasis transmission water points in the town. This information is important as it may be useful to enhance the effect of mass praziquantel distribution implemented by Ministry of Public Health through the National Program in charge of schistosomiasis control in Cameroon.

The objective of this study was to determine the presence and geographical distribution of snail intermediate hosts for schistosome, and their infection status among freshwater bodies in the urban area of Maroua town. In addition, we also assessed the environmental and physico-chemical factors that may influence snail distribution, and some human activities that may be related to the transmission.

2 MATERIALS AND METHODS

2.1 STUDY AREA AND WATER CONTACT ACTIVITIES

Maroua, the capital city of the Far North Region of Cameroon is situated in the Sahelian zone of Cameroon, with a soudano-sahelian tropical type climate, characterized by more than 7 months of dry season with the highest temperature of about 45°C, and a short rainy season. The annual precipitation varies between 400 and 1100 mm, August being the rainiest month [15], [16]. The population of Maroua is estimated to 3 111 792 inhabitants with a density of 90.8 inhabitants per km^2 [17]. The town of Maroua is built on a plain surface area with the soil having about 40 % of clay. These soils which crack during the dry season have a hydric behavior characterized by total impermeability when they are saturated [18]**.** This favors the creation of temporary standing water ponds during the raining season, where people normally carry out their domestic activities. The hydrography of Maroua town is therefore made up of non-permanent flowing, or standing water.

2.2 PRELIMINARY STUDY

A preliminary survey in the Maroua urban area in October 2013 was carried out in order to identify all available surface water bodies where human activities occurred. These activities are: water collection, clothes washing, bathing, swimming or playing (by children) and car or motorbike washing. Based on personals observations and report from neighboring human habitation, we selected 15 different water ponds within the study area (Fig.1): seven additional water bodies were sample at Meskine neighboring village, situated at about 6 km from Maroua town. At Maroua, five of the sample water bodies were at Palar quarter (Massinika1, Massinika2, Massinika3, Palar 1, Palar 2, Palar 3); three at Dougoï (Lougguéo pont, commissariat, dix villas); two at Domayo (SODECOTON, papala), two at Ouro Tchédé (OT, OT1) and one respectively at Ouro lopé and

Makabaye. At Meskine, the sample water bodies are located at: hardé antenne, banka, CMAO, école publique d'application, dougoïwo 1, dougoïwo 2, dougoïwo 3.

2.3 SNAIL SURVEY AND GEOGRAPHIC DISTRIBUTION

During the month of November 2013, snail sampling was performed once in each of the selected water ponds at two different human contact points. This was performed using a standard kitchen sieve mounted on a 2m wooden handle or by hand picking [19]. The search and collection of snails were done by two collectors for 15 minutes between 7.00 and 10.00 AM. Sampling area per water pond was approximately 0.5 m^2 (1 m along water pond shoreline). At each water pond, all collected snails were placed in a single labeled container and transported to the laboratory where they were sorted and washed. Snail identification was based on shell morphology [20], [21]. After identification, potential intermediate hosts of schistosome were examined for infections status under a dissecting microscope. Individual snail was placed in a well of Disposo-Tray® plate containing 1ml of dechlorinated tape water and exposed to indirect sun light from 10.00 PM to 3.00 AM. Exposed snails were fist of all checked for cercarial shedding at 12.00. Snails that were found negative were re-exposed and check again for cercarial shedding at 3.00 AM. Snails that did not shed cercariae on the first day exposure were re-exposed and check the next day.

In order to determine the geographic distribution of snails, all sampled water ponds were mapped using a small hand-held Global Positioning System (GPS) device, and the snail abundance was determined for each sample water body by categorizing density of each species to fore groups: 0, 1-50, 51-100, and 101-150.

2.4 ENVIRONMENTAL AND PHYSICO-CHEMICAL PARAMETERS

Environmental and physico-chemical parameters recorded are among those suggested to be important for freshwater snail distribution [22]. So aquatic vegetation (present or absent) and different types of human activities conducted within the sampled water ponds were recorded as environmental data. The physico-chemical parameters recorded include level of water turbidity (classified as weak, average, and strong), pH, conductivity, salinity and total dissolved solutes (TDS).

2.5 DATA ANALYSIS

All data analyses were performed using statistical Software GraphPad (Instat. Version, 3.10.) and P values < 0.05 were considered statistically significant. Comparison of mean abundance for collected snail species in all the sampled water bodies was performed using Wilcoxon test. Comparison for prevalence of infection between snail host species was performed using Chi-square test. This test was also used to determine the association between snail abundance and environmental and physico-chemical parameters. All the sample water ponds with snail abundance were plotted on a map using Geographical Information System (GIS) software ArcGIS (ESRI Inc., Version 9.2).

3 RESULTS

3.1 SNAIL SPECIES, DISTRIBUTION AND ABUNDANCE

A total of 658 freshwater snail specimens were collected from 21 out of the 22 sampling water bodies, 14 in Maroua urban area and 7 at Meskine. All sample sites were temporary water bodies. On the basis of shell morphology, two species of snail potential host of schistosomes were recognized: 378(57.45%) of the snails collected were recognized as *Bulinus senegalensis* and 280 (42.55%) as *Bulinus globosus* (Table 1). At least one of these snail species was collected in each sample water body. Eleven of them were found to have both *B. senegalensis* and *B. globosus*. Of the 10 remaining water bodies with single snails species, *B. senegalensis* was present in 8 and *B. globosus* in 2. The only water pond where snails were not found is in Maroua town (papala) at Domayo quarter (Fig. 2). *B. senegalensis* was collected in 19 (86.36%) water ponds of the 22 surveyed, whereas *B. globosus* was present at 13 (59.09) water ponds (χ^2 = 2.865, p= 0.0905 with Yates correction).

The mean abundance of snail per species in all the sample water bodies was 17±18 (0-61) snails for *B. senegalensis*, and 13±24 snails (0-83) for *B. globosus*, not significantly different (p = 0.161 by wilcoxon test). Eighteen (85.71%) of the sample water bodies have 1 – 50 snails and, just 2 (9.52%) and one (4.76%) have respectively 51 – 100 snails and 101 – 150 snails abundance (Fig. 3). Of the 19 water ponds with *B. senegalensis*, 89.47% (17) have 1- 50 snails; whereas 10.53% (2) have 51-100 snails (Fig. 4), and of the 13 with *B. globosus* snail specie, 84.42% (11) have 1 – 50 snails and 15.38% (2) have 51 – 100 snails (Fig. 5).

3.2 INFECTION IN SNAILS

Ten (1.56%) of 642 snails tested for infection were shedding *Schistosoma* cercariae. The mean percentage of snails shedding was not significantly different between *B. senegalensis* (2.21%) and *B. globosus* (0.71%) (χ^2 = 1.431, p= 0.232 with Yates correction). The ten infected snails were distributed in 6 water ponds: 2 at Dougoïwo 1 and hardé antenne at Meskine, 1 respectivelly at Palar3, Ouro tchédé, Ouro lope and dougoï 10 villas at Maroua. Hardé antenne at Meskine was the only water ponds with both *B. senegalensis* and *B. globosus* shedding *Schistosoma* cercariae (Table 2).

3.3 PHYSICO-CHEMICAL FACTORS OF WATER

The means, minimum and maximum values for chemical variables of sample water ponds are presented in Table 3. There was no association between water chemistry and the overall snail abundance. However water turbidity was associated with total snail abundant, in such a way that the total number of collected snails (abundance) seem to decrease significantly when the turbidity of the water increase (Table 4) (χ^2 = 275.6; p< 0.0001).

3.4 AQUATIC VEGETATION AND HUMAN WATER CONTACT ACTIVITIES

Three main aquatic vegetation types were identified (Table 5). They are: herbs (21 water ponds), *Numphea lotus* (12 water ponds) also known as lily, and *Ipomoea carnea* (18 water ponds). The total snail abundance increases significantly with the aquatic vegetation (p<0.0001).

Five main human activities were observed in the sample water ponds: fetching of water, swimming, washing clothes, washing dishes and fishing (as pleasuring activity for young boys and girls). Among those human activities, fishing, fetching of water and swimming were the most observed whereas washing clothes and dishes were the less within the 22 sampled water ponds (χ^2=27.427, p< 0.0001) (Table 5). For these three main water contact activities, only children were involved.

4 DISCUSSION

This study was an attempt to identified and map potential transmission water ponds for schistosomiasis in an urban area in Cameroon. This type of information is critical when a control measure other than mass drug distribution is needed [22]. Maroua town is surrounded by villages endemic for schistosomiasis and the presence of people infected with schistosomiasis raises the question of where they get the infection, as far as many of them are from those infected surrounding villages. Until now studies on schistosomiasis conducted in Maroua town were focused only on parasitological aspects (e.g. prevalence of infection), none was directed to transmission foci and snail host involved. It is well known that mapping prevalences does not necessarily indicate the origin of infections, particularly in urban areas, where the mobility of the population is high [23].

Results of our malacological surveys have shown that of the 22 water ponds surveyed, 21 were found to have at least one of the two identified snail species (*B. globosus* and/or *B. senegalensis*) and all the sample habitat were small temporary water ponds. These small temporary natural water ponds are known to be the main transmission sites for schistosomiasis in the Far North Region of Cameroon, where transmission goes for short season [11], [24]. Previous malacological surveys in the Far North Region of Cameroon reported the presence of *B. globosus*, *B. senegalensis* and *B. truncatus* (snails host of *S. haematobium*), *Biomphalaria pfeifferi* (snail host *S. mansoni*) and *B. forskalii* the only snail host of *S. guineensis* in Cameroon [24], [11]. Neither *B. truncates*, *Biomphalaria pfeifferi* nor *B. forskalii* were collected during our survey. This is not surprising for *B. truncates* and *Biomphalaria pfeifferi* as far as these species have been reported to be found mostly in permanent waters ponds in this region [20], [24]. However, *B. forskalii*, one of the most common and widely distributed of all the schistosome host species, was not found during our survey. When using shell morphology as identification means, confusion could happen between snail of *B. forskalii* group (which members found in Cameroon are *Bulinus forskalii* Ehrenberg, 1931; *B. senegalensis* Muller, 1971 and *B. camerunensis* Mandahl-Barth, 1975), particularly when they overlap in their distribution as it seem to be the case for *Bulinus forskalii* and *B. senegalensis* in the Far North Region of Cameroon [24]. One of the distinguishable morphological differences between these two species is the lack of shoulder angle (characteristic of *B. forskalii*'s shell) on the upper whorls of the shell of *B. senegalensis* [21]. During our survey all the snail identified as *B. senegalensis* was lacking the shoulder angle.

A relatively low percentage of snails tested for *Schistosoma* cercariae were found positive, and shedding rates were not quite different between the two snail species tested. It is generally agreed that snail population density and infection rates undergo great seasonal variations in all type of habitat and that rain fall and/or temperature are the main causative factors [22]. Indeed, studies on population dynamic of snails in temporary water ponds in the Far North of Cameroon have shown in

general that, the population density increases modestly during the rainy season and then rapidly declines after torrential rains have ended in September or October [25]. Our snail collection was performed during the month of November not far from the period were snail population variation is assumed to be relatively low.

Our results show that snail abundance seems to be higher when aquatic vegetation was present suggesting a positive association between these two variables. Similar observations were reported in Niger, where *Biophalaria pfeifferi* and *Bulinus truncatus* were found to be associated with submerged aquatic macrophytes or emergent hydrophytes [26]. Aquatic vegetation constitutes an important element in the habitat of snail schistosomes host and controlled of this aquatic vegetation is likely to have profound effect on the intermediates host snail [6].

Of the 5 human water contact activities observed during our malacological surveys, fishing (as entertainment activity), fetching of water and swimming were the main exposure activities and children were the one involved. Similar observation was done in Nigeria where swimming, fetching of water and cleaning clothes played important role in the spread of the urinary schistosomiasis in Ibadan, and young boy are more engaged than girl in water contact activities [27].

5 TABLES AND FIGURES

5.1 TABLES

Table 1. Summary of the distribution of snail species abundance in all the visited quarter

Quarters	Number of surveyed Water pounds	Snail species		Total snail abundance	Mean snail Abundance[1]
		B. globosus	***B. senegalensis***		
Domayo	2	0	2	2	1 ± 1
Dougoï	3	14	29	43	14 ± 8
Makabaye	1	1	16	17	17
Ouro lopé	1	0	29	29	29
Ouro tchédé	2	20	40	60	30 ± 8
Palar	6	56	108	164	27 ± 27
Meskine	7	189	154	343	49 ± 51

Values are means ±SD

Table 2. Percentage distribution of infected snails shedding Schistosoma cercariae in sample water ponds

	B. globosus		*B. senegalensis*		**Total snail**	
Name of Water pounds	NE	NP (%)	NE	NP (%)	NE	NP(%)
Massinika 1	0	0	21	0	21	0
Massinika 2	21	0	0	0	21	0
Massinika 3	1	0	22	0	23	0
Palar 1	2	0	0	0	2	0
Palar 2	8	0	8	0	16	0
Palar 3	24	0	55	1.82	79	1.3
Ouro lopé	0	0	29	3.45	29	3.4
Lougguéo pont	0	0	9	0	9	0
Dougoï commissariat	13	0	1	0	14	0
Dougoï dix villas	1	0	19	5.26	20	5
(OT1) Ouro tchédé collège Espoir	20	0	4	0	24	0
(OT) Ouro tchédé	0	0	36	2.78	36	2.8
Makabaye	1	0	16	0	17	0
Papala	0	0	0	0	0	0
SODECOTON	0	0	2	0	2	0
Banka	0	0	4	0	4	0
Hardé antenne	80	2.5	56	3.57	136	2.9
CMAO	83	0	9	0	92	0
EP d'application	0	0	3	0	3	0
Dougoïwo1	0	0	31	6.45	31	6.5
Dougoïwo2	10	0	34	0	44	0
Dougoïwo3	16	0	3	0	19	0
Total	**280**	**0.71**	**236**	**2.21**	**642**	**1.56**

NE: number of snail examined for cercaciae shedding; NP: Number of snail positive

Table 3. Summarizing values of water chemistry variable in all the sample water ponds

	Water chemistry				
	Temperature	pH	Conductivity	TDS	Salinity
Mean ± SD	28.54 ± 3.796	7.895 ± 0.776	236.024 ± 143.87	162.895 ± 88.198	11.664 ± 66.587
Minimum	20.40	6.82	94.2	69.3	46.200
Maximum	33.50	9.90	591.00	413.00	295.00

Table 4. Level of turbidity of sample water ponds in relation with total snail abundance in all sample water ponds

Level of turbidity	**weak**	**average**	**strong**
Total snail abundance	329	270	59

Table 5. Frequency distribution of different human water contact activities present in sample water ponds

Human activities									
fetching water		washing clothes		washing dishes		swimming		fishing	
P	P (%)	P	P (%)	P	P (%)	P	P (%)	P	P (%)
16	72.73	5	22.73	6	27.27	10	45.45	19	86.36

P: present; P (%): percentage of present

5.2 FIGURES

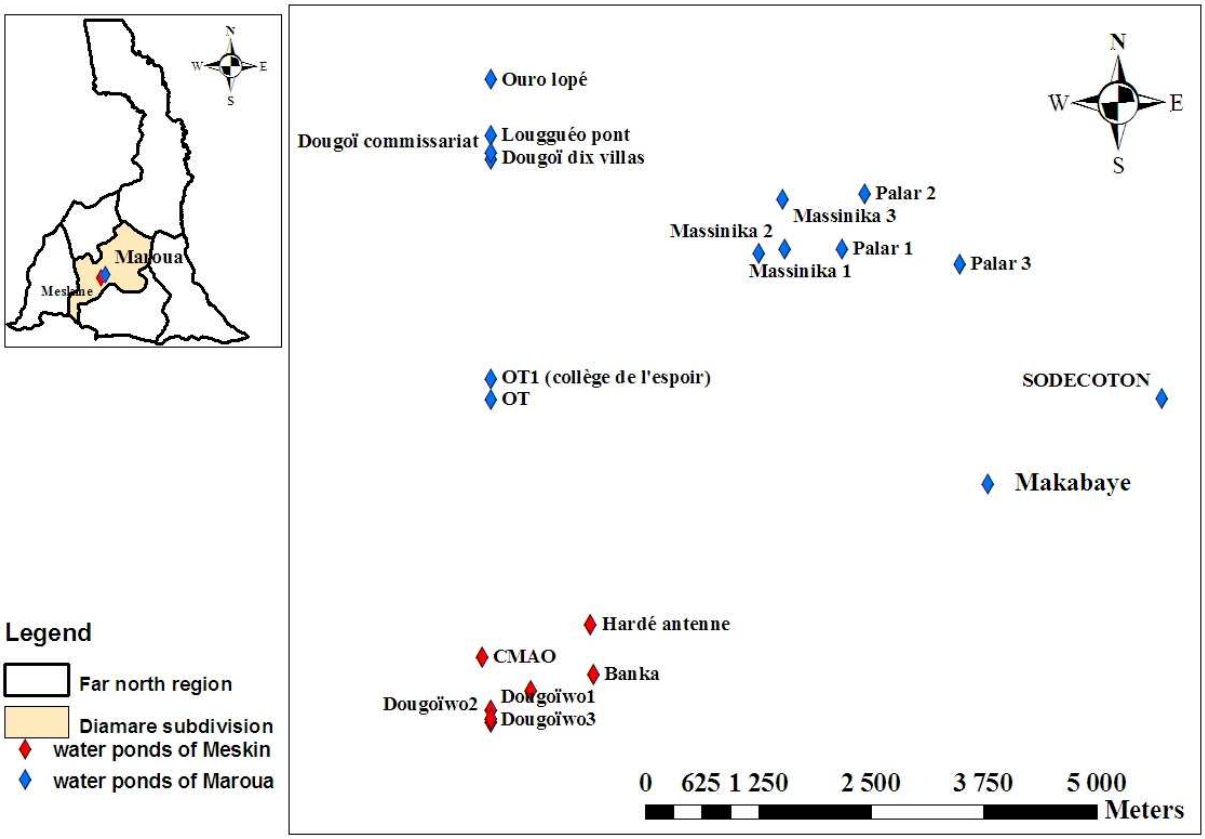


Fig. 1. Spatial distribution of sample water ponds within the studied area

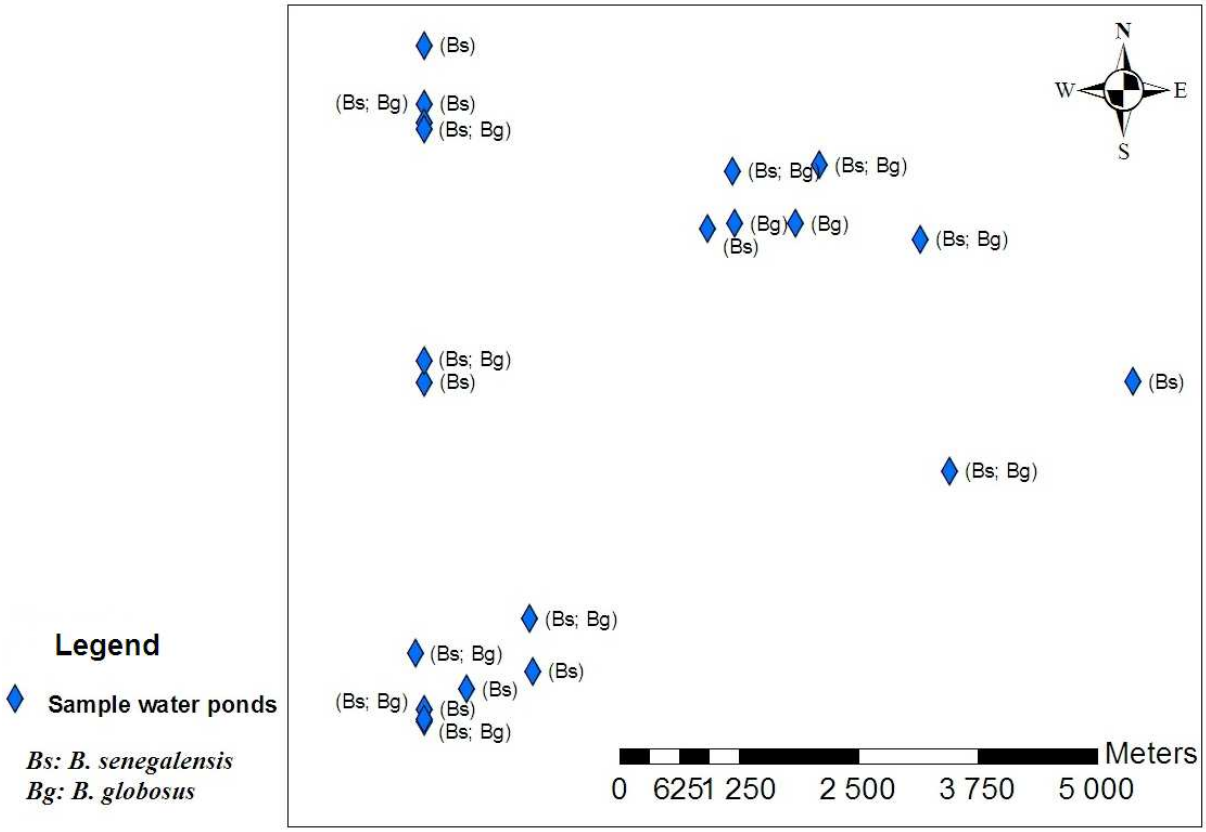


Fig. 2. Spatial distribution of collected snail host of Schistosoma within the studied area

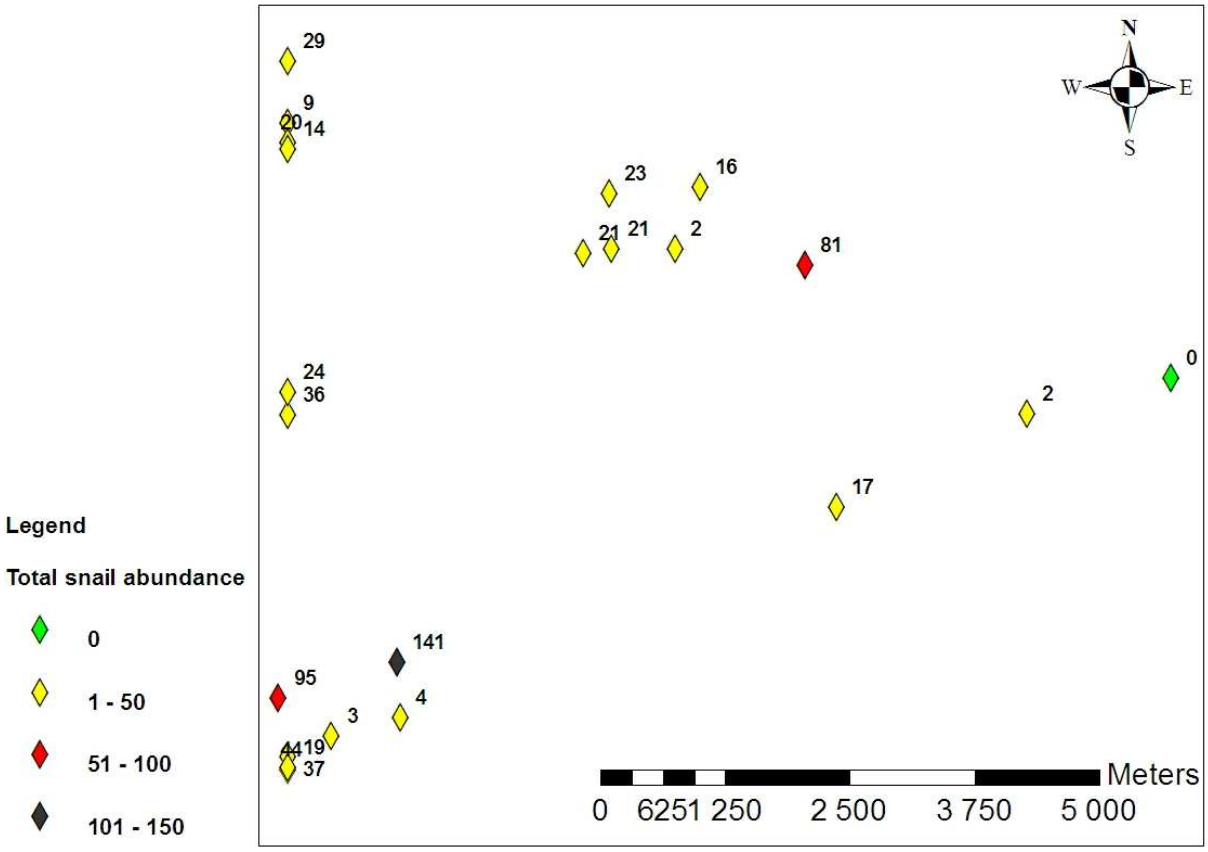


Fig. 3. Spatial distribution of total snail abundance within the studied area

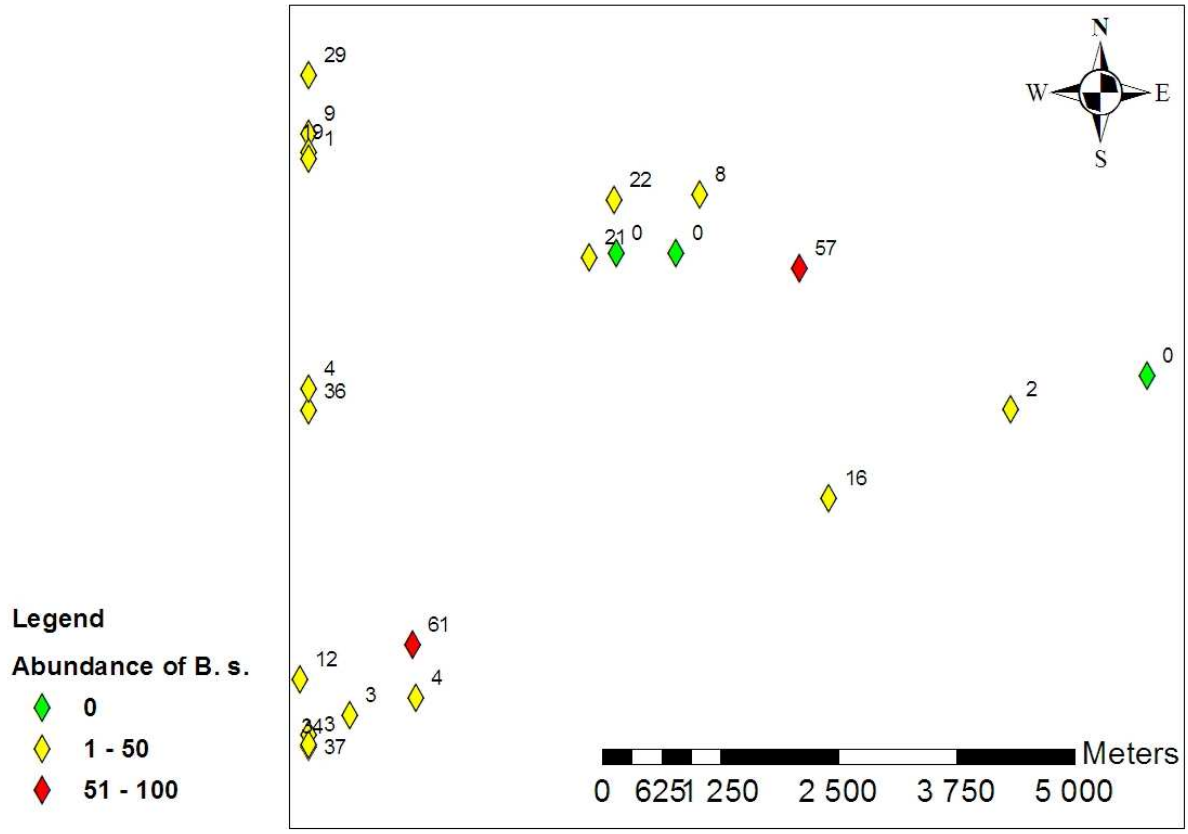


Fig. 4. Spatial distribution of B. senegalensis abundance within the studied area

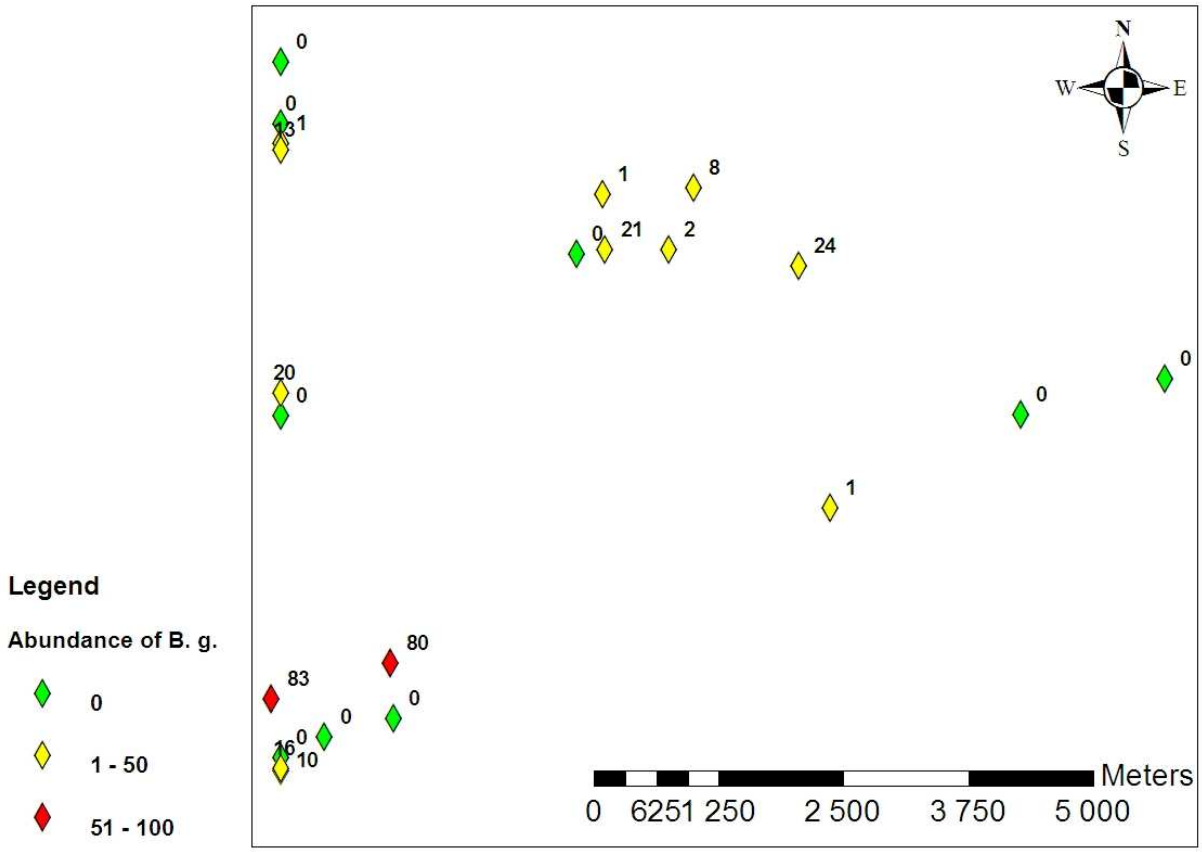


Fig. 5. Spatial distribution of B. globosus abundance within the studied area

6 CONCLUSION

In conclusion, our findings indicate that temporary standing water ponds in Maroua town are potential transmission sites for schistosomiasis and *B. senegalensis* and *B. globosus* are the potential snail host, in addition, the study also indicates that of the environmental factors observed, turbidity of water and aquatic vegetation were associated with snail abundance in the sampled water pond. Although the study doesn't provide a full picture of schistosomiasis transmission dynamic in Maroua town, it heds insights into malacological aspects that may underlie the schistosomiasis in the Far North Region of Cameroon. Further studies using frequent sampling covering the whole rainy season are needed to understand the dynamic of transmission. These will provide information on the most important transmission sites and seasons, and which indicators should be used to identify transmission sites in order to determine whether or not to carry out snail control in an identified site at a given time. Human water contact pattern also need to be screen in details in order to determine the socio-demographic and reasons of water contact that can be use for control purpose.

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REFERENCES

[1] D. Rollinson *et al*., "Time to set the agenda for schistosomiasis elimination". *Acta Trop*. http://dx.doi.org/10.1016/j.actatropica.2012.04.013. (2012).

[2] WHO, First WHO report on neglected tropical diseases 2010: Working to overcome the global impact of neglected tropical diseases. *World Health Organization*, Geneva, 2010.

[3] R.A. Kane, V.R. Southgate, D. Rollinson *et al*., "A phylogeny based on three mitochondrial genes supports the division of *Schistosoma intercalatum* into two separate species". *Parasitology*, no.127, Vol. 2, pp. 131–137, 2003.

[4] J.R. Pagès, J. Jourdane, V.R. Southgate, *et al*., Reconnaissance de deux espèces jumelles au sein du taxon *Schistosoma intercalatum* Fisher, 1934, agent de la schistosomose humaine rectale en Afrique. Description de *Schistosoma guineensis* n. sp. In: *Taxonomy, Ecology and Evolution of Metazoan Parasites*. Vol. 2, Edited by Combes C, Jourdane J. Perpignan: Presses Universitaires de Perpignan, 2003.

[5] D. Brown, Freshwater Snails of Africa and their Medical importance, Revised 2nd ed. *Taylor & Francis*,1994.

[6] E. Boelee and H. Madsen, Irrigation and schistosomiasis in Africa: Ecological aspects. Colombo, Sri Lanka: *International Water Management Institute*. 39p. (IWMI Research Report 99), 2006.

[7] P.J. Hotez, D.A.P. Bundy, K. Beegle *et al*., *Helminth infections: soil-transmitted helminth infections and schistosomiasis*. In: *Disease Control Pririoties in Developing Countries*, 2nd Edition. D. Jamison, M. Claeson, J. Breman and A. Meacham (Eds.), New York: Oxford University Press, 2006.

[8] F.O. Arene, E.T. Ukpeibo and E.A. Nwanze, "Studies on Schistosomiasis in the Niger Delta: *Schistosoma intecalatum* in the Urban City of Port Harcourt, Nigeria", *Public Health*, no.103, pp. 295–301, 1989.

[9] O. Doumbo, A. Dabo, M. Diallo, *et al.,* "Epidémiologie des schistosomiases humaines urbaines à Bamako au Mali", *Médecine Tropicale*, no.52, pp.427–434, 1992.

[10] L. M. Mungomba, and E. H. Michelson, "Urban schistosomiasis in Lusaka, Zambia: a preliminary study". *Journal of Tropical Medicine and Hygiene*, no. 98, pp. 199–203, 1995.

[11] R.C. Ratard, L.E. Kouemeni, M.M. Ekani Bessala *et al.*, "Human schistosomiasis in Cameroon I. Distribution of schistosomiasis", *American Journal of Tropical Medicine and Hygiene*, no. 42, pp. 561–572, 1990.

[12] F. Njiokou, A. R. Onguene Onguene, L. A. Tchuem Tchuente et al., "Schistosomose urbaine au Cameroun : étude longitudinale de la transmission dans un nouveau site d'extension du foyer de schistosomose intestinale de Mélen, Yaoundé", Bulletin de la Société des Pathologies Exotiques, no. 97, vol. 1, pp. 37-40, 2004

[13] L.A. Tchuem Tchuenté, R.I. Kamwa Ngassam, L. Sumo *et al*., "Mapping of schistosomiasis and soil-transmitted helminthiasis in the regions of Centre, East and West Cameroon", PLoS Negl. Trop. Dis. 2012, 6(3):e1553.

[14] P. Saotoing, T. Vroumsia, A.M. Njan *et al*., "Epidemiological survey of Schistosomiasis Due to *Schistosoma haematobium* in some Primary Schools in the Town of Maroua, Far North Region Cameroon", *International Journal of Tropical Medicine*, no. 6, vol. 2, pp. 19-24, 2010.

[15] N. Fonjong Lotsmart, E. Ngwa Nebasina, C. Fonchingong, *Rethinking the contribution of indigenous. Management in small-scale water provision among selected rural communities in Cameroun*. *Environment, Development and Sustainability*. Kluwer Academic Publishers, Printed in the Netherlands, no. 6, pp. 429–451, 2003.

[16] D. Sighomnou, Cameroun: Gestion intégrée des eaux de crues. Cas de la plaine d'inondation du fleuve Logone. *The Associated Programme on flood management*, pp 1-9, 2003.

[17] BUCREP, *3e recensement général de la population et de l'habitat : La population du Cameroun en 2010*. Yaoundé: Bureau Central des Recensements et des Etudes de Population, 2010.

[18] M. Raunet, Quelques clés morphopédologiques pour le Nord Cameroun à l'usage des agronomes, 2003. [Online] Available : http://agronoecologie.cirad.fr. (May 2010)

[19] H. Madsen, Ecological field studies on schistosome intermediate hosts: Relevance and methodological considerations. In: *Proceedings of a Status of Research on Medical Malacology in Relation to Schistosomiasis in Africa,* Zimbabwe, August 1995, 1996.

[20] A. Same Ekobo, Faune malacologique du Cameroun. Description, répartition des mollusques dulçaquicoles et foyers de trématodoses humaines. *Thèse de Doctorat d'Etat*. Université de Renne I, pp. 632, 1984.

[21] T.K. Kristensen, "Identification key to the schistosome intermediate host snails of Cameroon and Gabon". *Bulletin de la Société Française de Parasitologie*, no. 2, vol. 6, pp. 169 – 142, 1988.

[22] H. Madsen and N.Ø. Christensen, "Intermediate hosts of schistosomes: ecology and control". *Bulletin of the Society of Vector Ecology*, no.17, pp. 2-9, 1992.

[23] J.C. Ernould, A. Kaman Kaman, R. Labbo *et al*., "Recent urban growth and urinary schistosomiasis in Niamey, Niger". *Tropical Medicine and International Health*, no. 5, vol. 6, pp. 431–437, 2000.

[24] G.J. Greer, R. Mimpfoundi, E.A. Malek *et al*., "Human schistosomiasis in Cameroon. II. Distribution of the snails hosts". *American Journal of Tropical Medicine and Hygiene*, no. 42, vol. 6, pp. 573-780, 1990.

[25] E. Ngonseu, G.J. Greer, R. Mimpfoundi, "Dynamique des populations et infestation de *Bulinus globosus* en zone soudano-sahélienne du Cameroun". *Annales de la Société Belge de Médecine Tropicale*, no.71, pp. 295-306.
[26] H. Madsen, G. Coulibaly and P. Furu, "Distribution of freshwater snails in the river Niger basin in Mali with special reference to the intermediate hosts of schistosomes". *Hydrobiologia*, no. 146, pp. 77-88, 1987.
[27] E. I. Okoli and A. B. Odaibo, "Urinary schistosomiasis among schoolchildren in Ibadan, an urban community in south-western Nigeria". *Tropical Medicine and International Health*, no.4, vol. 4, pp. 308–315, 1999.

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ASSESSMENT OF LEVELS OF LEAD, CADMIUM, COPPER AND ZINC CONTAMINATION IN SELECTED EDIBLE VEGETABLES

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ABSTRACT: The aim of this study was to measure the level of heavy metals in edible vegetables (tomato, onion and green pepper) collected from Bahir Dar market, garden of Bahir Dar town and Adet Agricultural Research center (near Reb River). Levels of Pb, Cd, Cu and Zn were determined using flame atomic absorption spectrometry after dry ashing process. The average concentrations of Pb, Cd, Cu and Zn were in the range of; 0.244 - 0.987, 0.115 - 0.536, 0.962 -3.430 and 2.344 - 4.136 mg/kg in tomato, 0.241- 0.43, 0.12- 0.441, 0.879-3.428 and 2.197- 3.259 mg/kg in onion and 0.28- 0.392, 0.128- 0.573, 1.229-2.991 and 3.081-4.242 mg/kg in green pepper respectively. The levels of those metals in all vegetables collected from the market site was higher than Adet Agricultural Research center but lower than garden in Bahir Dar town. The highest concentration of Zn in all vegetables of the analyzed metals was probably because it is considered as essential micronutrients for plants growth and can easily be taken up by plants or may be obtained from the water. The concentration of zinc and copper were within WHO guideline in all analyzed samples, while samples collected from the market and gardens of Bahir Dar town showed high increment in concentration of lead and cadmium from the permissible level set by FAO/WHO for consumption.

KEYWORDS: FAAS; heavy metals; vegetable; contamination; FAO/WHO.

1 INTRODUCTION

The increasing demand for food safety stimulated research regarding the risk associated with consumption of foodstuffs contaminated by pesticides, heavy metals and/or toxins. Food safety issues and potential health risks make as one of the most serious environmental concerns. Heavy metal accumulation in plants depends upon plant species, and the efficiency of different plants in absorbing metals is evaluated by either plant uptake or soil-to plant transfer factors of the metals. Dietary exposure to heavy metals, namely cadmium (Cd), lead (Pb), zinc (Zn), copper (Cu) and other has been identified as a risk to human health through the consumption of vegetable crops. Heavy metals are given special attention throughout the globe due to their toxic and mutagenic effects even at very low concentration [1, 2].

Heavy metals are among the major contaminants of food supply and may be considered the major problem to our environment. Such problem is getting more serious all over the world especially in developing countries such as North and South Africa, Turkey, Yemen, Zimbabwe, Nigeria, Tanzania and Egypt. Contamination of vegetables with heavy metals may be due to irrigation with contaminated water, the addition of fertilizers and metal-based pesticides, industrial emissions, transportation, the harvesting process, storage and/or at the point of sale (market). Human beings are encouraged to consume more vegetables and fruits, which are beneficial for health. Heavy metals may enter the human body through inhalation of dust, consumption of contaminated drinking water and consumption of food plants grown in metal-contaminated soil [3, 4].

Lead and cadmium are among the most abundant heavy metals and are particularly toxic. The excessive content of these metals in food is associated with etiology of a number of diseases, especially with cardiovascular, kidney, nervous as well as

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bone diseases. In addition, they are also implicated in causing carcinogenesis, mutagenesis and teratogenesis. Copper and zinc are essential for important biochemical and physiological functions and necessary for maintaining health throughout life, but if theses metals have excessive concentration above the WHO value they may cause diseases [5].

The health effect of lead and cadmium is less studied even though peoples are consuming vegetable day to day in its raw and sauce form that may result the accumulation of trace metals in human body. However, to the extent of assessment done, there is no literature report on the determination of the levels of heavy metals in Ethiopian vegetables (tomato, onion and green pepper) around Bahir Dar town. Hence, this research is intended to determine the concentration of trace metals (cadmium, copper, zinc and lead) in edible vegetables from Bahir Dar town market and gardens of Bahir Dar around Lake Tanaand Adet Agricultural Research center (near Reb River).

2 MATERIALS AND METHODS

2.1 DESCRIPTION OF STUDY AREA

A study was conducted in Bahir Dar town and Adet Agriculture Research center from February to April 2011 to determine level of heavy metals in vegetables. Bahir Dar town is the capital city of the Amhara National Regional State in Ethiopia. It is located at $11^0$38'N, 37^0 10'E on the Southern side of Lake Tana (where Blue Nile River starts). The altitude of the town is about 1800 m above sea level and average annual rainfall and temperature of 1455.5 mm and 18.8^{o}c respectively. Adet Agriculture Research center have three irrigation branches. The one which was considering in this study is found in Woreta around Reb River. It is found in Fogera woreda which is one of the 106 districts in the Amhara Regional State and found in south Gondor zone. It is situated at 37^o 29' to 37^o 59' E longitude and 12^o 41' to 12^o 02'N latitude. Samples were collected from two purposely selected areas in Bahir Dar (market and gardens around shore of Lake Tana near the St. George church) and Adet Agricultural Research center (near Reb River).

2.2 CHEMICALS AND APPARATUS

Concentrated nitric acid 69% from LOBA CHEMIE PVT.Ltd., India was used as dry ashing aid. Lead nitrate cadmium nitrate tetrahydrate, zinc nitrate hexahydrate, copper nitrate tetrahydrate all from BLULUX Laboratories PVT. Ltd., India was all used for standard solution preparation. Distilled water ,Refrigerator, Polyethylene bags, ceramic pestle and mortar, Digital analytical balance (Mettler Toledo, Model AT250, Switzerland), oven (J. P. Select, Spain), Muffle furnaces (Philips Harris Ltd, England) Finally, atomic absorption spectroscopy (novAA 300) equipped with deuterium ark background correctors was used for analysis of the trace metals (Cu, Zn, Cd, and Pb).

2.3 CLEANING OF GLASS WARES AND APPARATUS

All glassware and plastic containers used were washed with liquid soap, rinsed with water, soaked in 10 % nitric acid for 24 hrs, cleaned thoroughly with distilled water and dried in such a manner to ensure that any contamination does not occur. All pipette rinsed immediately prior to use, three times with distilled water and once with sample solution to be dispensed [5].

2.4 SAMPLE COLLECTION, PRESERVATION AND HANDLING

Samples were collected from Adet Agricultural Research center (near Reb River) irrigation, St. George church garden and market in Bahir Dar town in April 2011 and transported with polyethylene bags to the laboratory immediately. Nine composite samples of vegetables (three each of onion (*Allium cepa*), tomato (*Lycopersicum esculantum*) and green pepper (*capsicum annuum*)) were collected (4 kg for each commodity) from the three sites randomly. Each vegetable type was sampled twelve times from three sites. All vegetables were collected and stored in polyethylene bags according to their type and were brought to the laboratory for preparation and treatment. Samples were kept in a refrigerator, until the samples were homogenized and then prepared. The collected samples were washed with tap water and rinsed three times with distilled water to make them free of extraneous substances, including soil and dust particles that may influence analytical results. For the analysis, only the edible portions were included, whereas bruised or rotten parts were removed. All the vegetables were chopped into slices with plastic knife and the chopped vegetables were composited and homogenized [1, 5, 7].

2.5 SAMPLE PREPARATION AND TREATMENT

Sub-samples (1kg, for each commodity from each source) were taken at random from the composite sample and were processed for analysis by the dry-ashing method. The samples were first oven dried at 105 ^{o}C for 24 h. The dried samples were powdered with porcelain mortar taking care not to overheat the sample. The ground solid samples (5 g, each) for each food item were accurately weighed and placed in crucibles and 5 drops of concentrated nitric acid was added to the solid as an ashing aid. Dry-ashing process was carried out in a muffle furnace by stepwise increase of the temperature up to 550 ^{o}C and then left to ash at this temperature for 4 h. The ash was left to cool; the ash was kept in desiccators and then rinsed with 1M nitric acid. The ash suspension was filtered into a 25 ml volumetric flask using Whatman filter paper No. 41, and the solutions were completed to the mark with nitric acid (1 M). The blank solutions also were prepared by the mixture of reagents following the same as dry-ashing procedure and diluted to 25 mL with nitric acid (1M). Finally, the digested samples were kept in the refrigerator, until the level of all the metals in the sample solutions were determined using AAS [2, 3].

2.6 ANALYTICAL PROCEDURE FOR HEAVY METAL ANALYSIS BY FAAS

Vegetable samples were analyzed for heavy metals using flam atomic absorption spectroscopy (FAAS). The heavy metals analysis adjustment of the operating condition was very essential target. Wavelength, slit width, limit of detection was adjusted for the analysis of Pb, Cd, Zn and Cu. Standard solutions of heavy metals, namely lead (Pb), cadmium (Cd), copper (Cu) and zinc (Zn) were prepared for calibration curve. The standards were prepared from the standard salt of each metal in 1000 ml volumetric flask then 1000 mg/l standards in 10 ml HNO_3. From this stock solution 100 mg/l of each metal were freshly prepared by diluting the stock solution in 100 ml volumetric flask with distillated water then the working solution 10 ml of each metal was prepared in 100 ml volumetric flask. For the determination of these metals, three solutions were prepared for each sample from each source and four standard solutions were made for Pb, Cd, Zn and Cu. A rinse blank (distilled water) was used to flush the uptake system to reduce memory interferences [3, 8].

Finally, the data was analyzed by Origin, Excel and One way ANOVA and its significance was determined at $P < 0.05$ level.

3 RESULT AND DISCUSSION

3.1 CONCENTRATION OF PB, CD, CU AND ZN USING FAAS IN VEGETABLES

The concentration of each metal in samples of the three sites was calculated from their corresponding absorbance value using the calibration curve. Table 3.1 shows mean concentrations of these metals investigated in the edible vegetable commonly consumed in Bahir Dar, Ethiopia. The heavy metal levels determined were based on plants dry weight. The values are given as mean ± SD and the results are means of three replicates.

Table 3.1. Mean (±SD) values of heavy metals concentration in vegetable for different area of study.*

Area of the study	Vegetable type	Pb (mg/kg)	Cd (mg/kg)	Cu (mg/kg)	Zn (mg/kg)
Adet Agricultural Research center (near Reb River)	Tomato	0.244 ± 0.010	0.115 ± 0.028	0.962 ± 0.038	3.902 ± 0.012
	Onion	0.241 ± 0.018	0.120 ± 0.011	0.879 ± 0.011	2.197 ± 0.258
	Green pepper	0.280 ± 0.005	0.128 ± 0.029	1.229 ± 0.346	3.081 ± 0.116
Gardens of Bahir Dar town around Lake Tana	Tomato	0.987 ± 0.017	0.536 ± 0.010	3.430 ± 0.013	4.136 ± 0.055
	Onion	0.441 ± 0.019	0.430 ± 0.001	3.259 ± 0.011	3.428 ± 0.368
	Green pepper	0.342 ± 0.033	0.573 ± 0.041	2.991 ± 0.003	4.242 ± 0.006
Bahir Dar market	Tomato	0.371 ± 0.002	0.291 ± 0.003	2.344 ± 0.003	2.494 ± 0.234
	Onion	0.358 ± 0.005	0.254 ± 0.002	3.237 ± 0.010	3.332 ± 0.204
	Green pepper	0.392 ± 0.001	0.331 ± 0.019	2.289 ± 0.334	3.181 ± 0.011

* Values are mean of the three determinations at 95 % confidence level

This means: $$\mu = \bar{X} \pm \frac{ts}{\sqrt{n}} \quad (1)$$

Where: μ - the expected value of the determination $\bar{X}$ - mean of the replication

t- Statistical factor whose value is determined by number of samples and the desired confidence level

s- The standard deviation of the measured value

n- The number of replicate measurement

3.2 COMPARISON OF THE AVERAGE HEAVY METALS CONCENTRATIONS AMONG THE THREE SITES

All vegetable (tomato, onion and green pepper) samples collected from the study areas showed the presences of Pb, Cd, Cu and Zn and all were found to be above their detection limits within nine (three each of tomato, onion and green pepper) samples. Comparison of the level of metal in tomato, onion and green pepper among the three sites are given in Figure 3.1, 3.2 and 3.3 respectively.

Tomato samples: in all the analyzed metals zinc content was high as compared to other metals (Figure 3.1). Its concentration ranges from 2.494 to 4.136 mg/kg. Garden provided maximum of 4.136 mg/kg while its concentration was found minimum in market (2.494 mg/kg) and the order of its concentration is garden > Adet > market. The second most accumulated trace metal next to zinc found in tomato was copper. Its mean concentration was found between 0.962 to 3.430 mg/kg (Figure 3.1). The maximum amount was found in tomato from garden (3.430 mg/kg) while minimum amount was found in Adet (0.962 mg/kg). The total accumulation of copper was in the order of garden > market > Adet.

Of the toxic metals, in all tomato samples the concentration of cadmium was relatively least amount than any other trace metal analyzed but its concentration is above WHO/FAO in all areas of study except in Adet. The concentration of Cd varies

within the tomato sample analyzed. The cadmium content in this study was in the range of 0.115 to 0.536 mg/kg (Figure 3.1). The highest and the least concentration were absorbed 0.536 mg/kg and 0.115 mg/kg in garden and Adet respectively. The concentration pattern of cadmium follows in order of garden > market > Adet. The other toxic metal accumulated in tomato sample was lead. Its concentration in samples was 0.244 mg/kg, 0.987 mg/kg and 0.371 mg/kg in Adet, garden and market respectively. Moreover, the lowest level of lead was accumulated in Adet tomato and the highest was in garden.

As can be seen from Figure 3.1, the order of all metals concentration in tomato samples in Adet, garden and market is in the same order of Zn > Cu > Pb > Cd. This trend suggests that zinc found in the highest concentration and cadmium is the least. The concentration of Pb and Cd are beyond the WHO guideline value in garden and market.

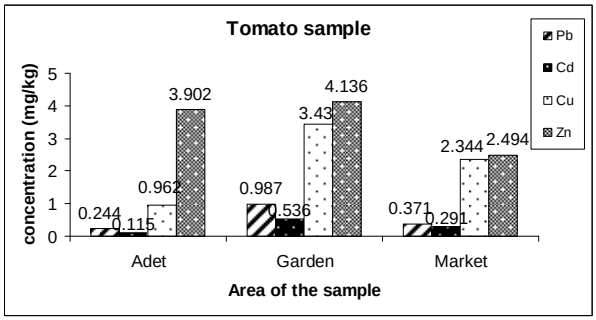


Fig.3.1. Mean concentration of Pb, Cd, Cu and Zn in tomato from different area of study.

Onion sample: Figure 3.2, shows the level of Pb, Cd, Cu and Zn of their average concentration among the study areas. The concentrations of the elements in the analyzed samples were quite varied. In the onion sample the same to that of tomato, Zn was observed at higher concentration than other metals with concentration range from 2.179 mg/kg in Adet to 3.428 mg/kg in garden followed by Cu with mean concentration range 0.879 mg/kg to 3.259 mg/kg. The concentration pattern of zinc and copper follows in order of garden > market > Adet.

Among the toxic metals lead and cadmium, Pb was found at higher concentration than Cd in all the three sample sites and its concentration ranging from 0.241 mg/kg in Adet to 0.441 mg/kg in garden. The lowest observed concentration for all the three sites was that of Cd and the maximum concentration was in garden (0.430 mg/kg) while its minimum concentration was in Adet (0.120 mg/kg). The total accumulation of lead and cadmium was in the order of garden > market >Adet. The trend occurrence with the selected vegetable (onion) of metal concentration of Adet, garden and market was in the order of Zn > Cu > Pb > Cd.

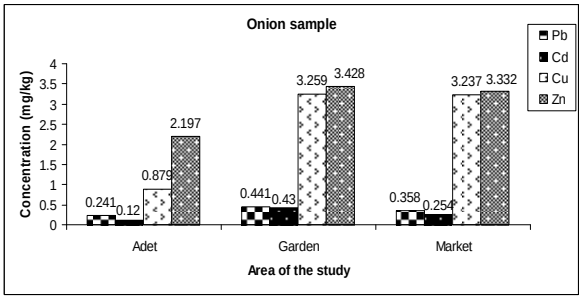


Fig.3.2. Mean concentration of Pb, Cd, Cu and Zn in onion from different area of study.

Green pepper sample: Figure 3.3, shows the metals average concentration in the three green pepper samples. For most of metals, garden has relatively more metals concentration followed by market, while Adet contains the least metal concentration. The concentration of zinc is higher in all the three samples followed by copper. The order of zinc and copper have the same trend that is garden > Market > Adet. For all the three green pepper samples Cd have least average concentration like that in tomato and onion samples and the order of its concentration is the same as that of Zn and Cu.

Concerning to lead in the study, the concentration with the analyzed green pepper samples was found to be 0.280 mg/kg, 0.342 mg/kg and 0.392 mg/kg in Adet, garden and market respectively. The increasing order of metals concentration in green pepper in Adet and market were in the order of Zn > Cu > Pb > Cd. However, the trend occurrence of metals concentration in garden were in the order of; Zn > Cu > Cd > Pb.

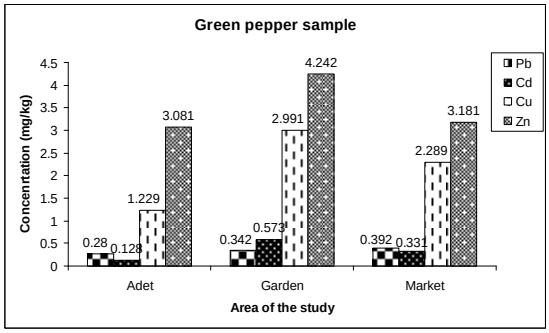


Fig.3.3. Mean concentration of Pb, Cd, Cu and Zn in green pepper from different area of study.

In general**,** as can be seen from Figures 3.1, 3.2, 3.3, the levels of all the heavy metals in all the vegetables collected from the market sites and garden of Bahir Dar town are higher than those of heavy metals in the respective vegetables collected from the production site of Adet Agricultural Research center. As Mr. Habtomu Tegegn (the horticulturalist of Adet Agricultural Research center) recommended, the institution use natural waters for irrigation from Reb River with the help of water pump, organic fertilizer like urea, which leads to less concentration of metals as compared to the other sites. However, small concentration was observed which may be from the soil and environmental pollution. The concentrations of all metals obtained from Adet in all vegetable samples are within permissible levels given by the FAO and WHO and are safe for human consumption.

The levels of Pb, Cd, Cu and Zn in all the vegetables collected from the market site are higher than Adet Agricultural Research center but lower than garden in Bahir Dar town. This might be due to heavy metal depositions on the vegetables during transport, marketing at the point of sale and most of Ethiopian farmers use fertilizer and pesticide in order to get good yield and protect from pests. The high contamination levels found in all vegetables in garden of Bahir Dar town may be related to pollutants in irrigation water, from soil and pollution from highway traffic, municipal wastewater, metal-based pesticides and inorganic fertilizer such as DAP (diammonium phosphate).

The high concentration of Zn is probably because it is considered as essential micronutrients for plants growth and can easily be taken up by plants. The higher concentration of Zn in the vegetable may also be ascribed to the use of Zn in fertilizers and metal-based pesticides around production site. The concentration of zinc and copper were within WHO guideline value in all analyzed samples. All analyzed samples that were collected from the market and gardens of Bahir Dar town showed slight increment in concentration of lead and cadmium are above the permissible level set by FAO/WHO for consumption. On whole, all vegetables (except Adet Agricultural Research center) that were studied in this study, are contaminated by lead and cadmium which were toxic to consumer.

Vegetables are important part of every human diet. Consumptions of toxic heavy metals in unsafe concentrations through vegetables may lead to accumulation of Pb and cadmium in kidney and liver [3] and could cause problem such as: **Lead** – brain damage, seizure, central nervous system disorders, kidney disease both acute and chronic, gastrointestinal disturbances, slight liver impairment and damage a child's central nervous system, kidneys, and reproductive system. **Cadmium -** accumulates in kidneys, where it damages filtering mechanisms. It also causes diarrhoea, stomach pains and severe vomiting, bone fracture, reproductive failure and possibly even infertility, damage to the central nervous system, damage to the immune system, psychological disorders and possibly DNA damage.

3.3 COMPARISON BETWEEN THE AVERAGE HEAVY METAL CONTENT OF VEGETABLES OF THIS STUDY WITH THAT OF LITERATURE AND WHO VALUES

There are some reports from different countries on the analysis of the metal contents of the tomato, onion and green pepper**.** It is important to compare the result obtained from the analysis of the three vegetables in this study with the values

sited in other countries and WHO guideline values. The comparative study of metals of tomato, onion and green pepper determined in this study and the reported values of other researchers are presented in Table 3. 2. The concentration of copper in tomato, onion and green pepper is in the average range of (**0.962 - 3.430, 0.879 – 3.428, 1.229 – 2.991**) mg/kg respectively and for zinc (**2.344- 4.136, 2.197 - 3.259, 3.081- 4.242**) mg/kg in tomato, onion and green pepper respectively. Both copper and zinc are found within the WHO values. The average concentration range value of lead is (**0.244 - 0.987, 0.241 – 0.43, 0.28 – 0.392**) and cadmium (**0.115 - 0.536, 0.12 – 0.441, 0.128 – 0.573**) mg/kg in tomato, onion and green pepper respectively. Hence the lower value of all the analyzed samples of lead and cadmium accepted by WHO guideline value and the higher concentration values of the range exceeded the WHO value; therefore, there is need of remedial action.

In comparing the result of this study with cited in literature, the concentrations of Cu in tomato, onion and green pepper samples found in this study was more or less agrees with the results of Mohamed *et al.* (4.47, 2.81, 4.49 mg/kg) [6], Onianwa *et al.* (1.41, 1.057, 1.279 mg/kg) [10], Radwan *et al.* (1.83, 1.49, 4.53 mg/kg) [3] from Saudi Arabia, Nigeria and Egypt respectively. However, it is lower than with the values reported by Dilek *et al.* (32.6, 53.83, 37.06 mg/kg) [9] from Turkey.

When the level of Zn in tomato, onion and green pepper obtained in this study is compared with literature values, it is higher than the result reported by Onianwa *et al.* (0.559, 1.276, 1.359 mg/kg) of Nigeria [10], while it is much lower than with the values reported by Mohamed *et al.* (14.4, 17.4, 8.51mg/kg)[6], Dilek *et al.* (3.56, 21.34, 10.47 mg/kg)[9], Radwan *et al.* (7.69, 11.4, 12.5 mg/kg) [3] from Saudi Arabia, Turkey and Egypt respectively except concentration of zinc in tomato from Turkey which is the same with this study.

Regarding the toxic metal, the level of lead in the analyzed samples (tomato, onion and green pepper) from this study is higher than those recorded by Onianwa *et al.* (0.03, 0.057, 0.63 mg/kg) in Nigeria [10]. But it is comparable with the values of Radwan *et al.* (0.26, 0.14, 0.47 mg/kg) [3] obtained from Egypt. However, higher concentrations of lead were recorded by Mohamed *et al.* (2.59, 10.29, 1.9 mg/kg)[6] and Dilek *et al.* (9.7, 8.7, 5.3 mg/kg)[9] from Saudi Arabia and Turkey respectively.

As shown in Table 5.6, concentration of cadmium in tomato, onion and green pepper obtained in this study and the result from Dilek *et al*. (0.41, 0.97, 0.62 mg/kg)[9] and Mohamed *et al*. (0.77, 0.76, 0.8 mg/kg) [6] from Turkey and Saudi Arabia are comparable. But, cadmium concentration found in this study is higher than data cited by Onianwa *et al*. (0.004, 0.005, 0.006 mg/kg) [10] and Radwan *et al*. (0.01, 0.02, 0.05 mg/kg) [3] from Nigeria and Egypt.

As described above, the results obtained in this study are comparable favorably with the finding of other researchers from other parts of the world. However, results with those given by Dilek *et al*. are observed to be that there are greet difference about the content of Pb, Cu and Zn in all samples. This difference in the concentration of heavy metals may be ascribed to variation due to application of fertilizer, metal-based pesticide, at time transportation and marketing, emission of vehicles, atmospheric deposition, soil composition, irrigation of wastewater industries and municipal wastewater.

Table 3.2 Comparison of average concentrations of metals in this study with literature and WHO values.

Method	Types of vegetables	Heavy metals concentration in (mg/kg)				Country
		Pb	Cd	Cu	Zn	
AAS	Tomato	9.7	0.41	32.6	3.56	Turkey
	Onion	8.7	0.97	53.83	21.34	
	Green pepper	5.3	0.62	37.06	10.47	
GFAAS	Tomato	2.59	0.77	4.47	14.4	Saudi Arabia
	Onion	10.29	0.76	2.81	17.4	
	Green pepper	1.9	0.8	4.49	8.51	
FAAS	Tomato	0.03	0.004	1.41	0.559	Nigeria
	Onion	0.057	0.005	1.057	1.276	
	Sweet pepper	0.063	0.006	1.279	1.359	
FAAS	Tomato	0.26	0.01	1.83	7.69	Egypt
	Onion	0.14	0.02	1.49	11.4	
	Green pepper	0.47	0.05	4.53	12.5	
FAAS	Tomato	0.244 - 0.987	0.115 - 0.536	0.962 - 3.430	2.344- 4.136	This study
	Onion	0.241 – 0.43	0.12 – 0.441	0.879 – 3.428	2.197 - 3.259	
	Green pepper	0.28 – 0.392	0.128 – 0.573	1.229 – 2.991	3.081- 4.242	
FAAS	vegetables	0.3	0.2	40	60	(WHO) Permissible level

4 CONCLUSIONS AND RECOMMENDATION

Heavy metals are not only affecting the nutritive values of vegetables but also have deleterious effect on human beings using these food items. Determination of heavy metals concentration in vegetables and food products is important for health risk assessment during food consumption. The levels of heavy metals in studied vegetables, and the permissible levels required for safe food were compared. The toxic metals, lead and cadmium were found in the least concentrations compared to other metals analyzed. However, the levels of Pb and Cd exceeded the permissible

level set by FAO/WHO specifications in all vegetable samples collected from market and gardens in Bahir Dar town. Especially, the levels of metals analyzed for all vegetables from garden were found at higher concentration compared to market and Adet agricultural research center (near Reb River). The higher concentration of Pb and Cd above the permissible level in vegetables used for human food may pose health risk to consumer although the concentration of Cu and Zn were below the recommended levels.

Concentrations of metals between samples were also compared using one-way ANOVA. The results of ANOVA indicated that there were significant differences in the levels of most metals between the three samples each of tomato, onion and green pepper among the three sites.

Generally, the levels of metals in similar vegetable samples differed between the three sampling site, that may be due to variation in sources and processes of contaminations that could attribute to metals contamination to take place during pre-harvest and post-harvest process. Possible sources during pre-harvest include from soil type, fertilizers, pesticides, municipal

wastewater and water used for irrigation, while post harvest sources may include contamination through air pollution and during transport to the market or at the point of sale.

Lastly the researcher recommends the following

- It is recommended that these types of vegetables should not be cultivated in farms and fields nearby urban areas which have heavy vehicle movements and irrigated with questionable water quality which could be sources of heavy metals contamination.
- This study further suggests that to reduce the health risk, vegetables should be washed properly before consumption as washing can remove a significant amount of aerial contamination from the vegetable surface.
- Markets establishments for vegetable sale should be away from motor vehicle parking and movement areas, as motor vehicle emissions can be a source of heavy metal contamination in vegetables at road side market.
- Use of good agricultural practices under supervision for proper fertilizer application.
- Further works should be carried out in the soil samples where the vegetables are grown, irrigation water and compost or fertilizers on the availability of metals to different vegetable, as it could be useful to take remedial measures by regulatory agencies of the town to abate the metal pollution and also restrict the cultivation of vegetables on contaminated soils.

REFERENCES

[1]. A. Maleki and M. A. Zarasvand, Heavy metals in selected edible vegetables and estimation of their daily intake in Sanandaj, Iran, *J. Med. Scie., Sanandaj, Iran*, vol. 39**,** no. 2, pp. 335- 337, 2008.

[2]. R. k. Sharma, M. Angrawal and F. M. Marshal, Heavy metal in vegetable collected from production and market sites of tropical urban area of India, *J. Food and Chem. Toxicol.,* vol.47, 583-591, 2009.

[3]. M. A. Radwan and A. K. Salama, Market basket survey for some heavy metals in Egyptian fruits and vegetables, *Food and Chem. Toxicol.*, vol. 44, 1273-1278, 2006.

[5]. S. R. Khan, Farooq, S. Shahbaz, M. A. Khan and M. Sadique, Health risk assessment of heavy metals for population via consumption of vegetables, *J. World App. Scie.,* vol. 6, no.1 1602-1606**,** 2009.

[6]. A. E. Mohamed, M. N. Rashed, and A. Mofty, Assessment of essential and toxic elements in some kinds of vegetables, *Ecotoxicol. and Environ. Safety*, vol. 55, 251–260,2003.

[7]. T. E. Bahemuka and E. B. Mubofu, Heavy metals in edible green vegetables grown along the sites of the Sinza and Msimbazi rivers in Dares Salaam, Tanzania, *J. Food Chem.*, vol. 66, 63-66,1999.

[8]. A. K. Salama and M. A. Radwan, Heavy metals (Cd, Pb) and trace elements (Cu, Zn) contents in some foodstuffs from the Egyptian market, *Emir. J. Agric. Scie. vol.* 17, no.1, 34-42,2005.

[9]. D. Demirezen and A. Aksoy, Heavy metal levels in vegetables in Turkey are within safe limits for Cu, Zn, Ni and exceeded for Cd and Pb, *J. of Food Quality*, **29** (2006) 252–265.

[10]. P. C. Onianwa , A. O. Adeyemo, O. E. Idowu, E. E. Ogabiela, Copper and zinc contents of Nigerian foods and estimates of the adult dietary intakes, *Food Chem.*, vol.72, 89-95, 2001.

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Educational System in British India and its Socio-Political Impacts on Pakistani Society

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ABSTRACT: Educational system in British India was in fact, a plan of control. British government wanted to facilitate Hindus therefore this system was destroying Muslim identity and recognition. Although, one of its prime objectives was to promote Christianity and western culture in Indo-Pak Subcontinent but its other features were covering interests of Hindus. Therefore, Muslims had been forced to give up getting education.

This article highlights all the seven educational plans which are called seven terms of British educational system in India, introduced by the British Government according to the need of time. Impacts of every term are also presented here while characteristics of British educational system are covering the whole tenure of British educational policies in Indo-Pak Subcontinent from 1813 to 1947. The socio-political consequences of this system after the formation of Pakistan are also discussed here.

KEYWORDS: Aligarh, Deoband, Persian, Indo-Pak Subcontinent, Britishers.

HYPOTHESIS

British educational system in India was totally against the Muslims benefits and identity. In fact, British East India Company snatched the rule of Indo-Pak Subcontinent from Muslims therefore it considered them as their big enemy. Therefore, all the seven terms of British educational system created fully negative impacts on Indian Muslims and they suffered a lot socially, economically, religiously, culturally, legally, politically and institutionally. But, some of rational thinkers perceived it as a reason of delivering defending thoughts to the Muslims. So, firstly they established their own political party in 1906 and secondly, they got a separate homeland in 1947.

INTRODUCTION

Most of the historians criticized British educational system in India and argued that it was designed against the Muslim identity and interests. All the seven terms introduced by the British Government were following backwardness of Indian Muslims. Therefore, Muslims had been forced to start their own educational movements. This study is highlighting all these seven educational terms with focusing upon their social, economic, political, institutional, religious, legal and economic impacts. And, after the formation of Pakistan, the socio-political consequences of this educational system and its counter educational thinking are described.

LITERATURE REVIEW

Leslie (1988) describes an importance of education for each country with declaring it as a big tool of generating skilled human resource.

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Riddick (2006) and Iraqi (2008) analyze an educational environment of Asia with specific perspective of Indo-Pak sub-continent while Welch (2011) focuses upon the educational planning and management of Southeast Asian countries which is a reason that they are called "Asian Tigers".

For highlighting British education policies, there is a work of Rao (1979), Aziz (1965), Marriott (2006), McCully (1966) and Jayapalan (2000). They emphasize on every point of each educational term. And also, they presented all the impacts of each educational term on the Indian society.

Similarly, Seth (2000), Pandey (2005) and Hunter (1871) describes charactristics of British educational system.

ESSAY

Education is played a vital role in development of any country on the modern lines. It gives specialization in a field that facilitate regarding covering up deficiencies in that field as well for the betterment. Similarly, state has special focus on higher and technical education, because it is the only source of generating skilled human resource (Leslie, 1988, P.186). If today, Southeast Asian countries are called Asian Tigers, then just because of concentration on promoting higher education among their folds (Welch, 2011, P.02).

Historically, Indo-Pak subcontinent was very weak in getting professional, technical or higher education, especially Muslims of this region. Although Indus civilization and Aryans were technical minded of that time, but in recent history, before British arrival, Muslims almost had said good bye to higher and technical education. They had adopted a trend of getting enrollment in orthodox religious schools, while Hindus continued their interest towards getting higher or technical education (Riddick, 2006, PP.117-118). In result, after War of Independence 1857, Hindus at one side, had gotten government jobs, and at second side, had also gotten favor of British government regarding their innocence. At that time, Muslims were not able to show their soft image in front of British government just because of educational lack (Riddick, 2006, P.181).

HISTORICAL BACKGROUND FROM 1813 TO 1947

Although British Educational System for South Asia[1] (1813-1947) can be divided into 7 terms, but it was designed for the time being needs. Now we have to discuss all these 7 terms regarding higher education policy for South Asia by the British government.

1ST TERM (1813-1835)

This term was called Charter Act of 1813. This is presented by Charles Grant, who is the founder of British Educational Policy in South Asia. His personal efforts and political links facilitated him to present this bill into British Parliament, and with the effort of 20 years almost, he got success regarding passing this bill from British parliament in 1813. Therefore he is called "forefather of modern education in India" (Rao, 1979, P.91)(Pandey, 2005, P.23)(Aziz, 1965, P.49)(Marriot, 2006, P.24).

Charles Grant was actually an employee in East India Company, and enacts corruption a lot. After this, he left the company and became Christian Preacher. In 1970, he returned back in U.K and opposed the government policy regarding restriction on Christianity promotion in India. In fact, at that time, this was a general opinion in U.K that America got independence from U.K due to free education, and this mistake must not repeat in India. But Charles Grant had a different opinion. He argued that India is ready to become Christian, and we can convert it through education. When they will become Christian, they will accept the authority of their religious fellows' rulers (Rao, 1979, P.92)(Aziz, 1965, P.49)(Marriot, 2006, P.24).

His resolution was to promote English language in India, but should not assign any governmental post to any local person. Such posts must be allocated just for Britishers (Aziz, 1965, P.49)(Marriot, 2006, P.24).

[1] *At that time, the term "South Asia" was used to the contemporary regions of Bangladesh, Bhutan, Burma, India and Pakistan.*

Through this act, Christian preachers had been acknowledged to open religious schools in India. Therefore, Charles Grant is called the forefather of modern education in India (Rao, 1979, P.93).

The basic characteristics of this act were as follows:

1. East India Company will utilize an amount of grant in Central Asia for promotion of British Education and literature (Pandey, 2005, P25) (Jayapalan, 2000, P49) (Aziz, 1965, P.49)(Marriot, 2006, P.24).
2. Educated persons will be appreciated and awarded by honorable status (Pandey, 2005, P25)(Jayapalan, 2000, P.49)(Aziz, 1965, P.49)(Marriot, 2006, P.24).
3. Scientific education will be introduced in British occupied India (Pandey, 2005, P25)(Jayapalan, 2000, P.49) (Aziz, 1965, P.49)(Marriot, 2006, P.24).
4. Calcutta Sanskrit College was established in 1824. Raja Raam Mohan Raye opposed this step with argument that India has just a need of scientific education (Pandey, 2005, P25)(Jayapalan, 2000, P.50) (Aziz, 1965, P.50)(Marriot, 2006, P.24).
5. Delhi College was entrenched in Delhi in 1824 with the help of grant, allocated by the minister of Oudh State, Etamad-ud-Dolah. All types of education in Urdu language, was introduced in this college at each level (Jayapalan, 2000, P.50)(Pandey, 2005, P25) (Aziz, 1965, P.50)(Marriot, 2006, P.25).
6. Allocated amount for promotion of education was enhanced from 100,000 to 1,000,000 rupees through the Charter Act of 1833 (Pandey, 2005, P25)(Jayapalan, 2000, P.50) (Aziz, 1965, P.50)(Marriot, 2006, P.25).

First term of British Educational System in subcontinent left some nominated impacts on Indain society. There are as follows:

Social and Cultural Impacts

There policy was actually an encouragemnt of old languages. Its basic objective was to restore loyality of domestic people in favor of Britishers as well as to come close with the Hindus. Socially and culturally, this plan was become popular and got favor of Hindus majority (Pandey, 2005, P26).

Economic Impacts

British government did not use the grant of 100,000 rupees till 1823 even this was so little for huge territory of India regarding educational purposes. Therefore, this charter was not proved useful (Pandey, 2005, P26).

Legal and Political Impacts

In 1828, when William Beetning came in India as Governor General, he closed endowments of Muslims by force. This act became a reason of huge lost for Muslims education and Britishers-Muslims rivalry became more intensified (Pandey, 2005, PP28-29).

Institutional Impacts

This charter was an initial step for the educational reforms in India. And, this charter showed the way for further developments in British Educational System in India (Pandey, 2005, P30).

2ND TERM (1835-1854)

2nd term of British Educational System in India was highlighted with the name of Lord Macaulay, who was columnist in British news papers. This field facilitated him to become a member of General Committee of Public Instruction, and he appointed in Calcutta in 1834 as a president of this committee. Now he had controlled Indian laws and educational system (Pandey, 2005, P31)(McCully, 1966, P.113).

Lord Macaulay called a meeting in 1834 regarding deciding the way of education, either in English language or in local languages, but committee could not take any decision. Lord Macaulay saved his opinion on a paper and then, in a meeting with Governor General Benting in February 2, 1835, he emphasized on British style of education in all over the India rather than the domestic ways (McCully, 1966, P.115). He also suggested closing of the Calcutta Madrassah and Calcutta Sanskrit College. This suggestion was spread in all over the India that Britishers are going to close Muslims and Hindus schools and Madrassas. A massive protest of Muslims and Hindus forced British government not to do this, But Governor General approved the suggestions of Lord Macaulay, and on March 7th, 1835, these suggestions were implemented in all over the British occupied India through an official announcement (McCully, 1966, P.116) (Pandey, 2005, P31).

These suggestions had winded up all the doors for domestic educational system. The basic characteristics of Lord Macaulay's suggested educational system are as follows:

1. He suggested medium of education was in English language, with arguing that Arabic or Sanskrit are not able to get popularity as well as these languages have not an international reputation regarding translation other books into these languages (Aziz, 1965, P.52)(Marriot, 2006, P.26)(Pandey, 2005, P32)(Jayapalan, 2000, P.51).
2. Lord Macaulay does not want to promote British education, but want to get local employees with British favor. He said, "We will have an effort to generate a group, who will be natively an Indian, but its thinking and living style will be British" (Aziz, 1965, P.52) (Marriot, 2006, P.26) (Pandey, 2005, P32)(Jayapalan, 2000, P.51).
3. In 1836, Hugli College Calcutta and Medical College Calcutta established (Aziz, 1965, P.52)(Marriot, 2006, P.26) (Pandey, 2005, P32)(Jayapalan, 2000, P.52).
4. According to new educational policy, government started to open new schools. In 1835, it crossed the number of 35. Then, government decided to open new schools at district level. Through this policy, in 1840, the number of schools crossed up to 40. These schools became so popular that people wanted to enroll their children in these schools even their fees was so high (Aziz, 1965, P.52) (Marriot, 2006, P.26) (Pandey, 2005, P32) (Jayapalan, 2000, P.52).
5. Due to popularity of English Schools, Christian preachers also forced to open the schools on British style of education. In 1853, the number of such schools was crossed from 22 just in Bengal province (Aziz, 1965, P.53) (Marriot, 2006, P.27) (Pandey, 2005, P32)(Jayapalan, 2000, P.53).
6. In 1841, Council of Education was established (Aziz, 1965, P.53)(Marriot, 2006, P.27) (Pandey, 2005, P32)(Jayapalan, 2000, P.53).
7. In 1844, Hindu College Calcutta started engineering classes, and in 1847, Engineering College was established in Rid (Aziz, 1965, P.53)(Marriot, 2006, P.27) (Pandey, 2005, P32)(Jayapalan, 2000, P.53).
8. In 1844, Lord Harding announced that educated people from English schools will be preferred for the government jobs. This announcement increased the demand of British education (Aziz, 1965, P.54)(Marriot, 2006, P.28) (Pandey, 2005, P32)(Jayapalan, 2000, P.53).

This term had also left some significant impacts on Indian society. These are as follows:

Social Impacts

In previous 20 years, thousands of Indians got education and it was quite impossible to give jobs to all of them. In fact, the basic objective of western education was to get job. Therefore, unemployment ratio was increased time to time and its became also a reason of 1857 war (Pandey, 2005, P34).

Economic Impact

This plan delivered realization that education is an actual source of getting job. And after this, western education got a superior status in India as Britishers (Pandey, 2005, P34).

Legal Impacts

British government offered scholarships for getting education but there was no any student. In fact, this quotation was become famous that:

پڑھو فارسی، بیچو تیل

"Read Persian language and sale the oil" means there is only a Persian language which make you able to earn something (Pandey, 2005, P35).

Religious Impacts

Although people were getting western education for the sake of job but Missionaries were trying to impose western culture and traditions through their religious education. And in result, there was a community, which was Indian by blood but western by thinking (Pandey, 2005, P35).

3RD TERM (1854-1884)

In 1853, East India Company presented its renewed charter in the British parliament, and Parliament approved it due to having an aim of controlling all over the India after Mughal rulers. On occasion of this approval, some participants spoke their ideas in parliament regarding socio-political system designing in India. Under the light of those ideas, Charles Wood designed a new Educational draft for India that is called "Wood's Dispatch" (Rao, 1979, P.95). Wood was also the president of East

Indain Company's Board of Control. His draft was forwarded to East Indian Company's board of directors in 1854, and this draft became a reason of educational changes in the British occupied India. Therefore, this draft is also called Magna Carta of Education (Pandey, 2005, P36) (Aziz, 1965, P.56)(Marriot, 2006, P.29) (Rao, 1979, P.96).

This draft also favors the ideas of Lord Macaulay, but diplomatic language is used in this draft regarding favoring and promoting western knowledge and literature. Fundamental aims of this draft were as follows:

1. Generate local employees for East India Company regarding free flow of resources from India to Britain (Pandey, 2005, P36) (Aziz, 1965, P.56)(Marriot, 2006, P.29) (Jayapalan, 2000, P.55).
2. Way of teaching was adopted in English language for secondary schools and colleges, while local languages were used till primary and middle classes (Pandey, 2005, P36) (Aziz, 1965, P.56)(Marriot, 2006, P.29) (Jayapalan, 2000, P.55).
3. Education department must be established in each province which will be administrated by Director of Public Instructions, who will be only answerable to the government. Inspectors will be appointed in the districts for help him who will visit schools and colleges. Directors and inspectors will be selected through civil service exam (Pandey, 2005, P37) (Aziz, 1965, P.57)(Marriot, 2006, P.29) (Jayapalan, 2000, P.56).
4. Universities will be established in Calcutta, Bombay and Madras same like University of London. Each university consisted of government representatives, chancellors, vice chancellors and several other boards of governing members. Universities will be allowed to deliver education in Sanskrit, Arabic and Persian. Universities were established in Calcutta, Madras and in Bombay in 1857, while University College was established in Lahore in 1869 and Punjab University was established in Lahore in 1878 (Pandey, 2005, P38) (Aziz, 1965, P.57)(Marriot, 2006, P.30) (Jayapalan, 2000, P.56).
5. Government will announce policies for promoting higher education for poor class people but the elite class will manage itself (Pandey, 2005, P38) (Aziz, 1965, P.57)(Marriot, 2006, P.30) (Jayapalan, 2000, P.57).
6. English schools will be established in each district, so that a common person can get status-full education. For this purpose, Government College was established in Lahore in 1864 (Pandey, 2005, P39) (Aziz, 1965, P.57)(Marriot, 2006, P.30) (Jayapalan, 2000, P.57).
7. Indian Schools will also be opened in parallel with English Schools, so that education can be delivered in domestic languages (Pandey, 2005, P40) (Aziz, 1965, P.58)(Marriot, 2006, P.31) (Jayapalan, 2000, P.57).
8. Already established schools or "Maktab" (Madrasas) will have funded by government for promoting primary education (Pandey, 2005, P40) (Aziz, 1965, P.58)(Marriot, 2006, P.31) (Jayapalan, 2000, P.58).
9. Scholarships will not be offered for the students who get education in Sanskrit or in Arabic language, but offer to the students of schools and colleges who get first position, so that they can continue their further education (Pandey, 2005, P40) (Aziz, 1965, P.58)(Marriot, 2006, P.31) (Jayapalan, 2000, P.58).
10. Institutes for teachers training will be established on the pattern of Britain teachers training institutes (Pandey, 2005, P41) (Aziz, 1965, P.58)(Marriot, 2006, P.31) (Jayapalan, 2000, P.58).
11. Private educational institutes will be funded by government if they will follow governmental policies (Pandey, 2005, P41) (Aziz, 1965, P.59)(Marriot, 2006, P.32) (Jayapalan, 2000, P.58).
12. Women education will be promoted (Pandey, 2005, P42) (Aziz, 1965, P.59)(Marriot, 2006, P.32) (Jayapalan, 2000, P.58).
13. Professional education will be promoted with the help of provincial governments (Pandey, 2005, P42) (Aziz, 1965, P.59)(Marriot, 2006, P.32) (Jayapalan, 2000, P.59).

Impacts of 3rd term were as follows:

Social Impacts

Before British arrival in India, Indians were worked at all the official posts but now, they were forced to get jobs of low rank. All the high posts were in control of Britishers. And for getting high posts, western education was must. This principle kept Indians far from high posts (Pandey, 2005, P43).

Similarly, it was said that there will be offered education of arts, science, philosophy and literature. But, there were just ordinary subjects in all over the classes till the higher education degrees which were not beneficial for the Indians regarding getting high official posts (Pandey, 2005, P43).

Economic Impacts

In 1868, British government impose one percent tax on agriculture land productivity. This tax was used for the British educational system. Board of Control was eliminated and post of Indian minister was established (Pandey, 2005, P44).

Religious Impacts

British government announced funding to private education institutions but the criteria was so typical that local institutes cannot get such funding. In fact, the basic objective of this funding was to facilitate Christian schools for preaching Christianity. But, after 1857, Britishers became conscious and now, they opened all the educational institutes with the name of government. But, the hidden objective was still the promotion of Christianity (Pandey, 2005, P44).

Legal Impacts

Department of Education was established in 1857, but instead of establishing schools and colleges, most of the revenue was utilized for appointments British officers as director and inspector and their expenditures (Pandey, 2005, P44).

Institutional Impacts

In 1857, on the model of London University, universities were established in Calcutta, Madras and Bombay. But these were just examination centers. An actual purpose was also to generate revenue from there. But in 3rd educational term, no new university was established in the India (Pandey, 2005, P45).

Cultural Impacts

At secondary level, English was declared as a way of getting education. At middle level, this announcement was in fact, a tactic of stopping Indians by force regarding getting education (Pandey, 2005, P45).

4TH TERM (1882-1904)

British government established a commission in 1882, which was headed by W.W.Hunter. Therefore, this commission was also called "Hunter Commission", which consisted of 20 members, in which two were Muslims and five were Hindus. Firstly, Sir Syed Amhed Khan and after him, his son, Dr.Syed Mehmood was its member. Second Muslim member was Haji Ghulam Hussain from Amritsar (McCully, 1966, P.118) (Aziz, 1965, P.61)(Marriot, 2006, P.32).

W.W.Hunter introduced some new approaches in the educational system of British India, which are given as follows;

1. Government schools will not provide education about any religion, but private schools are allowed to deliver religious education whatever they want to deliver (Pandey, 2005, P45)(Jayapalan, 2000, P.61) (Aziz, 1965, P.61)(Marriot, 2006, P.32).
2. School books publication rights were given to private publishers (Pandey, 2005, P46)(Jayapalan, 2000, P.61) (Aziz, 1965, P.61)(Marriot, 2006, P.32).
3. Government primary schools should be given under the control of local educational boards (Pandey, 2005, P47)(Jayapalan, 2000, P.61) (Aziz, 1965, P.61)(Marriot, 2006, P.32).
4. Government should promote primary education regarding overcome illiteracy rate (Pandey, 2005, P47)(Jayapalan, 2000, P.61) (Aziz, 1965, P.61)(Marriot, 2006, P.32).
5. Primary school teachers training courses must be held (Pandey, 2005, P47)(Jayapalan, 2000, P.62) (Aziz, 1965, P.62)(Marriot, 2006, P.32).
6. Secondary education will be delivering only in private schools but with the funding of government. Government will establish secondary schools just in the backward areas (Pandey, 2005, P48)(Jayapalan, 2000, P.62) (Aziz, 1965, P.62)(Marriot, 2006, P.33).
7. Government will support those "maktabs" (Madrasas) who will not gratify religious education (Pandey, 2005, P48)(Jayapalan, 2000, P.62) (Aziz, 1965, P.62)(Marriot, 2006, P.33).
8. Female educational institutes will be funded by government more fully, and there will be separate syllabus will be offering scholarships (Pandey, 2005, P49)(Jayapalan, 2000, P.63) (Aziz, 1965, P.62)(Marriot, 2006, P.33).
9. Colleges will be allowed to collect fee from students according to their needs, and there will not be flexibility in paying dues after a specific percentage (Pandey, 2005, P49)(Jayapalan, 2000, P.63) (Aziz, 1965, P.62)(Marriot, 2006, P.33).
10. Foreign degree holder teachers must be appointed (Pandey, 2005, P50)(Jayapalan, 2000, P.63) (Aziz, 1965, P.62)(Marriot, 2006, P.33).

11. The condition of being Britisher for the principal and head master had been ended in 1880 (Pandey, 2005, P50)(Jayapalan, 2000, P.63) (Aziz, 1965, P.64)(Marriot, 2006, P.34).
12. In 1886, on advice of Public service commission, Indian Education Service had been established (Pandey, 2005, P50)(Jayapalan, 2000, P.63) (Aziz, 1965, P.64)(Marriot, 2006, P.34).
13. Ala Abad University had been established in 1887 (Pandey, 2005, P50)(Jayapalan, 2000, P.63) (Aziz, 1965, P.64)(Marriot, 2006, P.34).
14. Hindu College had been established in Banaras in 1889 (Pandey, 2005, P50)(Jayapalan, 2000, P.63) (Aziz, 1965, P.64)(Marriot, 2006, P.34).
15. In 1901, Lord Curzen delivered roots to the First All India Educational Conference in Shimla (Pandey, 2005, P50)(Jayapalan, 2000, P.63) (Aziz, 1965, P.64)(Marriot, 2006, P.34).
16. The post of Director General of Education had been introduced this year for whole British India (Pandey, 2005, P50)(Jayapalan, 2000, P.63) (Aziz, 1965, P.64)(Marriot, 2006, P.34).
17. Indian Universities Commission presented its first report in 1902, and these were published in a shape of bill in 1903 (Pandey, 2005, P51)(Jayapalan, 2000, P.64) (Aziz, 1965, P.64)(Marriot, 2006, P.35).

Impacts of 4th term were as follows:

Social Impacts

Commission for 4th term suggested separate schools for girls with separate curriculum. Commission also announced scholarships for the female students and appointment of women inspectors (Pandey, 2005, P53).

Religious Impacts

Hunter commission decided to stop religious education in the government institutions. But, it conceded private institutes that if they want, then hey can deliver it (Pandey, 2005, P53).

Institutional Impacts

In 1887, Allahabad University was ingrained and the post of Director General of Education was established for the whole India (Pandey, 2005, PP.53-54).

5TH TERM (1904-1919)

British Indian 5th educational system was from resolution of 1904 to till 1919 (Rao, 1979, P.99). According to educational policy of 1904, such steps were taken by the government;

1. Resolution of 1904 forced to introduce technical education but this cannot be implemented (Aziz, 1965, P.66)(Marriot, 2006, P.35) (Pandey, 2005, P52)(Jayapalan, 2000, P.65).
2. Proficiency in mother language will be based of getting education in English language (Aziz, 1965, P.66)(Marriot, 2006, P.35) (Pandey, 2005, P52)(Jayapalan, 2000, P.65).
3. Education in English language will be started from the age 13 at least, and mother language will have a status of compulsory subject (Aziz, 1965, P.66)(Marriot, 2006, P.35) (Pandey, 2005, P50)(Jayapalan, 2000, P.65).
4. National council of education was established in 1905 for educational planning (Aziz, 1965, P.66)(Marriot, 2006, P.35) (Pandey, 2005, P53)(Jayapalan, 2000, P.65).
5. Before 1909, education department was a part of interior ministry. In 1909, it was shifted towards department of land and health, and post of director general of education was demolished (Aziz, 1965, P.66)(Marriot, 2006, P.35) (Pandey, 2005, P54)(Jayapalan, 2000, P.66).
6. 9,000,000 was allocated for education in 1911, and on an event of Delhi Darbar on December 12, 1911, 5,000,000 were allocated permanently for each year (Aziz, 1965, P.67)(Marriot, 2006, P.35) (Pandey, 2005, P54)(Jayapalan, 2000, P.66).
7. Resolution of 1913 forced for check the student's abilities through exams, but exams should not be only the reason of promotion in the next class (Aziz, 1965, P.67)(Marriot, 2006, P.36) (Pandey, 2005, P55)(Jayapalan, 2000, P.67).
8. Banaras University was established in 1915, while Women University was established in Patna in 1916, and Rangoon university was established in 1917 (Aziz, 1965, P.67)(Marriot, 2006, P.36) (Pandey, 2005, P55)(Jayapalan, 2000, P.67).

Impacts of 5th term were as follows:

Social Impacts

Due to huge demand from Indian, it was decided to deliver education in the mother language instead of English. For study English Language, at least student must be up to the age of 13 years old. Mother language will be introduced as a compulsory subject. But, in the Punjab, Urdu language was not included as a compulsory subject (Pandey, 2005, P56).

Economic Impacts

In 1911, 9,000,000 rupees were given to the India regarding educational development. And, in December 12, 1911, 5,000,000 rupees were fixed permanently for each year regarding educational development in India during Delhi Darbar (Pandey, 2005, P57).

Institutional Impacts

Banaras University was established in 1915. Patna University was established in 1916 and Rangoon University was established in 1917. Similarly in 1905, National Council of Education was established for national educational planning (Pandey, 2005, P57).

6TH TERM (1919-1929)

British government appointed a commission under the supervision of Dr. M.E Sadler in 1917 for the development of Calcutta University. Commission presented its report on 1919. In these two years, commission visited all the universities of the British India; therefore, some of the suggestions were very beneficial for all the universities (Pandey, 2005, P58)(McCully, 1966, P.120).

Suggestions, which were given by Sadler commission, are as follows;

1. There should be an educational board, which conduct the examinations for high schools and intermediate colleges (Pandey, 2005, P59) (Aziz, 1965, P.69)(Marriot, 2006, P.38) (Jayapalan, 2000, P.70).
2. Central advisory board for education was established in 1921 for getting opinions of educationists (Pandey, 2005, P60) (Aziz, 1965, P.69)(Marriot, 2006, P.38) (Jayapalan, 2000, P.70).
3. In 1923, municipalities were authorized to impose educational tax, and primary education was fixed from 6 to 12 years as compulsory education (Pandey, 2005, P61) (Aziz, 1965, P.69)(Marriot, 2006, P.38) (Jayapalan, 2000, P.70).
4. Sadler commission suggested to start B.S honor degrees in the universities, along with de-politicization if university affairs. Lacknow University was established in 1920, Nagpur University was established in 1922, Delhi University was established in 1922, and Inter University was established in 1925 (Pandey, 2005, P61) (Aziz, 1965, P.69)(Marriot, 2006, P.38) (Jayapalan, 2000, PP.70-71).

Impacts of 6th term were as follows:

Social Impacts

In 1919, Movement of Civil disobedience was started against the British government regarding Montague Chelmsford Reforms. In result, several local schools and universities were gone to be established by the intellectual Indians (Pandey, 2005, P62).

Economic Impacts

Municipal Committee was authorized regarding imposing educational taxes within their municipalities. In each municipality, primary education was compulsory declared (Pandey, 2005, P63).

Institutional Impacts

Central Advisory Board of Education was established in 1921 for educational development. Lucknow University was established in 1920. Nagpur University and Delhi University were established in 1922 (Pandey, 2005, P63).

7TH TERM (1929-1947)

British government send a commission, consisted of 7 British members, under the leadership of Sir John Simon in 1927. This commission established another sub-committee under the presidency of Philip Hartog. This sub-committee submitted its report in 1929 (Pandey, 2005, P64)(Rao, 1979, P103). Suggestions, which were given in this report, are as follows;

1. Committee putted blame on universities regarding issuing cheap and easy degrees. This committee suggested enhancing educational standard in the universities, along with establishing a central library (Pandey, 2005, P65)(Jayapalan, 2000, P.73) (Aziz, 1965, P.71)(Marriot, 2006, P.40).
2. Committee opposed separate examination system for common and technical subjects (Pandey, 2005, P65)(Jayapalan, 2000, P.73) (Aziz, 1965, P.71)(Marriot, 2006, P.40).
3. Method for teachers' appointment should be restricted more for enhancing standard of education (Pandey, 2005, P65)(Jayapalan, 2000, P.74) (Aziz, 1965, P.71)(Marriot, 2006, P.40).
4. Committee projected women education. It suggested co-education during primary education, while suggested separate syllabus for women's in further classes (Pandey, 2005, P66)(Jayapalan, 2000, P.74) (Aziz, 1965, P.71)(Marriot, 2006, P.40).
5. Committee suggested starting religious and Urdu education in government schools, so that Muslims leave to establish their separate schools (Pandey, 2005, P67)(Jayapalan, 2000, P.74) (Aziz, 1965, P.71)(Marriot, 2006, P.40).
6. During Second World War, Britain government started new plans for re-development. In 1944, British government presented Education Act in the parliament which was passed. War was ended in 1945, and implementation of Education Act had been started (Pandey, 2005, P68)(Jayapalan, 2000, P.75) (Aziz, 1965, P.72)(Marriot, 2006, P.40).
7. Provincial autonomy had been applied according to Indian Act of 1935, through which Education Minister had gotten so much powers (Pandey, 2005, P68)(Jayapalan, 2000, P.75) (Aziz, 1965, P.72)(Marriot, 2006, P.41).
8. All Indian Council for Technical Education established in 1945, and separate education department had been established in the central government same year (Pandey, 2005, P68)(Jayapalan, 2000, P.76) (Aziz, 1965, P.72)(Marriot, 2006, P.41).

This was the last term, announced by the British government. Impacts of 7th term were as follows:

Social Impacts

There was strictly focus upon the women education with separate syllabus at secondary level for male and female students (Pandey, 2005, P69).

Religious Impacts

Government accepted the demand of Muslims and offered religious education in government institutions for Muslims (Pandey, 2005, P69).

Legal Impacts

The training of teachers was declared as must. This was due to the betterment of educational structure (Pandey, 2005, P69).

Characteristics of British Educational System

Evolution of education in British India has certain characteristics which are showed during observing these seven terms.

1. British educational system became a cause of destroying domestic educational system. W.W.Hunter wrote in his book "Indian Mussalmans" that when Britishers took charge of Bengal, then 1/4th of income was specified for an education (Hunter, 1871, P.17). Such specified amount was used in running the affairs of several religious schools. Every school had its own administrator and several other teachers. There was free residential and mass facility. So a big part of Muslim population was getting education through this system. Britishers firstly attacked on this educational system through capturing it, and made a law for getting control over them in 1820. This procedure was continued till 18 years which resulted closing of almost all the Muslims educational Institutions (Pandey, 2005, P70)(Hunter, 1871, PP.18-19).
2. The radical aim of British educational system was to preach Christianity. Firstly, they try to change Hindu Elite class, and secondly, they opened primary schools for this purpose (Pandey, 2005, P71)(Seth, 2007, P.02).

3. Britishers wanted to promote their culture. So they designed such educational system which could be helpful regarding promoting British culture in India. Lord Mechalay said that they want to generate such group which even belongs to India by soul, but their thinking will be Britain (Pandey, 2005, P71)(Seth, 2007, P.03).
4. British government preferred to promote education in Hindus rather than Muslims which resulted ended relationship of Muslims with the schools. W.W.Hunter said that all schools were consisted of British and Hindu teachers while way of education was in Deonagri, Bengali and English language. Arabic, Persian and Urdu were absent here. Muslims were not allowed regarding getting holidays on their religious days while Hindus have all holidays on their religious occasions. Books which were taught in schools were consisted of lessons against Islam and Prophet Muhammad S.A.W (Pandey, 2005, PP.71-72)(Hunter, 1871, PP.35-36).
5. British government established universities in Hindu majority areas for getting Hindus favor regarding long term aiming of stay in India (Pandey, 2005, P72)(Seth, 2007, P.04).

Socio-Political Impacts of British Indian Educational System on Pakistani Society

It is clear that historians belong from Pakistan are usually write against the British Educational System in Indo-Pak subcontinent but this is also a reality that this system delivered awareness about modern culture, education and civilization to the people of this region. Here, we have to analysis all those points, on which bases, historian criticized British Indian educational system but in fact, their consequences on Pakistani society are being enjoyed till now.

1. It is claimed that British educational system in India was an indirect effort of promoting Christianity in the subcontinent. Of course there were several efforts regarding this but as a rational thinker, we can observe the relationship of religion with other social subjects of society in the west. And, if people of subcontinent follow this trend, they can find a way in between religion and modernity that can become a cause of development. So, Sir Syed and his followers observe this and tried to promote this trend in this region. Its result was an increasing number of Muslim populations who got modern education and established a separate Muslim political party called All India Muslim League in 1906 from the platform of All India Muhammadan Educational Conference. This new party was provided an educated leadership to the Muslims of Subcontinent that led the Pakistan movement. Similarly, after the formation of Pakistan, this mindset is contributing as a bridge among religious norms followed in Pakistan and western modernity. On the other hand, a mindset who oppose this relationship is still become a threat for socio-political stability of Pakistan since 1947 in the shape of different religious and traditional groups and parties (singh, 2007, PP.83-97)(Allender, 2006, PP.23-29).
2. British educational system contained economics, politics and history as the essential subjects. Several historians criticized that the fundamental aim of British government was to promote western capitalist system, history with the favor of British occupations and politics with criticizing Islamic as well as previous domestic governing system. But, rational intellectuals perceived all this with focusing upon their own mistakes in these fields which became the reasons of British occupation in this region. So, they also promoted these subjects along with religious education in their educational institutions and Madrassas. Sir Syed and his followers were at forefront for this effort. Such efforts realized Muslims of subcontinent about their own identity and interests and they firstly established a political party in 1906 and secondly, formed a separated homeland in 1947. Since 1947 to till now, Islamic economics and Islamic economic system is an essential part of the syllabus. Similarly, Muslims history in the fields of science, technology, literature and philosophy has been added in all most all the subjects. Similarly, Islamic governing system and governance during pious caliphs, Ottoman Empire, Delhi Sultanates, Lodhi Dynasty and Mughals have been taught at all the levels approximately. Students can easily analyze that what were the faults and problems which became the reason of falling Muslim rule and British occupation, and how these faults and problems can be countered and overcome in the future from avoiding such damages, experienced in the past (singh, 2007, PP.83-97)(Allender, 2006, PP.23-29).
3. The concept of nationalism was promoted in subcontinent just due to British Educational system. Democracy and the concept of nationalism had been evolved in United Kingdom since hudred of years. So, when students of British colonial areas got such education which was preaching a knowledge of democracy and nationalism. They demanded such patterns in their regions and started movements for availing such rights. That's the result, soon, British government had been forced to leave their colonial regions and delivered them independence. Pakistan and India got independence also through such wave of realization which had been emerged in this region due to British educational system (singh, 2007, PP.83-97)(Allender, 2006, PP.23-29).

Although, British government established several universities but these were established in Hindu majority areas. Similarly, educational system was becoming a reason of promoting Christianity and western culture that was not accepted by

hardliner and conservative Muslims. In result, some Muslim leaders had been forced to start educational movements. Aligarh and Deoband movements were its example. To see the popularity of these movements, British Government accepted the demand of religious education in government schools for Muslims but this was not sufficient. The level of Muslims deprivation had been increases now and their demands had converted into the one demand of a separate country for Muslims. So, every Indian Muslim was now waving a slogan of Pakistan and the students of Aligarh and Deoband were at frontline for availing this cause. This was the reason that Prime Minister of Pakistan Muhammad Ali Bogra said in 1954 that:

"We won the war of Pakistan with the help of Aligarh students."

REFERENCES

[1] Allender, T. (2006). Ruling Through Education: The Politics of Schooling in the Colonial Punjab. New Delhi: New Dawn Press Group.
[2] Aziz, Muhammad Abdul,. (1965). The Educational Pyramid Re-inverted. New York: United Publishers.
[3] Hunter, S. W. (1871). The Indian Musalmans: are they bound in conscience to rebel against the queen? Culcatta: Culcatta Englishman.
[4] Iraqi, S. (2008). Sir Syed Ahmad Khan: Vision and Mission. Aligarh: Manohar Publishers & Distributors.
[5] Jayapalan, N. (2000). History Of Education In India. New Delhi: Atlantic Publishers.
[6] Jayapalan, N. (2000). Social and Cultural History of India Since 1556. New Delhi: Atlantic Publishers and Distributors.
[7] Leslie, L. L. (1988). The Economic Value of Higher Education. New York: American Council on Education.
[8] Marriott, John. (2006). Britain in India 1765-1905: Education and Colonial Knowledge. London: Pickering and Chatto.
[9] McCully, B. T. (1966). English education and the origins of Indian nationalism. New York: P. Smith Publishers.
[10] Panday, Ram Shakal. (2005). Indian Educational System. New Delhi: Adhyayan Publishers and Distributors.
[11] Rao, Y. V. (1979). Education and Learning in Andhra Under the East India Company. New Delhi: N. Vidyaranya Swamy Publishers.
[12] Riddick, J. F. (2006). The History of British India: A Chronology. Westport: Preager Publishers.
[13] Seth, S. (2007). Subject Lessons: The Western Education of Colonial India. New York: Duke University press.
[14] singh, Y. K. (2007). History of Indian Education System. New Delhi: APH Publishing Corporation.
[15] Welch, A. (2011). Higher Education in Southeast Asia. New York: Routledge.

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Save breast-milk from pollution

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ABSTRACT: Human milk is the most natural and superior food for infants, providing a range of benefits for growth, immunity and development a significant decreasing risk for several acute and chronic diseases. However, breast milk is not pure. Pollutants have been intentionally or inadvertently produced and introduced into the environment. Due to long half-lives and fat solubility, chemicals tend to bio accumulate in long-lived species at the top of the food-chain, including in human milk. Through breastfeeding, a mother may transfer potentially toxic chemicals to the suckling infant, exercising systemic and harmful effects on the health of children. Although scientific evidence indicates that the advantages of breast-feeding outweigh any risks from contaminants, it is important to identify communities with major sources of human exposure, limit the presence of pollutants in the food supply and modify their critical short-and long-term action in children. Furthermore, by controlling the use of these toxic products safe breastfeeding could be ensured and encouraged. This review summarizes what is known about the relationship between environmental pollutants and contamination of human milk.

KEYWORDS: breast-milk; pollutants; newborns; environmental exposure.

1 INTRODUCTION

Breastfeeding has been recognized and promoted by public health officials as the most beneficial source of nourishment, growth, and development during infancy [1] providing a significant decreasing risk for several acute and chronic diseases (e.g., atopy, autoimmunity, infections, obesity, cardiovascular disease, and neoplasia) [1,2]. Because of its well-known health effects, early encouragement of breastfeeding has been promoted. Exclusive breastfeeding for six months is the recommended feeding mode for the vast majority of infants, followed by continued breastfeeding with appropriate complementary foods for up to 2 years or beyond [1].

However, in women in industrially established, as well as developing nations, human breast-milk is not pure. Based on available evidence, several studies have been conducted, with improved analytic methods, to evaluate pollution residues in human milk [3]. Moreover, breast milk reflects quantities of chemical residues well, and relatively large volumes can be non-invasively collected.

However, literature data are still controversial. Although adverse effects have been documented as being associated solely with consumption of human milk containing background levels of environmental chemicals, none have been clinically or epidemiologically demonstrated. In addition, breast milk contains protective factors that counteract potential effects related to prenatal exposure to toxic compounds [4].

Moreover, during lactation, a mother can modify her diet to further reduce an infant's exposure to such chemicals, and ensure adequate intake of protective elements for newborn growth. Studies have reported that switching to formula milk is not recommended: formula may have higher chemical levels [5]. There is no evidence that formula feeding can attenuate any effects that may occur from foetal exposure [6]. A paper by Cinar et al. gives the false impression that milk is unsafe and that if the infant is not breastfed, chemical exposure will not occur [7]. Authors further reported that nursing is a potential source of exposure to toxic chemicals [e.g., polychlorinated biphenyls (PCBs), dichlorodiphenyltrichloroethane (DDT) and its metabolites, dioxins, polychlorinated dibenzofurans (PCDFs), polybrominated biphenyls (PBBs), polybrominated diphenylethers (PBDEs), and heavy metals], which are known to accumulate in the food chain [8].

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Since 1976 the World Health Organization, through its GEMS/Food Programme, has collected and evaluated information on levels of persistent organic pollutants in foods, including human milk [9]. Such information provides guidance on the need for measures to reduce levels of these substances in human milk, which is an ideal matrix to generally monitor levels of persistent organic pollutants in the environment. A woman previously exposed to toxics, during lactation eliminates pollution up to 10% of the amount stored in her body [10], and an exclusively breast-fed infant, for a period greater than 6 months, accumulates 3 to 5% of these chemicals in serum, as well as in fat tissue [11]. Although newborns have higher recuperative capacities than adults, infants are growing and tissue is differentiating, thus deleterious effects can occur at lower exposure to pollutants [12]. Additionally, breast-milk levels of these chemical compounds may be higher than blood levels as breast tissue does not eliminate solvents as quickly as blood does [13].

Due to the extreme variability of the aforementioned data, to date, a final conclusion has not been reached. This review summarizes what is known about the relationship between environmental pollutants and contamination of human milk.

2 FACTORS INFLUENCING CHEMICAL RESIDUES IN BREAST MILK

Environmental chemicals can be absorbed by several routes: ingestion, dermal contact and infected blood. During nursing, all these pathways are involved in pollutant diffusion. Lipid-soluble pollutants tend to degrade slowly and are preferentially stored in the mother's adipose tissue, including brain, liver, kidney, and mammary glands. Here, the high-fat content, through a biological pathway also known as biomagnification, favours long half-lives and bio-accumulation of chemicals in breast milk [14]. These phenomena increase potentially significant impacts on a child's health. A large number of studies have reported that pesticide residues are implicated in causing immunological, neurological, endocrine and carcinogenic effects [15]. Probably, marked children's exposure to pesticides may also be related to less developed detoxification pathways [16], a longer life expectancy that favours diseases with long latency periods [17], and a higher body surface to adults [18].

A survey found that infant's intake of some pesticides from breast milk greatly exceeds adult acceptable daily intake levels [19].

Levels of chemical residues in breast milk may be influenced by individual (e.g., maternal age, number of pregnancies), demographic (place of residence), and lifestyle features (smoking, diet, occupation, household chemical use), as well as lactation related factors (e.g., previous lactation, duration of breastfeeding, volume and fat content milk) [20,21]. During the first week post-partum, a higher permeability of the epithelium of breast milk alveolar cells has been noted. Thus, maternal pathways and transferred chemical molecules probably display higher activity levels during this period.

In addition to aforementioned maternal characteristics, chemical peculiarity must be also considered [22]. The degree of ionization determines transfers into milk. Non-polar compounds are easily transported and, due to lipophilic properties, can be retained in milk fat. Furthermore, a molecular weight less than 800 Dalton favours passive transport mediated by plasma proteins or erythrocytes [22].

In addition to lipid solubility, the pH of plasma and milk both play a crucial role. Higher breast milk levels of weak alkaline pollutants rather than weak acids are reported [23]. Other factors modulating the quantity of chemical pollutants in human-milk include degree of "water solubility" and related elimination rate. Pollutants with a slower elimination rate have a long half-life, allowing for more time in the body. The ability of blood and/or milk to bind toxic components is also relevant. Milk components pass from capillaries to alveolar epithelial cell of the breast. During this process, chemical molecules are incorporated into breast milk [23]. These biological mechanisms highlight how lactation is the primary ways excretion human body. Thus, during lactation, maternal chemical values progressively decrease in a process known as ''depuration''. The medium half-life of pollutants in breast milk has been estimated to be approximately 6 months after environmental exposure [23]. Conversely, other research has indicated that breast-milk pollutant levels were not substantially reduced after 6 months of nursing. It might reflect differences in sources, pathways of human exposure, and mode of nursing (continuous vs. intermittent; exclusive vs. mixed) [24].

3 EFFECTS OF POLLUTANTS ON CHILD DEVELOPMENT

Although mechanism remains unclear, pollutant effects can be deleterious and/or irreversible in a growing subject, promoting the onset of several disorders. In humans, organochlorine compounds have been associated with changes in cellular and humoral immunity [25], and particularly with changes in T-cell–mediated immune cytokines related to allergies, such as interleukin-4 [26].

Moreover, the correlation between levels of pollutants such as chlorinated pesticides in the placenta and mothers' milk,

and bleeding tendencies of their infants has been reported, suggesting an organochlorine-induced immunotoxicity in infants developmentally exposed to pollutant agents. Breast milk toxic molecule values were associated with prolonged prothrombin time, a significant decrease in lymphocytes and platelet count, decreased serum vitamin K levels added to depressed cytokine secretion, i.e., TNF-α and IL-10, inducing altered bleeding tendencies [27].

The immature brain of a child is vulnerable to environmental exposure. There is a suspected relationship between lactation exposure to toxic molecules and decrements in mental and psychomotor development diseases (e.g., autism, attention deficit and hyperactivity disorders, brain cancer) [28,29], resulting from oxidative stress, neuroinflammation, and mitochondrial dysfunction [30].

Chemicals found in the environment have several mechanisms through which they may interfere also with endocrine and reproductive systems [31].

Many toxic chemicals are disruptors of endocrine signalling with critical effects on reproduction, diabetes, cardiovascular disease, overweight, and [32] growth. Breast-milk pollutant levels have been negatively correlated with head circumference and weight for age at birth [33].

Intake of chemical substances can modify thyroid function by competitively inhibiting iodide uptake in infants [34]. Some authors have hypothesized that environmental toxins could alter the distribution and kinetics of iodide in a time-dependent mode [35].

Rogan et al. state that pollutants can modulate anogenital distance at birth, thyroid function, peripubertal growth and the onset of puberty in female children. Toxic substances interfere with hormonal processes through induction of enzymes that metabolizes endogenous estrogens and through antiandrogen-like activities [36]. It has been reported that environmental chemicals might also mimic estrogens and, by binding to their specific kinase pathways and G protein-coupled receptors, [37] alter puberty timing [38].

Accordingly, increased amounts of pollutants in breast milk appear to modify the function of serum transporters. Due to transfer to breast milk, these chemical molecules compete for binding to iron and manganese and inhibit calcium secretion. Both pathways seem to promote renal damage, such as tubular proteinuria. Moreover, it has been reported that pollutant concentration in breast milk was significantly correlated with urinary pollutant levels [39].

Finally, evidence also suggests that pollutants, through increased genotoxicity of other chemicals, are promoting a higher prevalence of testicular cancer, male reproductive disorders, and impaired development of the foetal testis [40].

Although further data are needed, there are sufficient epidemiological results to talk about causal relationships between environmental chemical contaminants, breast-feeding and adverse child health outcomes.

4 CONCLUSIONS

In the light of literature data, we wish to underline that chemical contamination of human breast-milk requires higher consideration. Contaminants are numerous and data have been collected on a limited number of them. Additionally, levels of toxic elements in breast milk can vary in different regions. An effective monitoring program would identify communities with major sources/pathways of human exposure.

Moreover, breast-milk, the main food source for many newborns, might play a further critical role in children's exposure to pollutants. Infants may exhibit peculiar susceptibilities to the toxic effects of chemical toxins as they are undergoing rapid tissue growth and development at the same time as they take human milk. Although exposure occurs early in life, it predisposes the younger population to a higher risk of diseases in later life. Further studies are needed to better understand the relationship between maternal exposure to harmful environmental chemicals, breast-feeding and short- and long-term effects in children. Moreover, by controlling the use of these toxic products safe breastfeeding could be ensured and encouraged without discouraging it. In fact, depriving nursing infants of human milk will not reduce *in utero* effects of these dangerous substances. Moreover, environmental pollutants also occur in formula milk. Given that breastfeeding reduces child mortality and has health benefits that extend into adulthood, every effort should be made to protect, promote and support breastfeeding.

However, it should also be borne in mind that environmental pollutants remain a public health concern and information on human exposure to toxic agents is essential to protect human health.

REFERENCES

[1] WHO. The International Code of Marketing of Breast-milk Substitutes. Frequently Asked Questions. Geneva, World Health Organization, 2006.

[2] M. Nathaniel Mead, "Contaminants in Human Milk Weighing the Risks against the Benefits of Breastfeeding", *Environmental Health Perspectives*, vol. 116, 2008.

[3] E.P. Laug, F.M. Kunze, C.S. Prickett, "Occurrence of DDT in human fat and milk", *A.M.A. archives of industrial hygiene and occupational medicine,* vol. 3, pp. 245–2466, 1951.

[4] N.M. Díaz-Gómez, S. Ares, M.T. Hernández-Aguilar, J.A. Ortega-García, J.M. Paricio-Talayero, L. Landa-Rivera, Comité de Lactancia Materna de la Asociación Española de Pediatría. "Chemical pollution and breast milk: Taking positions", *Archivos de pediatría,* vol. 79, p. 391*,* 2013.

[5] J. Choi, T. Tanaka, G. Koren, S. Ito, "Lead exposure during breastfeeding", *Canadian Family Physician*, vol. 54, pp. 515-516, 2008.

[6] J.G. Dórea, C.M. Donangelo, "Early (in uterus and infant) exposure to mercury and lead". *Clinical nutrition*, vol. 25, pp. 369–376, 2006.

[7] N. Cinar, S. Ozdemir, O. Yucel, F. Ucar, "In which regions is breastfeeding safer from the impact of toxic elements from the environment?" *Bosnian journal of basic medical sciences,* vol11, pp. 234-239, 2011.

[8] G.M. Solomon and P.M. Weiss, "Chemical contaminants in breast milk: time trends and regional variability", *Environmental Health Perspect,* vol. 110, pp. 339-347, 2002.

[9] The Global Environment Monitoring System/Food Contamination Monitoring and Assessment Programme (GEMS/Food) is now implemented by WHO in collaboration with its participating institutions located in over 120 countries around the world.

[10] K. Abraham, O. Päpke, A. Gross, O. Kordonouri, "Time course of PCDD/PCDF/PCB concentrations in breast-feeding mothers and their infants", *Chemosphere*, vol.37, pp.9-12, 1998.

[11] G.M. Lackmann, "Pränatale, transplazentare Übertragung von polychlorinierten Biphenylen und Hexachlorbenzol beim Menschen" Teil: Hintergründe und aktueller Stand der Forschung. *Umweltmedizin in Forschung und Praxis,* vol. 6, pp. 87-96, 2001.

[12] R.L. Brent, S. Tanski, M. Weitzman, "A pediatric perspective on the unique vulnerability and resilience of the embryo and the child to environmental toxicants: The importance of rigorous research concerning age and agent", *Pediatrics*, vol. 113, pp. 935-944, 2004.

[13] F.P. Labreche and M.S. Goldberg, "Exposure to organic solvents and breast cancer in women: a hypothesis", *American journal of industrial medicine*, vol. 32, pp. 1-14, 1997.

[14] F. Massart, J.C. Harrell, G. Federico, G. Saggese, "Human Breast Milk and Xenoestrogen Exposure: A Possible Impact on Human Health", *Journal of Perinatology,* vol. 25, pp. 282-288, 2005.

[15] V.F. Garry, "Pesticides and children", *Toxicology and applied pharmacology*, vol. 198, pp. 152-163, 2004.

[16] J.K.M. Chen, W. Chan, G. Berkowitz, J.G. Wetmur, "Increased influence of genetic variation on PON1 activity in neonates", *Environmental Health Perspect*, vol. 111, pp.1403-1410, 2003.

[17] M. Sanborn, D. Cole, K. Kerr, C. Vakil, L.H. Sanin, K. Bassil, *Systematic review of pesticide human health wffects*, Ontario College of Family Physicians, 2004.

[18] S.L. Makris and J.N. Rowe, "Implementation of the Food Quality Protection Act (FQPA) as it relates to enhanced sensitivity of children", *Teratology*, vol. 57, p. 246, 1998.

[19] P.M.Quinsey, D.C. Donohue, F.J. Cumming, J.T. Ahokas, "The importance of measured intake in assessing exposure of breastfed infants to organochlorines", *European Journal of Clinical Nutrition*, vol. 50, pp. 438-42, 1996.

[20] M. Cohen, "Environmental toxins and health--the health impact of pesticides", *Australian family physician,* vol.36, pp. 1002-1004, 2007.

[21] C.A. Harris, M.W. Woolridge, A.W. Hay, 2Factors affecting the transfer of organochlorine pesticide residues to breastmilk", *Chemosphere,* vol. 43: pp. 243-256, 2001.

[22] L.L. Needham and R.Y. Wang, "Analytic considerations for measuring environmental chemicals in breast milk", *Environmental Health Perspect*, vol. 110, pp. 317-324, 2002.

[23] J.U. Skaare, J.M. Tuveng, H.A. Sande, "Organochlorine pesticides and polychlorinated biphenyls in maternal adipose tissue, blood, milk, and cord blood from mothers and their infants living in Norway", *Archives of environmental contamination and toxicology,* vol 17, pp. 55-63, 1998.

[24] K. Hooper, J. She, M. Sharp, J. Chow, N. Jewell, R. Gephart, A. Holden, "Depuration of polybrominated diphenyl ethers (PBDEs) and polychlorinated biphenyls (PCBs) in breast milk from California first-time mothers (primiparae)", *Environmental Health Perspect*, vol. 115, pp. 1271-1275, 2007.

[25] G.S. Cooper, S.A. Martin, M. Longnecker, D.P. Sandler, D.R. Germolec, "Associations between plasma DDE levels and immunologic measures in African-American farmers in North Carolina", *Environmental Health Perspect,* vol.112, pp. 1080-1084, 2004.

[26] H. Bilrha, R. Roy, B. Moreau, M. Belles-Isles, É. Dewailly, P. Ayotte, "*In vitro* activation of cord serum mononuclear cells and cytokine production in a remote coastal population exposed to organochlorines and methyl mercury", *Environmental Health Perspect*, vol. 111, pp. 1952-1957, 2003.

[27] M.F. Schaalan, S.M. Abdelraouf, W.A. Mohamed, F.S. Hassanein, "Correlation between maternal milk and infant serum levels of chlorinated pesticides (CP) and the impact of elevated CP on bleeding tendency and immune status in some infants in Egypt", *Journal of immunotoxicology,* vol.9, pp. 15-24, 2012.

[28] M. Gascon, M.A. Verner, M. Guxens, J.O. Grimalt, J. Forns, J. Ibarluzea, N. Lertxundi, F. Ballester, S. Llop, S. Haddad, J. Sunyer, M. Vrijheid, "Evaluating the neurotoxic effects of lactational exposure to persistent organic pollutants (POPs) in Spanish children", *Neurotoxicology*, vol. 34, pp. 9-15, 2013.

[29] L. For-Wey, C. Tung-Liang, L. Shio-Jean and S. Bih-Ching, "Incinerator Pollution and Child Development in the Taiwan Birth Cohort Study", *International Journal of Environmental Research and Public Health*, vol. 10, pp. 2241-2257, 2013.

[30] M.R. Herbert, "Contributions of the environment and environmentally vulnerable physiology to autism spectrum disorders", *Current opinion in neurology,* vol. 23, pp. 103–310, 2010.

[31] American Academy Of Pediatrics, "Committee on drugs: the transfer of drugs and other chemicals into human milk" *Pediatrics*, vol. 108, pp. 776–789, 2001.

[32] S.L.Tilghman, E.N. Nierth-Simpson, R. Wallace, M.E. Burow, J.A McLachlan, "Environmental hormones: Multiple pathways for response may lead to multiple disease outcomes", *Steroids*, vol. 75, pp. 520–523, 2010.

[33] E. Örün, S.S. Yalçın, O. Aykut, G. Orhan, G.K. Morgil, K. Yurdakök, R. Uzun, "Breast milk lead and cadmium levels from suburban areas of Ankara", *The Science of the total environment*, vol. 409, pp. 2467-2472, 2011.

[34] L. Valentín-Blasini, B.C. Blount, S. Otero-Santos, Y. Cao, J.C. Bernbaum, W.J. Rogan, "Perchlorate exposure and dose estimates in infants", *Environmental Science & Technology,*vol.1, pp. 4127-4132, 2011.

[35] R.A. Clewell and J.M. Gearhart, "Pharmacokinetics of toxic chemicals in breast milk: use of PBPK models to predict infant exposure" *Environmental Health Perspect*, vol. 110, pp. 333-337, 2002.

[36] W.J. Rogan and N.B. Ragan, "Some evidence of effects of environmental chemicals on the endocrine system in children", *International journal of hygiene and environmental health",* vol. 210, pp. 659-667, 2007.

[37] S.L. Tilghman, E.N. Nierth-Simpson, R. Wallace, M.E Burow, J.A. McLachlan, "Environmental hormones: Multiple pathways for response may lead to multiple disease outcomes", *Steroids*, vol. 75, pp. 520-523, 2010.

[38] M.S. Golub, G. W, Collman, P.M. Foster, C.A. Kimmel, M.E. Rajpert-De, E.O. Reiter, R.M. Sharpe, N.E. Skakkebaek, J. Toppari, "Public health implications of altered puberty timing", *Pediatrics*, vol. 121, pp. 218-230, 2008.

[39] R. Honda, K. Tenji, M. Nishijo, H. Nakagawa, K. Tanebe, S. Sito, "Cadmium exposure and trace elements in human breast milk", *Toxicology,* vol. 186, pp. 255–259, 2003.

[40] K.M. Taylor, M. Weisskopf, J. Shine, "Human exposure to nitro musks and the evaluation of their potential toxicity: an overview", *Environmental Health*, vol. 13, p. 14, 2014.

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Tumeur séreuse borderline sur ovaires restants à propos d'un cas avec revue de la littérature

[Serous borderline tumor of ovary remaining a propos one case and review of the literature]

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ABSTRACT: The definition of borderline ovarian tumors is pathological. It is based on the combination of several histological criteria established by Hart and Norris and reviewed by Scully et al. : pluristratification and epithelial budding, increased mitotic activity which can be very variable, cytonuclear atypia (differential diagnosis with benign tumors), absence of stromal invasion (differential diagnosis of malignant tumors). Serous tumors represent approximately 55% of borderline tumors. They are bilateral in 28-50% of cases. This histological type is, however, more often associated with extra-ovarian locations, as found in 30% of cases on average peritoneal implants whose detection is fundamental because the class tumor stage III. These can be invasive or non-invasive, the prognostic value of invasiveness is controversial. Pre and intraoperative diagnosis of borderline ovarian tumors is difficult and requires a multidisciplinary approach, involving surgeons, pathologists, radiologists and medical oncologists trained as much as possible with this type of lesion border. Staging should be as complete as possible and should be as far as possible during the initial surgical resection. A restaging should be made when the initial staging is incomplete. Restaging does not affect patient survival but used to evaluate the prognosis of the initial tumor. Its indication still remains controversial: it is recommended for early-stage tumors, for which the treatment is now well codified. The authors discuss the issue of keeping the ovaries during hysterectomy for benign lesions throught the case of a patient of 50 years who benefited 9 years ago a subtotal hysterectomy for polymyomatous uterus and presented a bilateral serous tumor borderline on remaining ovary.

KEYWORDS: Hysterectomy, Adnexectomy, Conservation ovarian, Ovary remaining, ovarian cancer.

RESUME: La définition des tumeurs borderline de l'ovaire est anatomo-pathologique et repose sur l'association de plusieurs critères histologiques établis par Hart et Norris puis revus par Scully et al. : pluristratification et bourgeonnement épithélial, augmentation de l'activité mitotique pouvant être très variable, atypies cytonucléaires (diagnostic différentiel avec les tumeurs bénignes), absence d'invasion stromale (diagnostic différentiel des tumeurs malignes). Les tumeurs séreuses représentent approximativement 55 % des tumeurs borderline. Elles sont bilatérales dans 28 à 50 % des cas. Ce type histologique est toutefois plus souvent associé à des localisations extra-ovariennes, puisque l'on retrouve dans 30 % des cas en moyenne des implants péritonéaux dont la détection est fondamentale puisqu'elle classe la tumeur en stade III. Ceux-ci peuvent être invasifs ou non invasifs, la valeur pronostique de leur caractère invasif étant controversé. Le diagnostic pré et per-opératoire des tumeurs borderline de l'ovaire est difficile et implique une prise en charge multidisciplinaire, associant chirurgiens, anatomopathologistes, radiologues et oncologues médicaux formés autant que possible à ce type de lésion frontière. La stadification doit être la plus complète possible et doit se faire autant que possible au cours de la chirurgie initiale d'exérèse. Une restadification sera pratiquée lorsque la stadification initiale est incomplète. Cette restadification ne modifie pas la survie des patientes mais permet d'évaluer le pronostic de la tumeur initiale. Son indication reste encore

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aujourd'hui controversée : elle est recommandée pour des tumeurs de stade précoce, pour lesquelles le traitement est actuellement bien codifié. Les auteurs discutent sur la question de conserver les ovaires au cours des hystérectomies pour lésions bénignes en rapportant le cas d'une patiente de 50 ans ayant bénéficiée il y a 9 ans d'une hystérectomie subtotale interannexielle pour utérus polymyomateux et qui a présenté une tumeur séreuse borderline bilatérale sur ovaires restants.

MOTS-CLEFS: Hystérectomie, Annexectomie, Conservation ovarienne, Ovaire restant, Cancer de l'ovaire.

1 INTRODUCTION

La conservation ou ablation des ovaires est un sujet débattu depuis des années et aucun consensus n'existe pour l'instant sur ce sujet. La revue de la littérature montre des différences nettes chez les auteurs en fonction de leurs habitudes et de leur expérience. Les auteurs rapportent le cas d'une tumeur séreuse borderline bilatérale sur ovaires restants après une hystérectomie subtotale interannexielle.

2 OBSERVATION

Madame T.N. âgée de 50 ans, 5ème geste, 5ème pare ayant bénéficié il y a 9 ans d'une hystérectomie subtotale interannexielle pour ménométrorragies compliquées d'une anémie sévère sur utérus polymyomateux. Cette décision était prise compte tenu de l'âge de la patiente (41 ans à ce moment-là), et de l'aspect normal des ovaires lors de l'exploration pelvienne. L'étude anatomopathologique était revenue en faveur de léiomyomes utérin avec hyperplasie glandulaire complexe sans atypies de l'endomètre. La patiente consultait neuf années après sa chirurgie pour algies pelviennes chroniques. L'examen clinique retrouvait une patiente obèse ayant un indice de masse corporelle à 40 kg/m2. L'abdomen était souple sans masse palpable. Au spéculum, le col était d'aspect sain et l'examen des seins sans particularités. Le dernier frottis cervico-vaginale remontant à une année était normal. Une échographie pelvienne était réalisé objectivant la présence de deux processus lésionnels tissulaires, de contours irréguliers, vascularisés au doppler couleur, renfermant des micro calcifications, mesurant à gauche 65/50 mm et à droite 56/36 mm, d'origine ovarienne probable (figure 1). Il n'y avait pas épanchement pelvien. Un complément IRM était réaliser objectivant deux grosses masses tumorales latéro-pelviennes bilatérales mesurant à gauche 70/54mm et 60/50 mm à droite, évocatrices de tumeurs ovariennes, sans adénopathies iliaques ni épanchement pelvien (Figure 2). Un dosage des marqueurs tumoraux comportant β-HCG, αFP,CA-19-9 et CA-125 avait montrer un taux élevé à 4 fois la normale pour le CA125. Le dosage du reste des marqueurs tumoraux était normale. Devant cette forte probabilité de tumeur ovarienne, une fibroscopie gastrique était réalisé à la recherche d'un cancer gastrique dans le cadre du syndrome de Krukenberg. Cette dernière est revenue normale. Après une discussion collégiale, la décision était de réaliser une laparotomie exploratrice. A l'exploration, on notait la présence de quelques millilitres de liquide péritonéal séro-hématique qui était prélevé pour examen cytologique, avec deux volumineuses masses d'aspect « cérébroïde », irrégulières non encapsulées faisant 7/6 cm aux dépens des ovaires (figure 3). De plus, on notait la présence d'un petit nodule au niveau de l'épiploon de consistance dure. Il n'y avait pas de nodules péritonéaux, la surface hépatique était d'aspect normal ainsi que l'appendice. Le geste chirurgical avait consisté en une annexectomie bilatérale emportant les deux masses après ligature section des ligaments lombo-ovariens, d'une omentectomie infra colique et de biopsies péritonéales. L'examen anatomopathologique était revenu en faveur d'une tumeur séreuse borderline de l'ovaire (figure 4), l'omentectomie et la biopsie péritonéale était indemne d'élément tumoral. La cytologie péritonéale était de nature inflammatoire. Devant ce résultat et après un staff multidisciplinaire avec les oncologues la décision était de faire une surveillance radio-clinique régulière.

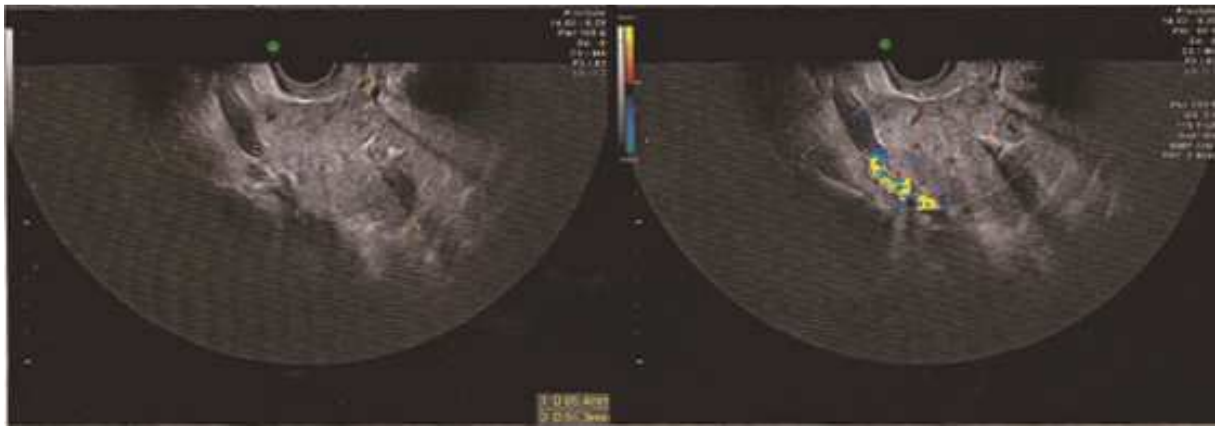


Figure 1 : Echographie pelvienne endovaginale : Coupe Longitudinale montrant la présence d'un processus lésionnel tissulaire, de contours irréguliers, vascularisés au doppler couleur, renfermant des micro calcifications**.**

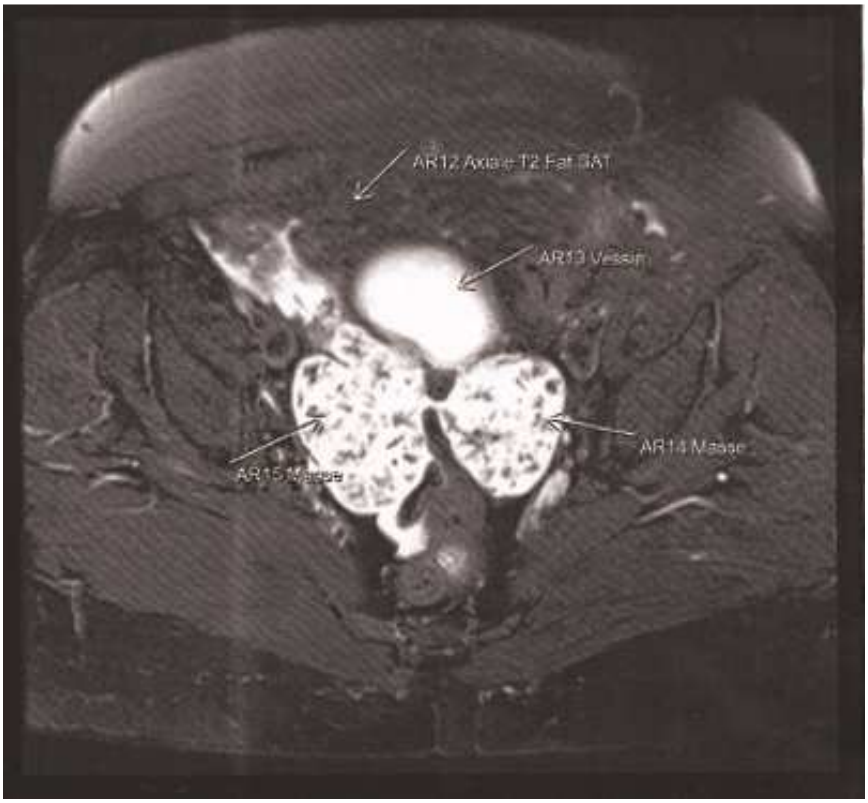


Figure 2 : IRM : Coupe axiale objectivant deux grosses masses tumorales latéro-pelviennes bilatérales évocatrices de tumeurs ovariennes, sans adénopathies iliaques ni épanchement pelvie



Figure 3 : Aspect macroscopique de la tumeur après sa résection

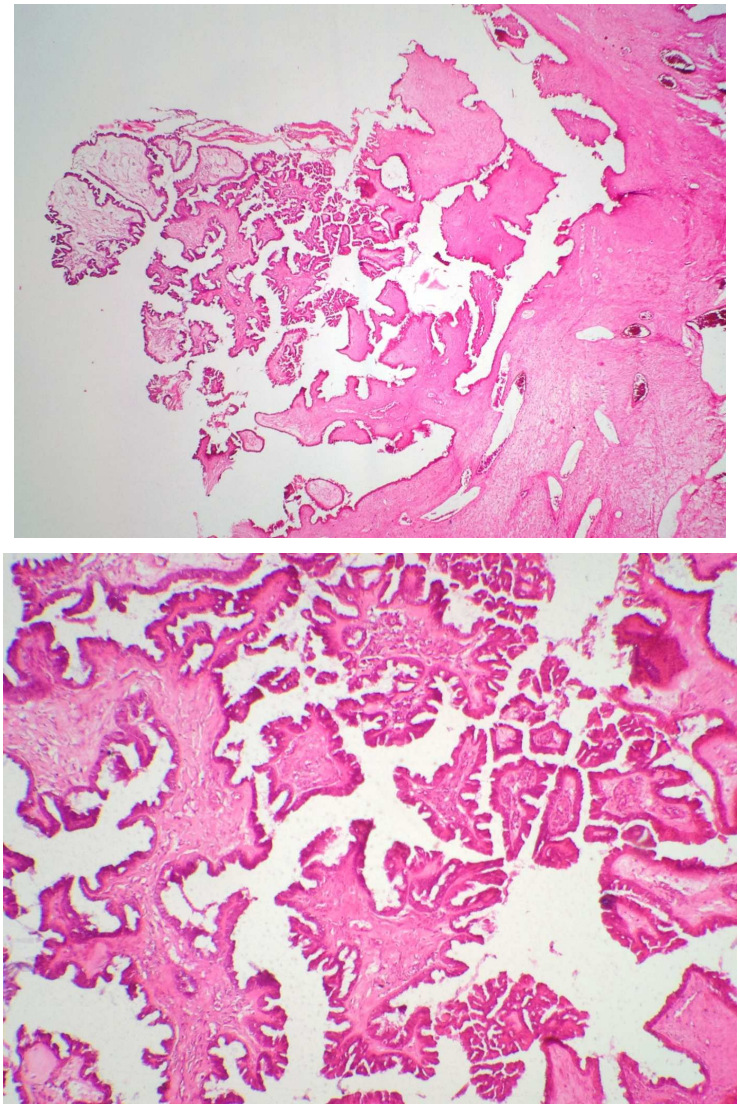


Figure 4 ,5: Prolifération tumorale d'architecture papillaire montrant des bourgeonnements épithéliaux de taille variable (HE, Gx40 & Gx100).

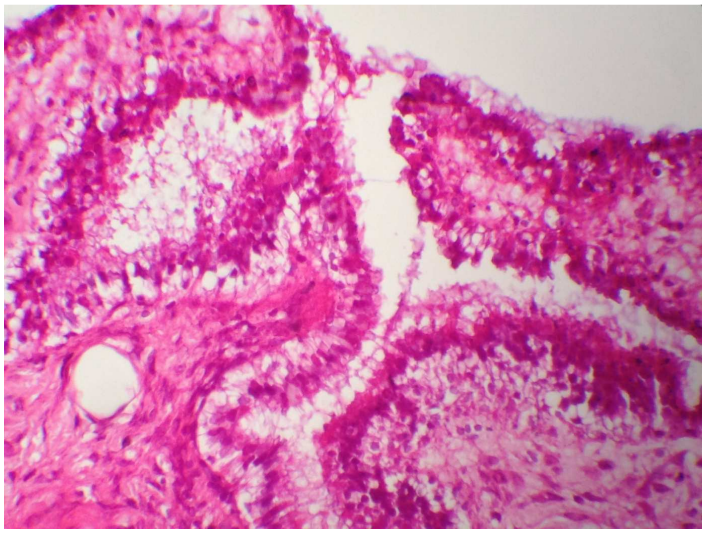


Figure 6 : Ces papilles sont tapissées d'un revêtement pluristratifié, pourvu d'atypies cyto-nucléaires légères. (HE, Gx400).

3 DISCUSSION

La question de « Devons-nous conserver les ovaires au cours des hystérectomies pour lésions bénignes ? » est un sujet qui est toujours débattu et pour lequel aucune attitude consensuelle ne peut être dégagée. Les habitudes varient en effet d'un pays à l'autre mais aussi d'un chirurgien à l'autre dans la mesure où s'opposent des arguments pour et contre l'annexectomie à titre systématique.

3.1 ARGUMENTS EN FAVEUR DE L'ANNEXECTOMIE

3.1.1 LE RISQUE DE CANCER DE L'OVAIRE

C'est sûrement l'argument le plus important. L'incidence est de 14/100000 (50/100000 dans la tranche d'âge 55 à 65 ans) [3]. C'est un cancer fréquent et grave car il est presque toujours diagnostiqué à un stade avancé (70 à 80 % de diagnostic au stade III) avec un taux global de survie qui n'excède pas 30 % à 5 ans [4]. Si certains facteurs de risque sont bien établis (âge élevé, race blanche, ménarche précoce, nulliparité, infertilité, ménopause tardive, antécédent de cancer du sein, antécédent familial de cancer de l'ovaire, le rôle protecteur qu'assure l'hystérectomie est lui moins connu (risque relatif × 0,5 à 0,7 pour l'hystérectomie) [4].Plusieurs mécanismes d'action ont étés avancés quant à cette protection [5], [6], [7]

- diminution de la vascularisation ovarienne après section de l'artère utérine entraînant une diminution du nombre d'ovulations ;
- arrêt de l'exposition ovarienne aux carcinogènes extérieurs ;
- visualisation des ovaires lors de l'hystérectomie et ablation de tout ovaire paraissant suspect.

La théorie vasculaire est celle qui est le plus fréquemment citée dans la littérature. Malgré cet effet protecteur, il est régulièrement observé des cancers de l'ovaire chez des femmes ayant préalablement bénéficié d'une hystérectomie. D'importantes études concernent le cancer sur ovaire restant : Celles qui étudient le devenir de femmes ayant subi une hystérectomie interannexielle pour pathologie bénigne montrent que 0,3 % à 2 % des patientes développeront un cancer de l'ovaire. On peut considérer que ce taux est faible et par conséquent n'incite pas à la réalisation systématique d'une annexectomie. Mais les travaux étudiant les antécédents chirurgicaux de femmes atteintes de cancer de l'ovaire montrent que 4 à 15 % d'entre elles ont bénéficié au préalable d'une hystérectomie pour lésion bénigne. On ne peut alors s'empêcher de penser qu'une attitude radicale aurait pu éviter la survenue du cancer et que le rôle protecteur de l'hystérectomie n'est que relatif. Ainsi pour Grundsell [8] et Schwartz [9] l'annexectomie permettrai d'éviter plus de 10 % des cancers ovariens.

L'étude la plus importante est celle réalisée par l'équipe de Anne Loft à Copenhague portant sur toute la population féminine du pays entre 1977 et 1981 [10]. Les femmes ont été séparées en deux groupes :

- celles ayant eu une hystérectomie pour lésion bénigne dans la période avec conservation d'au moins un ovaire (22 135 femmes) ;
- toutes les autres Danoises (2 554 872 femmes).

Dans le premier groupe 71 ont développé un cancer de l'ovaire (2,1 %, RR = 0,7). Dans le groupe témoin 10 659 cas ont étés observés (2,7 %). D'autre part, il est à noter que 2,4 % des femmes ayant bénéficié d'une hystérectomie ont du être réopérées de kyste ou de dystrophie ovarienne représentant ce qui est appelé le syndrome de l'ovaire restant. Cette étude à très grande échelle confirme les données des autres études publiées. Ces différentes études nous montrent que le risque relatif de développer un cancer de l'ovaire après hystérectomie multiplié par 0,7 et que cette protection est limitée dans le temps et disparaît au bout de 10 à 15 ans. En effet une étude multicentrique du Cancer and Stéroid Hormone Study réalisée en 1991 portant sur une cohorte importante de patientes âgées de 20 à 54 ans avait montré que la réduction du risque s'observait encore 10 ans après la chirurgie mais qu'elle disparaissait après 2 décades [7]. Pour la majorité des auteurs cette protection ne persiste pas plus de 10 ans. Il est de plus établi qu'enlever un seul ovaire ne diminue pas le risque relatif de développer un cancer ovarien. On note un antécédent d'hystérectomie chez 3,2 à 14 % des femmes présentant un cancer de l'ovaire. Comment expliquer ceci alors qu'il est prouvé que l'hystérectomie exerce un rôle protecteur ? Cela est lié à la fréquence de l'hystérectomie dans la population générale : 20 % des Européennes bénéficieront au cours de leur vie d'une hystérectomie pour lésion bénigne. Le fait que le taux d'hystérectomie soit légèrement inférieur chez les femmes atteintes de cancer de l'ovaire, tend à confirmer la relative protection qu'assure l'hystérectomie vis à vis de ce cancer.

3.1.2 LA PATHOLOGIE BÉNIGNE DE L'OVAIRE CONSERVÉ (SYNDROME DE L'OVAIRE RESTANT)

Elle est fréquente mais difficile à évaluer (3 % selon Christ) [11]. Dans 75 % des cas, Celle-ci se manifeste sous forme de dystrophies ovariennes et dans 25 % sous forme de kystes fonctionnels ou organiques [12]. Cette pathologie bénigne nécessite néanmoins une réintervention dans 2 à 8 % des cas avec son risque de morbidité voire de mortalité opératoire.

3.1.3 LES SÉCRÉTIONS HORMONALES DES OVAIRES SONT ALTÉRÉES APRÈS HYSTÉRECTOMIE

Funck Brentano avait dans son étude démontré que 21 % des femmes dont les ovaires avaient étés conservés présentaient des troubles climatériques et des ménopauses plus précoces [13]. Ceci a surtout été observé chez des femmes de plus de 40 ans. Les femmes plus jeunes auraient de meilleures chances de voir se pérenniser l'activité de leurs ovaires restants. De la même manière, Oldenhave avait, en 1993, réalisé une étude cas témoins chez des femmes ayant eu une hystérectomie entre 39 et 40 ans et avait montré que la ménopause survient en moyenne à 45 ans dans le groupe opéré contre 49 ans dans le groupe témoin [14].Ces données contredisent quelque peu l'étude de Mercall réalisée en 1992 qui avait prouvé par des dosages hormonaux que les taux restaient identiques qu'il y ait eu ou non une hystérectomie [14]

3.1.4 LE THS PEUT PALLIER SIMPLEMENT ET DE MANIÈRE ADÉQUATE AU DÉFICIT HORMONAL

Les études portant sur la compliance au THS ont montré que l'observance est meilleure après hystérectomie. En effet le traitement se trouve facilité par l'absence de spotting mais surtout par le fait qu'en l'absence d'utérus, il n'est plus nécessaire d'associer un progestatif. Les limites du THS reposent sur son observance. Il semblerait néanmoins qu'elle soit légèrement meilleure chez les patientes opérées. Ainsi pour Speroff [15], l'hormonothérapie prescrite serait débutée par 31 à 89 % des femmes hystérectomisées et seulement par 21 à 61 % des femmes ayant une ménopause naturelle.

3.2 ARGUMENTS EN FAVEUR DE LA CONSERVATION OVARIENNE

3.2.1 PERSISTANCE DES SÉCRÉTIONS HORMONALES

Avant la ménopause, l'argument le plus en faveur de la conservation annexielle est évidemment le maintien de l'activité endocrine de l'ovaire. Même si un traitement hormonal substitutif peut corriger la carence oestrogénique, la non-observance de ce dernier en réduit considérablement son utilisation. Ainsi pour 100 femmes démarrant un THS [15] : 20 l'arrêtent avant 9 mois, 10 le prennent irrégulièrement, 30 ne le commencent même pas et seules 15 le poursuivent plus de 5 ans. Il est donc nécessaire d'accorder du temps à l'explication du THS afin d'augmenter ses chances de succès. Il doit être évoqué en préopératoire et son utilisation postopératoire ne se fait qu'à condition d'une bonne compréhension de la part de la patiente. Après la ménopause, il est maintenant établi qu'il persiste une sécrétion hormonale ovarienne surtout orientée vers la synthèse des androgènes et notamment de la testostérone. La sécrétion d'oestrogènes est quasi nulle mais une discrète production par le tissu ovarien ne peut être complètement exclue. Quant aux androgènes, l'ovaire ménopausique continue à sécréter 20 % de la production d'androsténedione et 40 % de la production de la testostérone [12].La castration après la ménopause provoquerait une diminution de 50 % du taux de testostérone et de manière moins significative une diminution des taux d'androsténedione et d'oestrogènes. Or, l'action de la testostérone se manifeste par une augmentation significative de la libido et du bien être général, et dans une moindre mesure de la masse musculaire et de la masse osseuse limitant ainsi

l'ostéoporose [16]. Il y aurait donc une diminution des capacités orgasmiques et des troubles du comportement sexuel directement imputables à la castration. L'ovaire post ménopausique n'est donc pas totalement inutile, mais il est à peu près certain qu'un traitement hormonal substitutif bien conduit a des effets identiques à long terme. Le problème posé est celui de la compliance au traitement qui est aléatoire. On peut néanmoins penser, comme il a déjà été dit plus haut, qu'en l'absence de progestatifs et de métrorragies l'observance tendrait à s'améliorer. Pour certains l'annexectomie pourrait avoir d'importantes répercussions psychologiques en relation avec un trouble de la perception du schéma corporel . Beaucoup de femmes n'ont pas une perception claire de la réalité anatomique et fonctionnelle des ovaires. Pour Lachowsky c'est la raison pour laquelle elles leur imputent souvent bien des maux : douleur, pesanteur... mais aussi leur féminité et leur sexualité [17]. Il est donc impératif de les rassurer quant à leur crainte de voir leurs capacités sexuelles s'altérer. Le risque de développer un cancer de l'ovaire chez les femmes hystérectomisées reste présent mais il est inférieur à celui observé dans la population générale D'autre part en l'absence de THS le risque de mortalité et de morbidité par maladie cardio-vasculaire ou ostéoporose est de loin bien supérieur au risque de cancer sur ovaire restant. Ainsi pour Randall, il faudrait réaliser 5 000 annexectomies systématiques pour éviter 2 cancers ovariens [18].

3.2.2 L'AUGMENTATION DU RISQUE OPÉRATOIRE ET LES COMPLICATIONS LIÉES AU GESTE SONT À PRENDRE EN COMPTE [19], [20], [21]

Il est classiquement décrit qu'en chirurgie tout geste supplémentaire représente un risque supplémentaire. La réalisation de l'annexectomie par voie vaginale n'étant pas toujours aisée on peut alors penser que la morbidité et la mortalité de l'intervention pourraient être par conséquent plus importantes. Ceci est en contradiction avec l'étude de Sheth [22] pour qui les complications à la fois opératoires et à moyen terme sont les mêmes avec ou sans annexectomie à condition que la technique soit rigoureuse et que les opérateurs soient entraînés.

4 CONCLUSION

La crainte du cancer sur ovaire restant, ne doit pas inciter de manière déraisonnée à la réalisation de l'annexectomie. Il faut garder à l'esprit que son incidence est rare (0,3 à 2 %) et que d'autre part, comme le souligne Randall [23], il faudrait réaliser 5 000 annexectomies afin d'éviter 2 cancers. Définir un âge optimal pour l'annexectomie est nécessaire. En l'absence de consensus ce choix est le plus souvent laissé à l'appréciation des chirurgiens. Néanmoins en reprenant l'ensemble de la littérature il semble que :

- avant 40 ans il n'y a pas de discussion et la conservation doit être la règle ;
- à la ménopause confirmée l'annexectomie soit recommandée malgré les bénéfices apportés par la sécrétion d'androgènes ;
- l'âge de 50 ans pour la majorité des auteurs représente une limite à la conservation. Les ovaires ayant accompli leur rôle, les laisser peut faire courir un risque potentiel (pathologie bénigne ou maligne) ;
- la tranche d'âge suscitant le plus de controverses se situe entre 45 et 50 ans.

En l'absence de consensus, la décision doit être prise en accord avec la patiente, au cas par cas et en prenant en considération l'âge, les antécédents personnels et familiaux, et le degré de compliance attendu concernant le THS. Par contre dans les populations à risque, l'annexectomie doit être la règle devant les antécédents familiaux de cancer ovarien et le syndrome de Lynch. La question reste débattue en ce qui concerne les femmes qui ont bénéficié de multiples inductions de l'ovulation.

REFERENCES

[1] Hart WR, Norris HJ. Borderline and malignant mucinous tumors of the ovary. Histologic criteria and clinical behavior. Cancer 1973 ; 31 : 1031-45.

[2] Scully RE. Common epithelial tumors of borderline malignancy (carcinomas of low malignant potential). Bull Cancer 1982 ; 69 : 228-38.

[3] Mc Gowan L. Ovarian Cancer after hysterectomy. Obstet Gynecol 1987; 69 : 386-9.

[4] Ménégoz F, Chérié-Challine L. Le cancer en France : incidence et mortalité. Ministère de l'emploi et de la solidarité. Réseau Francim 1995.

[5] Magnin G. Hystérectomie conservatrice avec ou sans annexectomie. Hystérectomie et annexectomie. Éditions RGO, 1993; Chapitre 3 : 18-21.

[6] Ferrero JM, Teissier E, Namer M. Cancer épithélial des ovaires. Réunion du 21 mars 1998. Éditions Arnette 1998.

[7] Sightler SE, Boike GM, Estape RE, Averette HE. Ovarian cancer in women with prior hysterectomy: A 14 years experience at the university of Miami. Obstet Gynecol 1991; 78 : 681-4.

[8] Parazzini F, Negri E, La Vecchia C, Lucchini L, Mezzopane R. Hysterectomy, oophorectomy, and subsequent ovarian cancer risk. Obstet Gynecol 1993; 81 : 363-6.

[9] Grundsell H, Ekman G. Some aspect of prophylactic oophorectomy and ovarian carcinome. Ann Chir Gynaecol 1981; 70 : 36-42.

[10] Schwartz PE. The role of prophylactic oophorectomy in the avoidance of ovarian cancer. Int J Gynaecol Obstet 1992; 39: 175-84.

[11] Loft A, Lidegaard O, Tabor A. Incidence of ovarian cancer after hysterectomy, a nationwide controlled follow up. Br J Obstet Gynaecol 1997; 104 : 1296-301.

[12] Christ JE. The residual ovary syndrome. Obstet Gynecol 1975; 46 : 551-6.

[13] Kazadi B, Rovira M, Laparte E, Lopez G. L'ovaire restant après hystérectomie. Rev Fr Gynecol Obstet 1994; 89 : 15-20.

[14] Funck Brentano. Les méfaits de la conservation ovarienne -In L'ovaire restant après hystérectomie. Bull Fed Soc Gynecol Obstet Fr 1959; 11 : 82-93.

[15] Mercall M. What are the long term effects of hysterectomy on the ovaries of normal women. J Endocrinol 1992; 133 : 972-9.

[16] Speroff T, Dawson N, Speroff L, Haber R. A risk benefit analysis of elective bilateral oophorectomy: effect of changes in compliance with oestrogen therapy on outcome. Am J Obstet Gynecol 1991; 164 : 165-74.

[17] Rozenbaum H. Why has menopause became a public health problem. Therapie 1998; 53 : 49-59.

Lachowsky M. The consequence of longevity. Maturitas 1997; 27 : 101-4.

[18] Levêque J, Eon Y, Colladon B, Foucher F, Chaperon D, Grall JY, Taillanter L. Hystérectomies pour pathologies bénignes en région Bretagne : analyse des pratiques. J Gynecol Obstet Biol Peprod 2000; 29 : 41-7.

[19] Sheth S. The place of oophorectomy at vaginal hysterectomy. Br J Obstet Gynaecol 1991; 98 : 662-6.

[20] Davies A, O'Connor H, Magos A. A prospective study to evaluate oophorectomy at the time of vaginal hysterectomy. Br J Obstet Gynaecol 1996; 103 : 915-20.

[21] Richardson RE, Bournas N, Magos AL. Is laparoscopic hysterectomy a waste of time? Lancet 1995; 345 : 36-41.

[22] Jacobs I, Oram D. Prevention of ovarian cancer: a survey of the pratice of prophylactic oophorectomy by fellows and members of the Royal College of Obstetrician and Gynaecologists. Br J Obstet Gyncecol 1989; 96 : 510-5.

[23] Randall GL. The frequency of oophorectomy at the time of hysterectomy. Am J Obstet Gynecol 1968; 100 : 718-23.

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Lymphangiome Ovarien: A Propos d'un Cas et Revue de la Littérature

[Ovarian lymphangioma: About a Case and Review of the Literature]

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ABSTRACT: Introduction: Cystic lymphangioma of the ovary is a rare benign vascular tumor. Its histogenesis is still hypothetical and its preoperative diagnosis difficult to establish. We report a case of cystic lymphangioma of the ovary that was a problem with differential malignant ovarian tumor diagnosis, with a recent review of the literature.
Observation: Patient 35 years primigravida primipara without significant pelvic pain consults history dating back more than three months without increased abdominal volume or urinary or digestive signs associated. A pelvic ultrasound done complemented by magnetic resonance imaging have objectified aspect for a right ovarian cyst formation by 8 cm to confront the histological data. The patient underwent a right oophorectomy returned for mature cystic teratoma of a cystic hygroma associated. The postoperative course was uneventful and no recurrence was noted.
Results: Cystic lymphangioma of the ovary is rare benign tumor formation. There are no specific symptoms. Radiology despite progress remains inconclusive in the diagnosis of this tumor type. Histological study is the only way to confirm the diagnosis. The outcome was favorable, no cases of malignant transformation have been reported.
Conclusion: Cystic lymphangioma of the ovary is a rare benign tumor of the malformation. The diagnosis rarely made preoperatively should be considered in any cystic ovarian mass. Only complete surgical resection of the tumor is associated with prolonged survival and a favorable prognosis.

KEYWORDS: ovarian tumor, lymphangioma, cyst, benign, prognosis.

RÉSUMÉ: Introduction: Le lymphangiome kystique de l'ovaire est une tumeur vasculaire bénigne rare. Son histogenèse est encore hypothétique et son diagnostic préopératoire difficile à établir. Nous rapportons un cas de lymphangiome kystique de l'ovaire qui a posé un problème de diagnostic différentiel avec une tumeur maligne de l'ovaire, avec une revue récente de la littérature.
Observation: Patiente de 35 ans primigeste primipare sans antécédents notables consulte pour douleurs pelviennes remontant à plus de 3 mois sans augmentation du volume abdominal ni signes urinaires ou digestifs associés. Une échographie pelvienne faite complétée par une imagerie par résonance magnétique ont objectivées un aspect en faveur d'une formation kystique ovarienne droite faisant 8 cm à confronter aux données histologiques. La patiente a bénéficié d'une ovariectomie droite revenue en faveur d'un tératome kystique mature associé un lymphangiome kystique. Les suites opératoires étaient simples et aucune récidive n'était notée.
Resultats: Le lymphangiome kystique de l'ovaire est en formation tumorale bénigne rare. Il n'y a pas de symptomatologie spécifique. La radiologie malgré les progrès reste non concluante dans le diagnostique de ce type de tumeurs. L'étude anatomopathologique reste le seul moyen pour confirmer le diagnostique. L'évolution est favorable, aucun cas de transformation maligne n'a été rapporté.
Conclusion: Le lymphangiome kystique de l'ovaire est une tumeur malformative bénigne rare du. Le diagnostic rarement fait en préopératoire devrait être évoqué devant toute masse kystique de l'ovaire. Seule l'exérèse chirurgicale complète de la tumeur est associée à une survie prolongée et à un pronostic favorable.

MOTS-CLEFS : tumeur ovaire, lymphangiome, kyste, benigne, pronostic

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1 INTRODUCTION

Le lymphangiome est une lésion bénigne des voies lymphatiques due à une prolifération angio-lymphatique, plus ou moins exubérante, le plus souvent congénitale mais parfois acquise. Il s'agit d'une lésion vasculaire composée de larges kystes unis ou multiloculaires, bordés par une couche d'endothélium et entourés par des fibroblastes, ainsi que par de nombreuses fibres musculaires lisses. La localisation est le plus souvent extra-abdominale, en particulier au niveau de la tête et du cou. Seulement 5 % des cas concernent une localisation abdominale. Le lymphangiome de l'ovaire est extrêmement rare et seulement peu de cas ont été rapportés dans la littérature (1, 2). IL est le plus souvent asymptomatique et découvert fortuitement par une échographie pelvienne mais le diagnostic reste histologique. De nombreuses complications peuvent survenir au cours de l'évolution du lymphangiome kystique, liées à sa localisation et son volume. Il est donc essentiel de faire le diagnostic de cette masse afin d'éviter la survenue de ses complications. Nous rapportons un cas de lymphangiome kystique de l'ovaire qui a posé un problème de diagnostic différentiel avec une tumeur maligne de l'ovaire, avec une revue récente de la littérature.

2 CAS CLINIQUE

Patiente de 35 ans primigeste primipare sans antécédents notables consulte pour douleurs pelviennes remontant à plus de 3 mois sans augmentation du volume abdominal ni signes urinaires ou digestifs associés, le tout évoluant dans un contexte de conservation de l'état général. À l'examen, la patiente était en bon état général et son abdomen était souple sans masse latéro-utérine palpable au toucher vaginal. Une échographie pelvienne (figure 1) faite complétée par une imagerie par résonance magnétique (figure2) ont objectivé un aspect en faveur d'une formation kystique ovalaire ovarienne droite faisant 8 cm sans cloisons ou végétations intra kystiques, l'ovaire gauche et l'utérus étaient sans particularités. Les marqueurs tumoraux étaient normaux. Une laparotomie était décidée . La patiente a bénéficié d'une ovariectomie droite revenue en faveur d'un tératome kystique mature associé un lymphangiome kystique (figure 3). Les différents prélèvements à visée bactériologique, biochimique et cytologique du contenu liquidien de la tumeur ne révèlent rien de particulier. Les suites opératoires étaient simples et La patiente fut régulièrement suivie en consultation et ne présenta aucun élément de récidive ni clinique ni échographique.



Figure1 : image échograpgique évoquant un kyste organique

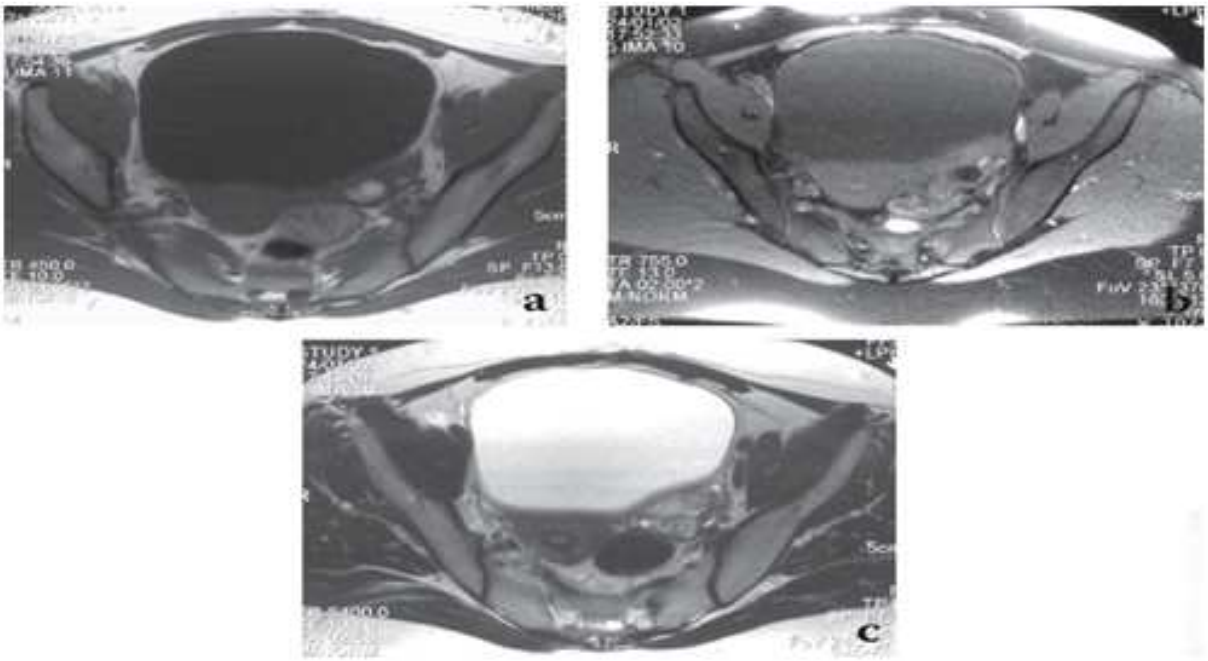


Figure 2 : (a) Séquence dépendante du T1.
(b) Formation de 1 cm de diamètre située à la partie postérieure de l'ovaire dont le signal, égal à celui du tissu adipeux, est annulé sur la séquence de suppression de graisse.
(c) Le signal de ce kyste est élevé sur la séquence dépendante du T2.

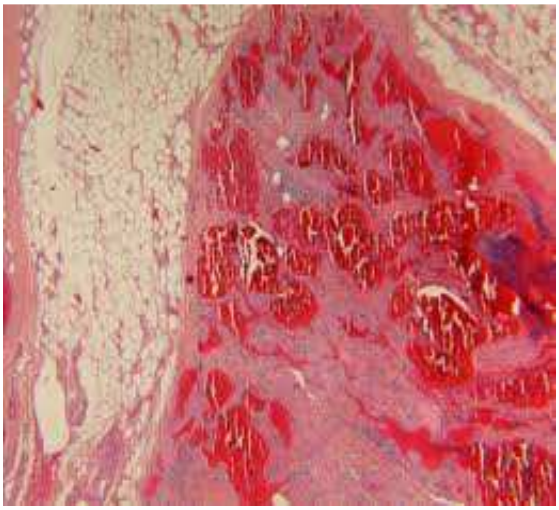


Figure 3 : Aspect microscopique de la tumeur

3 DISCUSSION

Les lymphangiomes kystiques pelviens sont des tumeurs très rares, qui se voient surtout chez l'enfant [1,3].

Chez l'adulte, elles représentent 7 % des kystes abdominopelviennes [2].

Cette malformation s'explique, sur le plan pathogénique, par un défaut congénital de connexions des espaces lymphatiques primaires au système central des collecteurs [4]. Elles sont rarement évoquées en préopératoire ou découvertes de façon accidentelle. Ces tumeurs se développent beaucoup plus sur le mésentère ou dans le rétro péritoine que sur l'épiploon en raison d'une plus grande richesse du réseau lymphatique dans ces régions [5].

Le tableau clinique n'est pas très évocateur. Le plus souvent, douleurs pelviennes, vagues, ou masses abdominopelvienne ; parfois un syndrome sub-occlusif voire une occlusion par compression intestinale ou volvulus ; plus rarement une péritonite ou une rupture traumatique du kyste [2].

La radiographie d'abdomen sans préparation peut montrer une opacité de tonalité hydrique refoulant les clartés digestives.

L'échographie pelvienne permet actuellement d'évoquer le diagnostic de lymphangiome en précisant la nature Liquidienne bien limitée multiloculée et non-vascularisée de la tumeur et en vérifiant l'état des ovaires [3,6].

L'imagerie par résonnance magnétique abdominopelvienne complète les données de l'échographie et détermine avec plus de précision la forme anatomique du lymphangiome, son siège, son étendue et ses rapports avec les organes de voisinage, et permet d'explorer les chaines ganglionnaires lombo-aortiques et iliaques comme elle permet d'évoquer une tumeur d'origine appendiculaire [4,5].

Le diagnostic différentiel se fait le plus souvent avec une masse kystique intrapéritonéale ou une tumeur de l'ovaire.

Le dosage des marqueurs tumoraux ainsi que des sérologies spécifiques peut aider à évoquer le diagnostic.

Évoqué par la clinique, suspecté par la radiologie et porté lors de l'intervention, le diagnostic du lymphangiome kystique ne peut être confirmé que lors de l'examen histologique. Macroscopiquement, la lésion est formée de kystes en grappes de raisin de nombre et de taille variable indépendants ou communiquant entre eux [4,5]

L'histologie retrouve constamment un conglomérat d'espaces lymphatiques dilatés coexistant avec des formations ganglionnaires et un important développement hémangiomateux [5,6].

Le seul traitement admis est l'exérèse chirurgicale complète rendue plus ou moins facile selon la localisation. Le pronostic est bon et les récidives sont exceptionnelles.

4 CONCLUSION

Le lymphangiome kystique pelvien est une tumeur bénigne rare. Sa clinique est très polymorphe. Son diagnostic peut être évoqué sur les données de l'échographie et l'IRM ; il n'est confirmé que par l'étude anatomo-pathologique. Son traitement est chirurgical et bien codifié, son pronostic est excellent.

REFERENCES

[1] KABLY A., MOUMEN M., RAISSOUNI N. : Le lymphangiome kystique du mésentère et de l'épiploon. A propos de 2 cas. Gynécologie obstétrique et fertilité, 2003 ; 31 : 136-138.
[2] LOSANOFF J.E., RICHMAN B.W., EL-SHERIF A. : Mesenteric cystic lymphogioma. J. Am. Coll. Surg., 2003 ; 196 : 598-603.
[3] MABRUT J.Y., GRANDJEAN J.P., HENRY L. : Les lymphangiomes kystiques du mésentère et du méso-colon. Prise en charge diagnostique et thérapeutique. Ann.Chir. 2002 ; 127 : 343-349.
[4] Singer T, Filmar G, Jormark S, Seckin T, Divon M. Rare case of ovarian cystic lymphangioma. J Minim Invasive Gynecol. 2010; 17:97-9.
[5] Iwasa T, Tani A, Miyatani Y, et al. Lymphangioma of the ovary accompanied by chylous ascites. J Obstet Gynaecol Res. 2009; 35:812-5.
[6] Akyildiz EU, Peker D, Ilvan S, et al. 2006. Lymphangioma of the ovary: a case report and review of the literature. Journal of the Balkan Union of Oncology 11:91– 93.

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EPIDMOLOGICAL AND SENSITIVITY PATTERNS OF SPECIFIED ANTIBIOTICS INIMICAL TO PATHOGENS CAUSING URINARY TRACT INFECTIONS (UTIs)

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ABSTRACT: 100 urine specimens were cumulated for microbial urinalysis and antibiotic susceptibility appraisal, further infection boutade survey concerning gender and age was executed. From the microbial urinalysis it was exonerated that stereotyped urinary micro-organisms were *Escherichia coli, Enterococci, Klebsiella pneumonia, Staphylococcus aureus, Streptococci species, Pseudomonas aeruginosa* and *Candida albicans* which were isolated from 28 affirmative specimens. *Escherichia coli* (54%) and *Klebsiella pneumonia* (25%) were imperious bacterial species having same resistivity impressions as *Pseudomonas aeruginosa. Enterococcus was* exceptionally resistant bacterial specie while *Staphylococcus aureus* and *Streptococci species* were profoundly sensitive in sentiment to the exquisite antibiotics. Gender and age based survey adjured that fecunds and individuals beyond age of 50s are crucially supine to intermittent urinary infections, thus demands legitimate sanitation regime of privy lots.

KEYWORDS: Urinary Tract Infection, Antibiotic Sensitivity, Epidemiology.

1 INTRODUCTION

Urinary tract infections are a pathological condition that infects parts of urinary tract. It is trivially denoted as UTIs and is characterized as Acute cystitis. Infection of the upper urinary regions is entitled as Pyelonephritis or kidney infections, while infections of lower urinary quarters are signified as Simple cystitis or Bladder infections. Bacteria peculiarly *Escherichia coli, Staphylococcus saprophyticus*, *Klebsiella, Proteus, Pseudomonas, Enterococci and Enterobacter* are prevalent etiology of the infection [1]. Estimated 85% - 90% UTIs are founded via *E.coli,* rare fungal or viral onsets are inscribed [2]. Study evaluation divulges that women are more prone to infection due to their anatomy [3]. Urinary catheterization may also be a prime source of bacteriuria, leading to severe UTIs [4,5]. Symptoms of the infection comprehends burning sensations in urine, pyuria, hematuria, pyrexia, vaginal dispense, nausea and back pains [6]. Epidemiological survey proclaimed that women are the predisposed entities and frequency of infection per annum is computed as 10% [7]. Prospect of approximately 60% infection eventuate at some point of female lives [1]. Annually 40% of hospital beds are populated due to bladder and kidney infections [8]. Neonates at age less than one year are vulnerable to the indisposition, guesstimated 20% frequency of infection is diagnosed yearly. During pregnancy, soaring levels of progesterone surges likelihood towards bacterimia which escalates 20% - 40% chances of encountering a UTI [9]. Potential antibiotics are prescribed by the physicians to cope the mild to severe complications. Customarily dynamic antibiotics such as trimethoprim/sulfamethoxazole, cephalosporins, amoxicillin, clavulanic acid, nitrofrantoin or fluoroquinolones are prescribed along with Phenazopyridine and Paracetamols to subsist fevers, burning sensations and urgency. A research investigation published earlier in 2011 discerned that utilization cranberry juice and probiotics may assist to tackle recurrent infections [1,10].

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The research perusal was mapped on the basis to investigate pre-dominant bacterial and fungal microflora incredibly *Escherichia coli, Enterococci, Klebsiella pneumonia, Staphylococcus aureus, Streptococci species, Pseudomonas aeruginosa* and *Candida albicans* in the urine samples acquired from afflicted UTI patients, affirmed via episodes of biochemical tests. Then asserted predilected microbial colonies were prior to antibiotic sensitivity appraisal employing eloquent antibiotics. Finally epidemiological evaluation of accrued specimens was presided over to analyze upturns of UTI in the region.

2 METHODOLOGY

2.1 SPECIMEN COLLECTION

Urine specimens were racked up in sterile borate accommodating containers from 100 exasperated invalids enduring mild to severe urinary tract infection. The samples were processed within 24 hours of collection.

2.2 PHYSIOCHEMICAL PROPERTIES OF SPECIMEN

Physical color of urine specimens was varying from mild creamy yellow to vibrant orange, owing wavering tactile magnitude of turbidity. pH analysis via Multistix urine test strip manifested pH range of (5.5 – 7.5). The entire urine specimens were held at room temperature prior to examination.

2.3 MICROBIAL CULTURING

For microbial urinalysis of amassed specimens, sterile CLED (cysteine lactose electrolyte deficient medium, pH 7.3) agar plates were employed. The specimens were streaked evenly on the prepared sterilized medium as per described streaking protocols (Cappuccino et al., 2008). Then the cultured plates were sustained in the aseptic environment of laminar flow hood during culturing to avoid unwanted contamination. All the petri-plates were then incubated in upside down orientation at 37^{o}C for 24 hours. Later on the culture status was observed morphologically.

2.4 MICROBIAL IDENTIFICATION

For identification phase, the bacterial colonies that were evidently proliferated on the CLED medium were further forged ahead through series of bacterial identification explorations including Gram staining, Catalase test, Coagulase test, Oxidase test, Indole test, Mannitol test and Methyl red test in order to specify UTI pathogens distinctively *Escherichia coli, Enterococci, Klebsiella pneumonia, Staphylococcus aureus, Streptococci species* and *Pseudomonas aeruginosa.*

For pathogenic yeast such as *Candida albicans, germ* tube test was conducted as per described protocol.

2.5 DISC DIFFUSION ANTIBIOTIC SENSITIVITY ASSESSMENT

Antibiotic sensitivity assessment of sterling yearned UTI pathogens was explored as per described protocols (Mohanty, 2010). UTI pathogens succeeding identification activity were exorcised on sterilized Muller-Hinton agar medium. Ten stellar antibiotics titled as Amoxicillin, Amikacin, Ceftriaxone, Cefixime, Ciprofloxacin, Fosfomycin, Imipenem, Piperacillin, Nitrofurantoin and Naladixic acid were assigned on the purified microbial culture plates. These plates were then incubated at 37^{o}C for 24 hours. On the next day of incubation, coherent zones of inhibitions were observed conveying antibiotic sensitivity depiction.

3 RESULTS

3.1 MICROBIAL CULTURING

From microbial culturing, it was espied that out of 100 infected urine specimens, 28 were pathogenically UTI positive discerning that yenned pathogens particularly *Escherichia coli, Enterococci, Klebsiella pneumonia, Staphylococcus aureus, Streptococci species, Pseudomonas aeruginosa* and *Candida albicans* were responsible for (28%) of integral acute to chronic UTI cases. These pathogens some what reside as solo or co-infectious entities.

3.2 MICROBIAL IDENTIFICATION

Biochemical explorations were executed to identify prominent inimical UTI pathogens discriminatingly *Escherichia coli, Enterococci, Klebsiella pneumonia, Staphylococcus aureus, Streptococci species* and *Pseudomonas aeruginosa.* Microscopic germ tube test vouched the presence of *Candida albicans* mycelia. Compendium of results is indicated in (Table 1) and (Table 2). From these results its evident that urinary tract lurgy is predominantly caused by bacterium *Escherichia coli* that helm for about (54%) of sum total infection frequency. Relatively *Klebsiella pneumonia* is also accountable for the indisposition revealing moderate infection periodicity of (25%). *Enterococci, Pseudomonas aeruginosa* and *Candida albicans* own low infection regularity of (11%), (4%) and (7%), but its pathogencity leads to excruciating chronic maladies. *Staphylococcus aureus* and *Streptococci species* were remarked to be present as co-infectious quiddities and that ascends severity of disease. Compendium of results is indicated in (Graph 1).

Table 1: Tabular representation of convicted UTI pathogens isolated from infected urine specimens

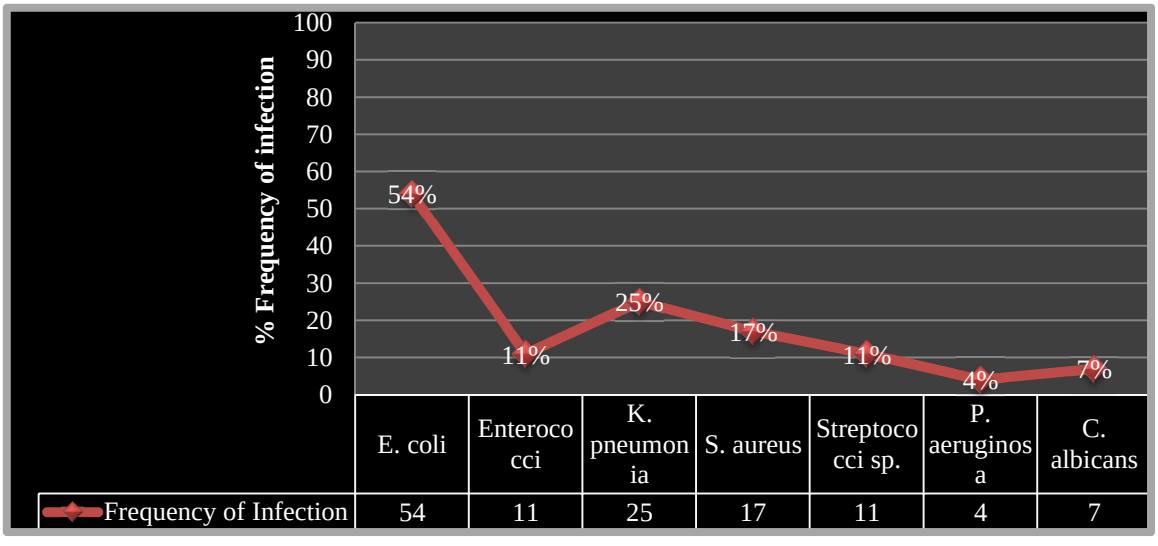
List Of Bacteria	MICROBIAL IDENTIFICATION							
	MORPHOLOGY	GRAM STAINING	CATALASE TEST	COAGULASE TEST	OXIDASE TEST	INDOLE TEST	MANNITOL TEST	METHYL RED TEST
E. coli	Bacilli	+	-	-	-	+	-	-
Enterococci	Cocci	+	-	+	-	-	-	-
K. pneumonia	Bacilli	-	+	-	-	-	+	-
S. aureus	Cocci	+	+	+	-	-	+	+
Streptococci sp.	Cocci	+	-	-	-	+	-	+
P. aeruginosa	Bacilli	-	+	-	+	-	-	-
C. albicans	Visible mycelial or budded growth under microscope (40X or 100X)							

(+) cue regard for positive sequel, **(-)** cue regards for negative sequel

Table 2: Tabular representation of convicted UTI pathogens declared as microbial resource

SAMPLE NO.	MICROBIAL SPECIES DISCERNED FROM URINE SPECIMENS						
	E. COLI	ENTEROCOCCI	K. PNEUMONIA	S. AUREUS	STREPTOCOCCI SP.	P. AERUGINOSA	C. ALBICANS
1	+	-	-	-	-	-	-
2	+	-	-	-	-	-	-
3	+	-	-	-	-	-	-
4	+	+	-	-	-	-	-
5	-	-	-	+	-	-	+
6	-	-	+	+	-	-	-
7	-	-	+	-	-	-	-
8	-	-	-	-	+	-	-
9	-	-	-	-	-	+	-
10	+	-	-	-	-	-	+
11	+	-	-	-	-	+	-
12	+	-	+	-	+	-	-
13	-	-	+	-	-	-	-
14	-	+	-	-	-	-	-
15	-	-	-	+	+	-	-
16	-	-	-	-	-	-	+
17	+	+	-	-	-	-	-
18	+	-	-	-	-	-	-
19	+	-	-	-	-	-	-
20	-	-	+	-	-	-	-
21	-	-	+	-	-	-	-
22	+	-	-	-	-	-	-
23	+	-	+	-	-	-	-
24	+	-	-	-	-	-	-
25	-	-	+	-	-	-	-
26	+	-	-	-	-	-	-
27	-	-	+	-	-	-	-
28	+	-	-	-	-	-	-

(+) cue regard for positive sequel, **(-)** cue regards for negative sequel



Graph 1: Pictorial representation of prevalence of microbial infection via convicted UTI pathogens

3.3 DISC DIFFUSION ANTIBIOTIC SENSITIVITY ASSESSMENT

From sensitivity examination of aced atibiotics against the adverse UTI pathogens it was espied that *Staphylococcus aureus* and *Streptococcus species* growth were vehemently restrained by almost all of the plied antibiotic disc. Gram negative *Escherichia coli, Klebsiella pneumonia* and *Pseudomonas aeruginosa* accounted for same resistivity patterns against the antibiotics with least variability i.e. Fosfomycin was benign towards *Pseudomonas aeruginosa* while *Klebsiella pneumonia* desists the effectiveness of Nitrofurantoin. *Enterococci* were most resistant bacterial specie and were responsive only towards Fosfomycin, Imipenem, Piperacillin and Nitrofurantoin. Antibiotics i.e. Amoxicillin and Naladixic acid had no cogency to restrain bacterial augmentation. Fungal pathogen *Candida albicans* was resistant towards the dynamic potency antibiotics. Compendium of results is indicated in (Table 3).

Table 3: Tabular representation of sensitivity patterns of virtuoso antibiotics against convicted UTI pathogens

LIST OF BACTERIA	ANTIBIOTIC SENSITIVITY PATTRENS									
	AMOXICILLIN	AMIKACIN	CEFTRIAXONE	CEFIXIME	CIPROFLOXACIN	FOSFOMYCIN	IMIPENEM	PIPERACILLIN	NITROFURANTOIN	NALADIXIC ACID
E. coli	R	S	R	R	R	S	S	S	S	R
Enterococci	R	R	R	R	R	S	S	S	S	R
K. pneumonia	R	S	R	R	R	S	S	S	R	R
S. aureus	R	S	R	R	S	S	S	S	S	R
Streptococci sp.	R	S	R	R	S	S	S	S	S	R
P. aeruginosa	R	S	R	R	R	R	S	S	S	R
C. albicans	R	R	R	R	R	R	R	R	R	R

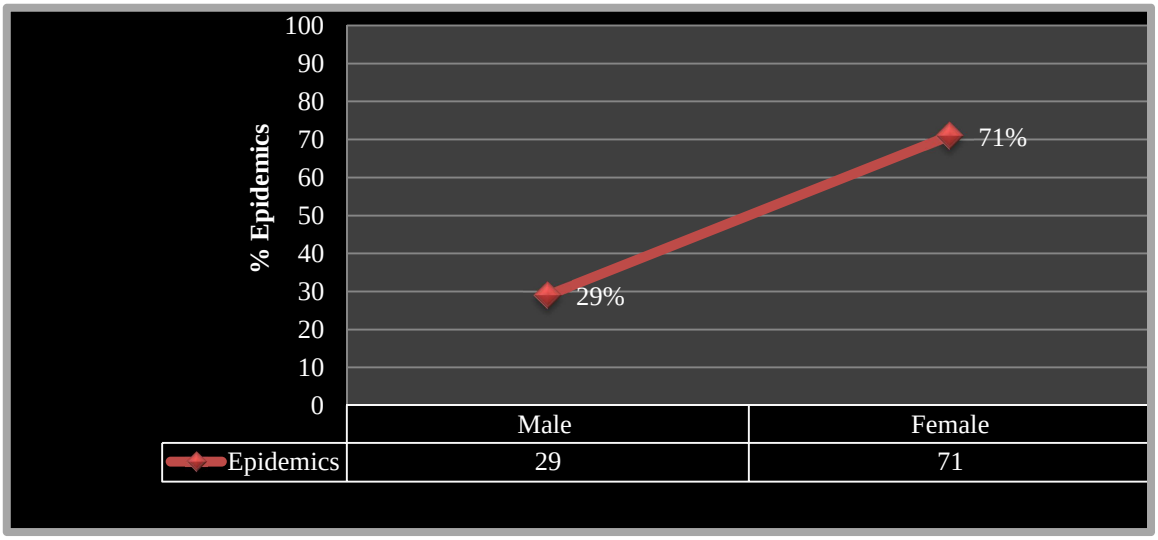
(S) cue regard for positive sequel, **(R)** cue regards for negative sequelEpidemics Of UTIs With Respect To Gender And Age

Pervading disposition of urinary tract infection is idiosyncratically based on pathogenicity of micro-organisms, their remarkable character of invasion, persistence, decamping host defenses, infection genesis and recurrence of reiterative infections owing more resistance towards medications. From the epidemic study it has been espied that conventionally two substantial aspects are superintended for the regularity of the ailment i.e. Gender and Age. From the evaluation survey of 28 positive urine specimens out of 100, it was manifested that females are most prone to the infection due to their indispensible anatomy. Estimated probability of infection frequency for females was (71%) while for males it was (29%), signifying high infection rate in females. Compendium of results is indicated in (Table 4) and (Graph 2).With respect to age, estimated probability of invalids manifested that individuals above the age of 50s are more liable to onset and recurrent urinary infection due to their incapacitated immunity and impecunious health care. Infection frequency for individuals above age of 50 is computed as (64%) evincing higher obstinate microbial infection rates. Compendium of results is indicated in (Table 4) and (Graph 3).

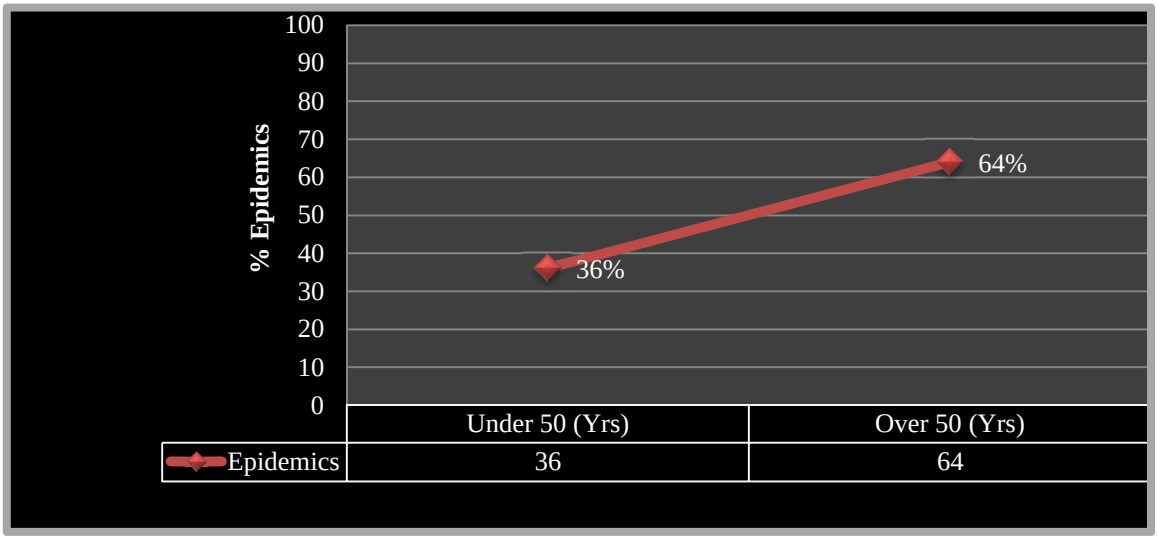
Table 4: Tabular representation of epidemics of UTIs on the basis of gender and age

SAMPLE NO.	EPIDEMICS OF UTIs	
	GENDER	AGE (YRS)
1	F	55
2	F	53
3	M	75
4	F	74
5	F	35
6	F	48
7	F	55
8	F	62
9	M	60
10	F	79
11	F	71
12	F	70
13	F	70
14	F	9 (MONTHS)
15	F	73
16	F	85
17	M	70
18	M	42
19	F	40
20	F	60
21	F	2
22	F	62
23	F	55
24	M	45
25	M	78
26	M	38
27	M	33
28	F	3

(M) cue regard for Male sex, **(F)** cue regards for Female sex



Graph 2: Pictorial representation of epidemics of UTIs on basis of convalescent's gender



Graph 3: Pictorial representation of epidemics of UTIs on basis of convalescent's age

4 DISCUSSIONS

From a research exploration over sighted randomly on culled populace of elderly and robust youthful proffers, it was refuted that urinary tract infection is rampant specifically in middle aged and elderly women due to their diacritic biology [11]. Most preponderant cause of debilitation are bacteria pivotally *Escherichia coli*. Patients bordering on $>10^5$ bacteria (CFU)/ml of freshly void sample are diagnosed with symptomatic UTIs [12]. Currently antimicrobials are employed to encounter urinary prodromes but still clinging on few backlashes [13]. United States review in 1995 insinuated that annual expense on UTI remedial therapy was augmented up to $25.5 billion. To rig the coeval situation cinch vaccine should be established to preclude onslaught of introductory contagion [14].

5 CONCLUSION

From the research manifestation, it has been concluded that gram negative *Escherichia coli* (54%) and *Klebsiella pneumonia* (25%) were presiding ascendant of urinary tract infections. Other bacterial and fungal species pretenced as opportunistic organisms which dilapidate acute infection to chronic stages. Fosfomycin, Imipenem, Piperacillin and Nitrofurantoin were the most commendable bateriostatics and bactericides to repress the proliferation of pathogenic bacteria. Fungal mycelial growth was not inhibited by the antibiotics and which require a potential route to impede infection rate. Proper medication should be prescribed by the physicians in order to circumvent microbial resistance and sporadic

infections. Individuals at age above 50s, exceptionally females must emulate the standards of hygiene care discretely of intimate areas in order to stay healthy and avoid urinary tract related maladies.

REFERENCES

[1] S. Salvatore, E. Cattoni, G. Siesto, M. Serati, P. Sorice, and M. Torella, "Urinary tract infections in women", *European Journal of Obstetrics, Gynecology, and Reproductive Biology*, vol. 156, no. 2, pp. 131–6, 2011.

[2] S. M. Bagshaw and K.B. Laupland, "Epidemiology of intensive care unit-acquired urinary tract infections", *Current Opinion in Infectious Diseases*, vol. 19, no. 1, pp. 67–71, 2006.

[3] L. E. Nicolle, "The chronic indwelling catheter and urinary infection in long-term-care facility residents". *Infect Control Hosp Epidemiol*, vol. 22, no. 5, pp. 316–21, 2001.

[4] E. J. Dielubanza and A.J. Schaeffer,"Urinary tract infections in women", *The Medical clinics of North America,* vol. 95, no. 1, pp. 27–41, 2011.

[5] L. E. Nicolle, "Uncomplicated urinary tract infection in adults including uncomplicated pyelonephritis",*Urol Clin North Am*, vol. 35, no. 1, pp. 1–12, 2008.

[6] D. R. Lane and S. S. Takhar, "Diagnosis and management of urinary tract infection and pyelonephritis", *Emergency medicine clinics of North America,* vol. 29, no.3, pp. 539–52. 2011.

[7] R. Colgan and M. Williams,"Diagnosis and treatment of acute uncomplicated cystitis", *American Family Physician*, vol. 84, no. 7, pp. 771–6, 2011.

[8] Brunner and Suddarth, Textbook of medical-surgical nursing, 12th Ed. Philadelphia. Wolters Kluwer Health/Lippincott Williams & Wilkins, pp. 1359, 2010.

[9] F. Smaill and J. C. Vazquez, "Antibiotics for asymptomatic bacteriuria in pregnancy", *Cochrane Database Syst Rev, vol.* 18, no. 2, pp. 490, 2007.

[10] R.G. Jepson, G. Williams, and J. C. Craig, "Cranberries for preventing urinary tract infections." *Cochrane database of systematic reviews*, vol. 16, no. 4, pp. 126, 2012.

[11] D. J. O'Sullivan, M. G. FitzGerald, M. J. Meynell, and J. M. Malins, "Urinary Tract Infection", *British Medical Journal,* vol. 1, no. 5228, pp. 786–788, 1961.

[12] B.L. Jasmine and H. N. Guy, "Urinary tract infection", *Medicine,* vol. 35, no. 8, pp. 423–428, 2007.

[13] H. R. Robert, D. S. Eugene, T. A, Vincent, J. D, Robert, and E. S. Walter, "Evaluation of new anti-infective drugs for the treatment of urinary tract infection", *Clinical Infectious Diseases,* vol. 15, no. 1, pp. 216-227, 1992.

[14] B. Foxman, R. Barlow, H. D'Arcy, B. Gillespie, and J. D. Sobel, "Urinary Tract Infection", *Annals of Epidemiology,* vol. 10, no. 8, pp. 509-515, 2000.

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Genèse et développement du maraîchage urbain en République du Bénin

[Genesis and development of urban vegetable farming in Republic of Benin]

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ABSTRACT: A fast development of urban agriculture has recently taken place in many areas of the Republic of Benin. This study was conducted from January to December 2013 in southern and northern Benin in three major vegetable farms. It aimed to assess the genesis and the rapid expansion of urban agriculture especially, its contribution to the improvement of living conditions to urban populations.

The protocol was based on the collection of sociological data by interviewing vegetable farmers regarding on the history of vegetable farming in Benin, the various agricultural practices, the types of pesticides used, the typology of vegetable farms, the advantages and disadvantages of this agriculture.

Results from this study showed that:

(1) The creation of the first vegetable farmer was the work of the Christian missionaries and this in the context of their dietary requirements, but nowadays, the rapid development of urban agriculture is mainly due to unemployment observed in major cities, rural exodus and the search for a balanced diet by urban populations and increases the farmers' household income and their living standard;

(2) Vegetable farming activity is still devotes to young people (21-40 years old) where 75% among them are permanents gardeners, against 10% working part time and 15% on a temporary basis.

(3) Farmers used various types of pesticides, which in many cases were not recommended for this activity.

This study confirmed an increase activity of the vegetable farming in urban areas of Benin.

It has led to the use of insecticide in an improper manner to control vegetable pests, thus causing the emergence of insecticide resistance in malaria vectors.

KEYWORDS: vegetable farming; vegetables; Insecticides; urban agriculture.

RESUME: L'agriculture urbaine, en particulier le maraîchage est devenu un nouveau métier au Bénin.

La présente étude réalisée de janvier à décembre 2013 dans les sites maraîchers au Sud et au Nord du Bénin, fournit des informations sur la genèse et le développement du maraîchage en milieu urbain.

Le protocole d'étude s'est articulé premièrement sur des données sociologiques. Les jardiniers ont été choisis de façon aléatoire sur les trois grands sites (Houeyiho, Acron et Azereke) de maraichage au Benin. Ils ont été interviewés 1) sur l'historique du maraîchage, les pratiques agricoles en matière de lutte contre les ravageurs des cultures. Dans un deuxièmement temps, l'étude s'est focalisée sur 2) les acteurs de cette agriculture et leur typologie. Enfin, 3) les avantages et inconvénients de cette agriculture.

Les résultats de cette étude ont montré que : **i**) La création des premiers sites maraîchers fut l'œuvre des premiers missionnaires et ceci dans le cadre de leurs exigences alimentaires. Au cours de nos investigations, 67% des paysans

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déclarent se procurer des pesticides dans des structures illégales de vente de pesticides contre 33% dans les structures agréées par l'Etat.
ii)-Sur les 03 sites visités, le maraîchage reste dominé par les jeunes (21 à 40 ans), avec 75% de maraîchers permanents, 10% de maraîchers à temps partiel et 15% de maraîchers temporaires. **iii**)- En plus des apports nutritionnels qu'apporte l'agriculture maraîchère aux populations urbaines, cette dernière, sur le plan social, constitue un secteur pourvoyeur d'emploi pour des milliers de bénéficiaires directs et indirects.
Le développement de l'agriculture urbaine notamment le maraîchage au Bénin reste et demeure une réalité. Cependant, l'utilisation anarchique d'insecticides chimiques pour lutter contre les ravageurs de légumes, contribue à la sélection de la résistance des vecteurs du paludisme.

MOTS-CLEFS: sites maraîchers; légumes; insecticides; Agriculture urbaine.

INTRODUCTION

Dans plusieurs villes africaines où le taux d'accroissement démographique est en moyenne de 4% [**1-2**], la malnutrition protéino-énergétique sévit en permanence dans les milieux pauvres [**3**]. Des méthodes alternatives de production et des sources complémentaires d'aliments sont requises pour améliorer l'état nutritionnel des populations et la production maraîchère semble se prêter à relever ce défi.

Ainsi, depuis plus d'une décennie, l'agriculture maraîchère se développe dans plusieurs capitales et villes africaines. Jadis, pratiquée autour des maisons des missionnaires sur de petites superficies pour des exigences alimentaires, elle connait aujourd'hui un essor fulgurant du fait de la poussée démographique d'une part, mais aussi du chômage galopant et de la crise alimentaire d'autre part [**4**]. Cette situation a pour conséquences une multiplication des acteurs intervenant dans cette activité: hommes, femmes, enfants, diplômés sans emploi et même des fonctionnaires en fin de semaine et pendant leurs congés [**5**] et une diversité des cultures [**6-9**].

De façon générale, les espaces inutilisés (marécages, bordures des rues, plages) sont de plus en plus transformés en jardins où l'on cultive des légumes de toutes sortes et des fleurs.

A Abidjan, capitale de la Côte-d'Ivoire, de nombreux sites de maraîchage se sont développés pendant ces dernières décennies, surtout sur les berges lagunaires [**6**]. A Cotonou, capitale économique du Bénin, le phénomène est très frappant. On rencontre des sites maraîchers partout surtout au cœur même de la ville. Déjà, à partir de l'aéroport, l'espace qui longe la voie au centre de la ville est occupé de part et d'autre par de nombreux maraîchers qui ont transformé une partie de la plage en site maraîcher.

Mais contrairement à la production saisonnière de vivriers dans les campagnes, la production maraîchère en zone urbaine est pratiquée toute l'année grâce à des techniques de production intensive (irrigation/arrosage et équipements associés, engrais organiques et minéraux, lutte phytosanitaire, etc.) sur de petites et grandes surfaces.

Cependant, l'envolée de cette agriculture semble être freinée par des handicaps qui entravent le bon développement de cette filière [**10-11**]. A ces problèmes s'ajoutent le faible niveau de technicité des maraîchers, le problème d'approvisionnement en intrants, l'écoulement des produits de récolte et l'accès réduit aux sources de financement.

Sur le plan sanitaire, la formation des planches de cultures crée de très nombreuses rigoles qui retiennent de l'eau de pluie et d'arrosage. Ainsi, pendant les saisons pluvieuses, ces rigoles constituent de véritables gîtes de moustiques, en particulier d'*Anopheles gambiae*, principal vecteur du paludisme en Afrique [**12-15**]. Sur le plan phytosanitaire, la forte utilisation d'insecticides chimiques dans le but de lutter contre les ravageurs des cultures et dont la plupart restent encore non recommandés pour le maraîchage, pourraient, conduire au développement de la résistance des moustiques, en particulier d'*Anopheles gambiae* vis-à-vis de ces insecticides [**16-17 ; 14**].

Au Bénin, il existe très peu de données ou d'informations liées à la genèse et au développement du maraîchage. Celles qui existent sont vieilles et nécessitent une véritable réactualisation.

La présente étude a été réalisée dans le but de connaître la genèse des sites maraîchers, les avantages et inconvénients liées a cette agriculture maraîchère dans les grandes 3 communes (Cotonou, Porto-Novo et Parakou) en République du Bénin.

Les résultats que nous présentons ici, fournissent des informations sur : (i) la genèse des sites maraîchers et les raisons actuelles liées au développement de l'agriculture urbaine de même que la typologie des acteurs intervenant dans cette

agriculture, (ii) les pratiques paysannes en matière de gestion des sites maraîchers; (iii), les avantages et inconvénients de cette activité sur l'environnement et la santé humaine.

MATÉRIEL ET MÉTHODES

Zone d'étude

L'étude a été réalisée en République du Bénin, de janvier à décembre 2013 dans les sites maraîchers de Cotonou, Porto-Novo et celui de Parakou.

Toutefois, les sites de ''Houeyiho'' (à Cotonou, capitale économique du Bénin) de ''Acron'' (à Porto-Novo, capitale politique du Bénin) et de ''Azêrekê'' (à Parakou, la plus importante ville de la région septentrionale du Bénin), qui sont les plus importants et les plus anciens ont retenu plus notre attention au cours de nos investigations.

Enquêtes sur la genèse et le développement des sites maraîchers au Bénin

A l'aide d'un GPS (Global Positioning System) et de la carte de la localisation de chaque commune, tous les sites maraîchers installés au centre et à la périphérie de Cotonou, Porto-Novo et Parakou ont été localisés et recensés. Au cours du recensement, les producteurs de légumes ont été soumis à un questionnaire semi-structurés. Pour mieux cerner les raisons liées au développement des zones maraîchères au Bénin, des enquêtes KAP ("Knowledge-Attitude-Practice ") à échantillonnage aléatoire ont été menées et organisées dans les sites maraîchers de Houeyiho, de Acron et de Azèrèkè. Le questionnaire avait porté, entre autres, sur l'histoire de chaque site, sa superficie, le nombre de personnes qui exploitent le site, la famille agricole que cette ressource humaine représente, les variétés de légumes cultivés, les tranches d'âges des maraîchers, le genre, la typologie des maraîchers, leur niveau d'instruction et les avantages directs et indirects qu'offre cette agriculture aux populations ; mais aussi les handicaps qui entravent l'envolée du maraîchage. Les techniques de recueil des données qualitatives ont porté sur l'observation directe sur le terrain et sur des entretiens individuels et collectifs (groupes de parde) afin de connaître les divers groupes d'insecticides qui sont utilisés sur les sites maraîchers. Chaque groupe (au moins 6 par périmètre) avait été interviewé deux fois trimestriellement sur une durée de 45 minutes chacun.

Analyse des données

Les données sociologiques recueillies auprès des maraîchers ont été traitées à l'aide du logiciel Epi info version 6 et les graphes ont été réalisés à l'aide du logiciel Microsoft Excel version 2007 afin de connaître la superficie des sites maraîchers, le nombre de personnes qui exploitent le site, la famille agricole que cette ressource humaine représente, les variétés de légumes cultivés, les tranches d'âges des maraîchers, le genre, la typologie des maraîchers, leur niveau d'instruction les problèmes phytosanitaires liés au maraîchage et les avantages directs et indirects qu'offre cette agriculture aux populations.

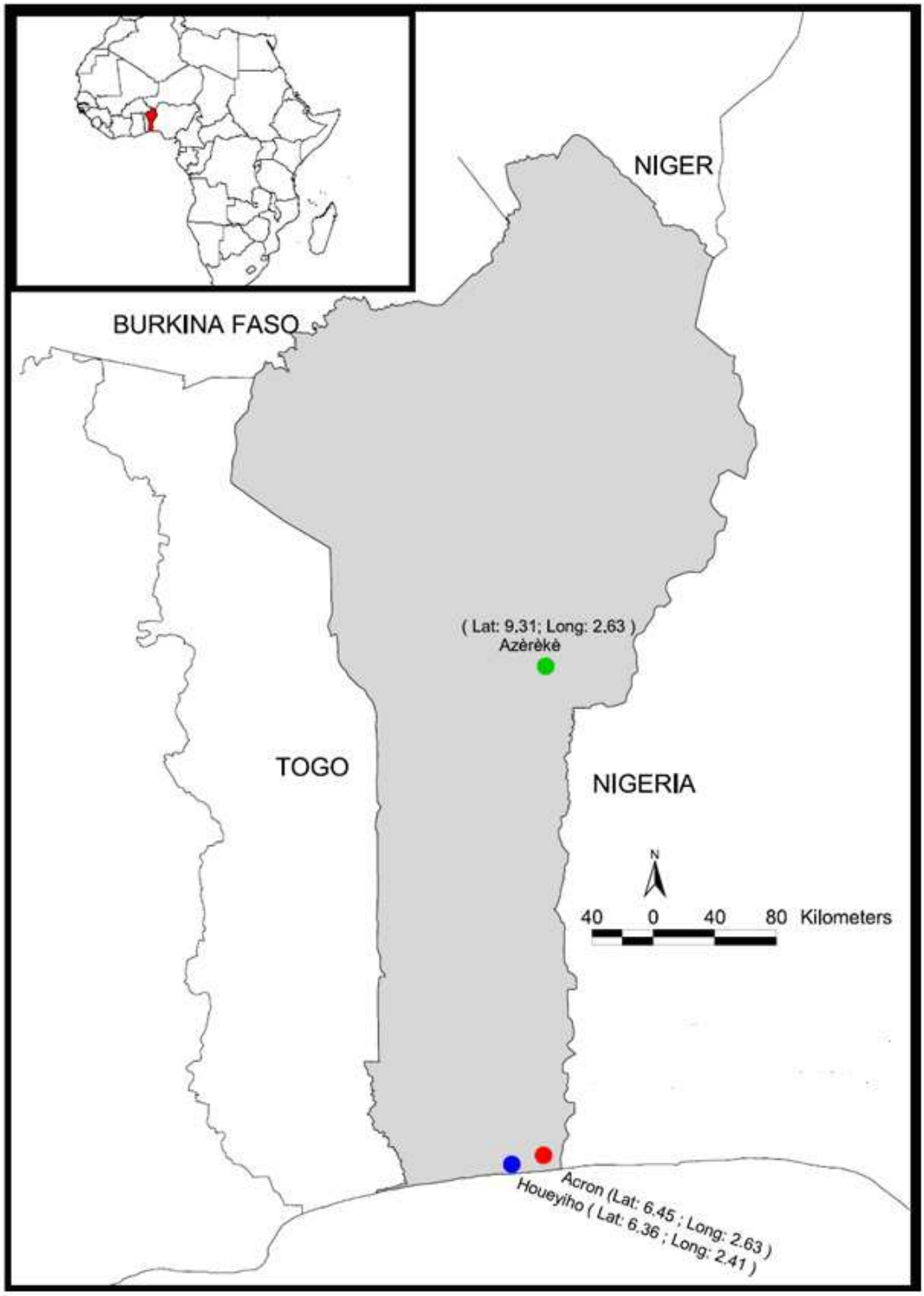


Figure1: Carte du Bénin illustrant les sites d'études.

RÉSULTATS

1. Genèse et gestion des sites maraîchers au Bénin

Les informations recueillies auprès des maraîchers au cours de nos investigations indiquent que la production maraîchère avait débuté durant la période coloniale sur le site d'Acron avec les premiers missionnaires Français en 1945 pour des besoins de subsistance. Ce site est situé au sud de la ville de Porto-Novo sur une superficie de 3 hectares avec 10 maraîchers. Il compte aujourd'hui plus de 150 maraîchers qui travaillent tous les jours sur une superficie de plus de 20 hectares. La particularité de ce périmètre maraîcher est sa situation dans une zone marécageuse et sa proximité avec la lagune de Porto-Novo.

Mais en 1972, le maraîchage a connu une réforme avec les autorités municipales qui ont entrepris d'organiser les maraîchers urbains. A Cotonou, le premier site occupé en 1972 était un domaine inoccupé de l'ASECNA, actuel Houeyiho, avec un effectif de 35 maraîchers au départ. Mais en 1974, cet effectif s'est accru à 112 avec une superficie agricole de 1200 m^2 par personne. Avec le temps, le mouvement s'est intensifié avec les jeunes diplômés sans emploi, les jeunes déscolarisés, les migrants ruraux, ainsi que les déflatés des sociétés de l'Etat. Ainsi, le site maraîcher de Houéyiho, situé au centre de la ville de Cotonou, dans un quartier de forte densité humaine et d'une superficie de 14 hectares est divisé en 5 groupes de maraîchers dont chacun est dirigé par un bureau qui a, à sa tête un président. Ce site regroupe plus de 3000 maraîchers qui y travaillent tous les jours. Ces derniers estiment que cette situation s'est accentuée avec la crise économique qui a conduit le Bénin au gel du recrutement des nouveaux diplômés à partir de 1987. Avec cette nouvelle donnée, cette activité est devenue un nouveau métier auquel s'adonnent plusieurs couches de la société. La ville de Cotonou qui comptait 5 sites maraîchers il y a une décennie, compte en 2013 plus d'une cinquantaine (figure 2) dont quinze sont très importants en terme de superficie et de nombre de maraîchers.

Cette multiplication de sites maraîchers est observée aussi dans la ville de Parakou. En effet, le site d'Azèrèkè qui a retenu notre attention au cours de nos investigations était le premier du Septentrion à être installé en 1980 par des anciens maraîchers de Cotonou suite au problème foncier du site de Houeyiho. Il est majoritairement animé par les hommes (35-50 ans).

Les investigations faites sur le développement de la filière du maraîchage au Bénin montrent que cette filière reste dominée par les jeunes (21 à 40 ans) formant plus de 67% de la population des exploitants (figure 3), ce qui augure d'une activité en plein essor. Aussi, le taux non négligeable d'adultes (plus de 40 ans) dans ce type d'activité est la preuve que le maraîchage intéresse tous les âges de la société.

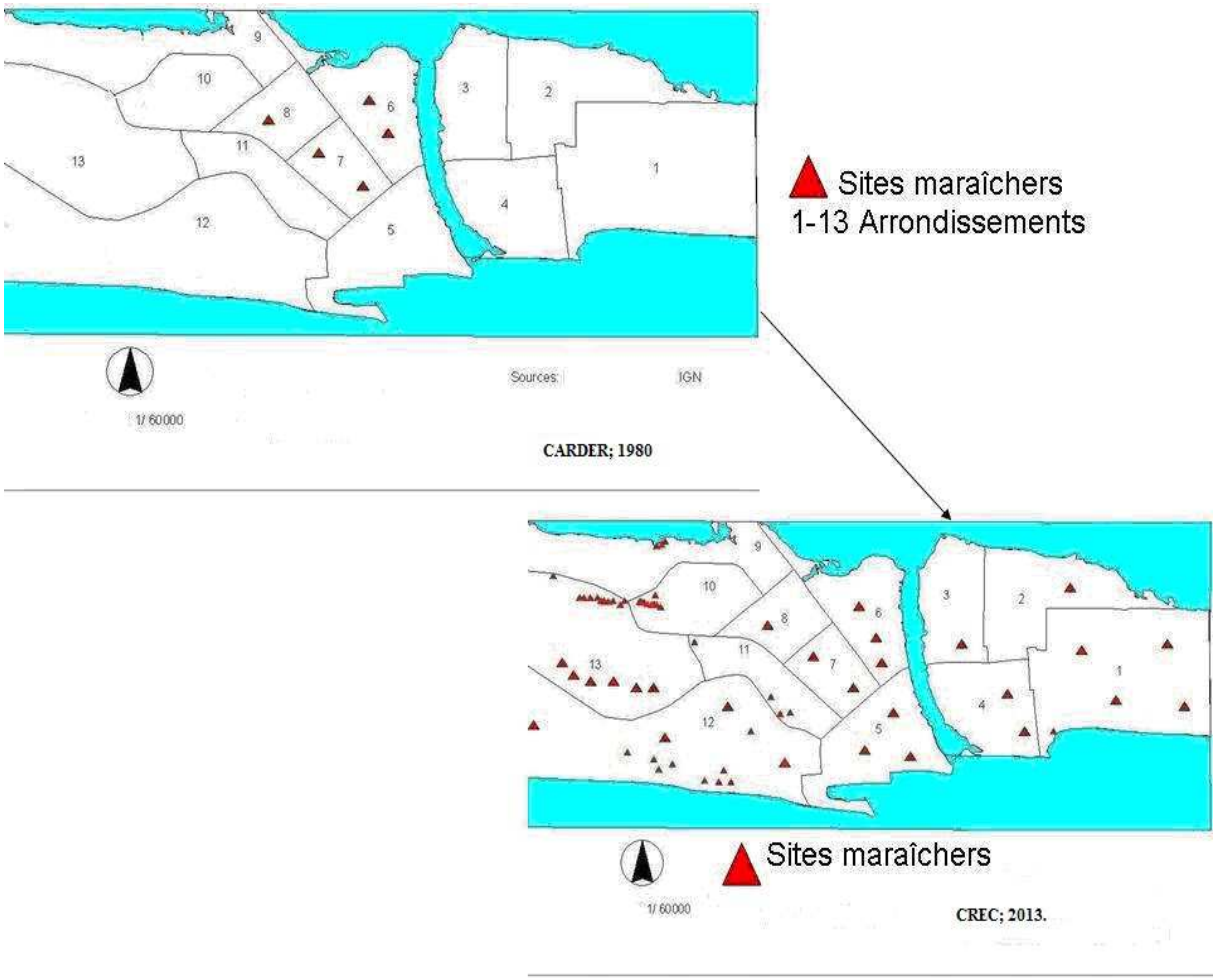


Figure 2 : Carte de la ville de Cotonou illustrant la multiplication des sites maraîchers de 1980 à 2013 dans la ville de Cotonou.

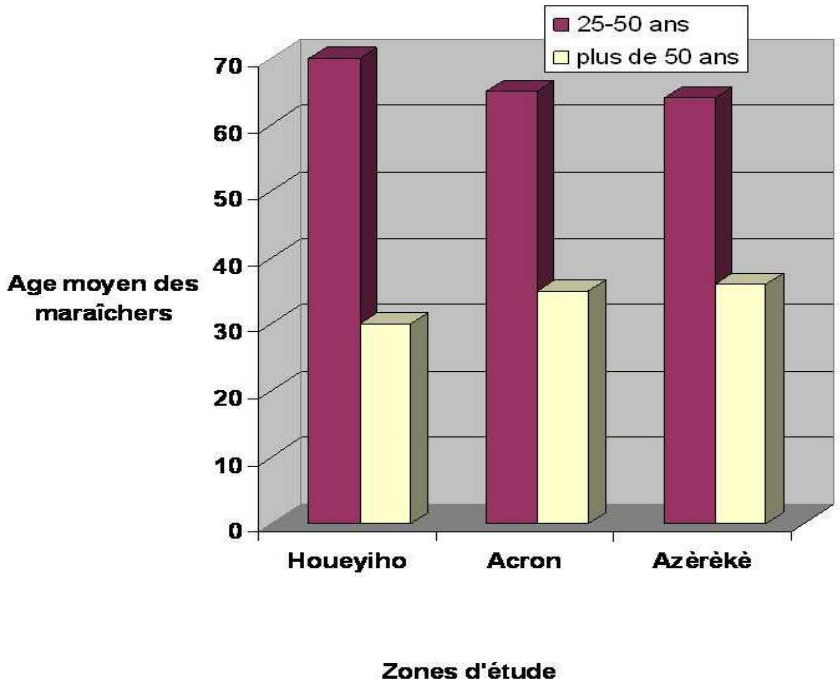


Figure 3: Age moyen des maraîchers dans les zones d'étude

2-Utilisation des insecticides sur les sites maraîchers.

Dans les périmètres maraîchers de Houéyiho, d'Acron et d'Azèrèkè, la totalité des maraîchers interrogés ont reconnu qu'il n'est pas possible de cultiver les légumes sans utiliser des insecticides. Certains légumes comme le chou vert, la laitue et l'amarante sont sensibles aux attaques de certains ravageurs. Ainsi, lors des traitements phytosanitaires, beaucoup de maraîchers font l'association d'insecticides chimiques (insecticides + insecticides, insecticides + fongicides, insecticides + nématicides, etc).

Parmi les insecticides les plus utilisés, deux viennent en tête : le Decis® (deltaméthrine EC10.75 g/l), et le Kinikini (mélange de cyfluthrine et de malathion) (Tableau I). Sur le site de Houéyiho et d'Acron, les insecticides sont vendus par un magasin géré par les maraîchers et installé sur le site. Toutefois, au cours de nos investigations, moins de 20% des maraîchers de Houeyiho contre 40% à Acron déclarent s'approvisionner dans une coopérative maraîchère formelle et agréée par l'Etat. A Azèrèkè, 80% des maraîchers interrogées déclarent s'approvisionner dans le ''marché noir '' et 20% dans les services spécialisés du Ministère de l'Agriculture, de l'Elevage et de la Pêche (MAEP).

Aussi, dans les trois sites maraîchers, moins de 15% des maraîchers respectent les doses des traitements recommandées par les encadreurs ; au moins 42 % font des associations des doses et 45% ne respectent pas les doses recommandées (figure 4). En cas d'attaque avancée des cultures par les insectes, cette dose est augmentée à volonté selon certains maraîchers ou remplacées par des insecticides qu'ils qualifient de '' très forts'' et qui sont souvent les insecticides chimiques du coton. Parmi ces insecticides, on peut citer: Phaser, Conquest plus, Decis, Dursban et qui sont beaucoup plus utilisés par les maraîchers de Azereke et ceci du fait de la production intense du coton dans cette circonscription.

Tableau 1 : Insecticides régulièrement utilisés sur les sites maraîchers de Houeyiho, Acron et Azèrèkè

Nom commercial	Nom de la matière active	Famille
Cyhalone	deltaméthrine	PYRETHRINOÏDE
Decis	deltaméthrine	PYRETHRINOÏDE
Malathion	malathion 500 g/l	ORGANOPHOSPHORE
Furadan	carbofuran	CARBAMATE
Kinikini	mélange cyfluthrine+malathion	PYRETHRINOÏDE
Nurelle D35/300	mélange cyperméthrine 35 g/l + chlorpyriphos méthyl 300 g/l	ORGANOPHOSPHORE
Cytoate 335EC	mélange cyperméthrine 35 g/l + diméthoate 300 g/l	PYRETHRINOÏDE
Cypercal D335	Cyperméthrine	PYRETHRINOÏDE
Dursban B18/300	mélange cyfluthrine 18 g/l – chlopyriphos éthyle 300 g/l	PYRETHRINOÏDE
Callisulfan 350EC	endosulfan 350g/l	CYCLODIÈNE
Orthène 50	Acéphate	CARBAMATE

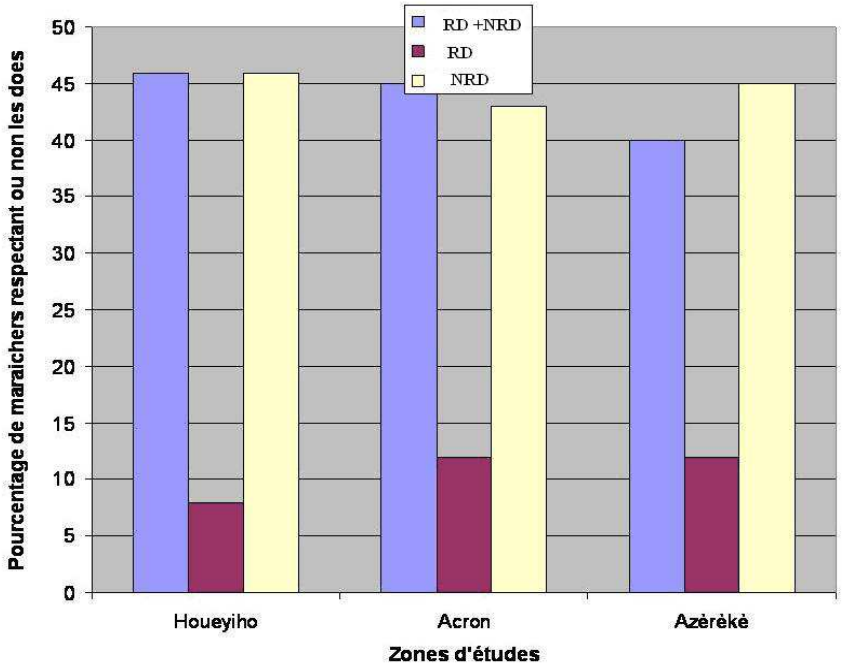


Figure 4: Pourcentage des maraîchers respectant ou non les doses d'insecticides dans les trois zones d'étude

Légende :
- RD = Respect des doses recommandées
- NRD= non respect des doses recommandées
- RD+DNR= Association des deux doses

3-Typologie des producteurs maraîchers

Les résultats issus de nos investigations montrent que le maraîchage, dans sa valorisation fait apparaître 3 types de maraîchers ; permanents, à temps partiel et temporaires. En effet, les maraîchers permanents représentent respectivement 75% ; 85% et 90% de l'effectif total des maraîchers de Houeyiho, Acron et Azèrèkè et regroupent les jeunes déscolarisés et chômeurs. Alors que les maraîchers à temps partiel qui font 15% ; 10% et 8% de l'effectif total des maraîchers de Houeyiho,

Acron et Azèrèkè regroupent des fonctionnaires, des petits commerçants, des artisans, des apprentis, des élèves ou des salariés du secteur privé.

Les maraîchers temporaires se composent des individus sans emploi fixe. Ils font 10% ; 5% et 2% de l'effectif total des maraîchers de Houeyiho, Acron et Azèrèkè.

Mais cette classification des maraîchers est seulement indicative, car certains peuvent se trouver dans l'un ou l'autre type selon leurs besoins immédiats.

4-Avantages de l'agriculture urbaine

Sur le plan économique, l'agriculture maraîchère offre beaucoup d'avantages aux maraîchers. Les données quantitatives et qualitatives générées par les entretiens individuels et collectifs avec les maraîchers des 3 grands sites de notre étude révèlent un impact socio-économique de l'agriculture urbaine de type maraîcher sur le niveau de vie des familles impliquées. Une étude statistique réalisée au cours de nos investigations dans les divers périmètres maraîchers montre que l'agriculture urbaine rapporte en moyenne plus de 300 millions de F Cfa de marge brute par an à l'ensemble des maraîchers. Les informations collectées au cours de nos investigations indiquent que cette agriculture contribue à rentabiliser aussi l'élevage de volaille en consommant annuellement près de 50 tonnes des fientes produites par les fermes d'élevage ; soit près d'un million de francs Cfa/ha d'achat aux aviculteurs.

Sur le plan social, l'agriculture maraîchère constitue un secteur pourvoyeur d'emploi. En effet, dans les sites maraîchers de Cotonou, on dénombre plus de 600 chefs d'exploitation et environ 1000 maraîchers qui y travaillent de façon permanente. Des milliers de bénéficiaires indirects tels que les vendeurs d'intrants, les grossistes et détaillants de ces légumes frais tirent aussi des revenus substantiels de cette activité.

Ces sites maraîchers constituent aussi des centres par excellence d'apprentissage pratique aux diverses techniques de productions des légumes pour les déscolarisés, les diplômés sans emploi et les retraités.

Aussi, bon nombre de maraîchers déclarent améliorer leur condition de vie et celle de leurs familles à partir des revenus du maraîchage. Les résultats de nos investigations auprès de ces derniers et dans leur ménage montrent que plus de 75% des maraîchers disposent d'un moyen de déplacement, d'une ou des maisons construites, scolarisent leurs enfants et ceci à partir des revenus que leur procure le maraîchage.

Sur le plan environnemental, l'impact positif du maraîchage est non moins négligeable. En effet, l'agriculture maraîchère contribue à l'assainissement de la ville de Cotonou grâce à la valorisation des ordures ménagères à travers la fabrication du compost qui se fait sur les sites maraîchers dont notamment celui de Houeyiho.

5-Inconvénients du développement de l'agriculture maraîchère sur l'environnement et la santé humaine

Malgré les multiples avantages qu'offrent les sites maraîchers, ils constituent sur le plan sanitaire, des endroits par excellence favorables au développement des gîtes larvaires, en particulier ceux d'*An. gambiae*, principal vecteur du paludisme en Afrique de l'Ouest. En effet, la formation des planches de cultures crée de très nombreuses rigoles qui retiennent de l'eau de pluie et d'arrosage. Ainsi, pendant les saisons pluvieuses, ces rigoles constituent de véritables gîtes de moustiques, en particulier d'*Anopheles gambiae*, principal vecteur du paludisme en Afrique. En plus de ces gîtes, les jardiniers creusent des trous d'eau qui sont utilisés pour l'arrosage des cultures. Ces trous d'eau sont des endroits favorables au développement des larves d'*An. gambiae*. Ces conteneurs généralement non couverts sont propices à la ponte des œufs de moustiques.

Dans la lutte contre les ravageurs des cultures, une forte utilisation d'insecticides chimiques dont la plupart restent encore non recommandés en maraîchage a été constatée ce qui, pourraient contribuer à la résistance des insectes ravageurs des cultures mais aussi chez les vecteurs du paludisme.

DISCUSSION ET CONCLUSION

Les informations recueillies lors des entretiens avec les maraîchers et les observations faites dans les divers périmètres maraîchers confirment un développement des zones maraîchères au Bénin et leur importance économique. En effet, l'agriculture urbaine contribue à la satisfaction de la demande alimentaire et aux besoins nutritionnels des populations urbaines. Elle procure un revenu régulier et subséquent aux producteurs tout au long de l'année. Une étude statistique réalisée au Bénin sur le maraîchage en 2003 montre que le revenu annuel moyen d'un maraîcher qui cultive en plein temps est estimé à 640.000F CFA [**11, 18**]. A Lomé, le revenu mensuel (net) du maraîcher est en moyenne de 185 000 F CFA, soit un salaire de plus de 10 fois le SMIG (Salaire Minimum Interprofessionnel Garanti) actuel et voisin de celui d'un haut cadre dans

l'administration publique [**19**]. Ces quelques exemples sont la preuve que cette activité apporte sa contribution à l'amélioration des conditions de vie des maraîchers et de celles de leur famille. De ce fait, cette agriculture est devenue un nouveau métier auquel s'adonnent plusieurs couches de la société : hommes, femmes, enfants, diplômés sans emploi et même les fonctionnaires en fin de semaine et pendant leurs congés. Elle contribue à la résorption du sous-emploi en rassemblant une ressource humaine agricole de plus de 1000 habitants sur les sites de Cotonou en majorité jeunes (20-40ans) qui y voient ainsi un refuge.

L'évolution du nombre de maraîchers (plus de 6 fois que celui de 1972) témoigne que le maraîchage est une activité intéressante à plein temps ou à temps partiel au Bénin.

Cependant, malgré les multiples avantages qu'offrent les sites maraîchers, ils constituent sur le plan sanitaire, des endroits par excellence favorables au développement des gîtes larvaires, en particulier ceux d'*An. gambiae*, principal vecteur du paludisme en Afrique de l'Ouest. En effet, les travaux de Klinkenberg et *al.* [**20**] au Ghana et de Yadouléton et *al.* [**15**] au Bénin ont montré que les zones maraîchères contribuent à l'augmentation de la faune culcidienne.

Si les résultats de l'enquête ont montré que l'utilisation des insecticides agricoles est une réalité au Bénin, la plupart de ces insecticides restent non recommandés pour le maraîchage. Cette situation serait due à la libéralisation du secteur de vente d'intrants en République du Bénin et par le coût élevé que pratiquent les magasins agréés par l'Etat et qui, malheureusement, se trouvent souvent en rupture de stocks.

Ces traitements qui s'effectuent toutes les semaines envoient des particules d'insecticides dont certaines sont en contact avec le sol et les gîtes, et par conséquent avec les larves de moustiques [**21-22**]. La pression exercée par ces insecticides pourrait conduire au développement de la résistance des moustiques, en particulier d'*An. gambiae* vis-à-vis de ces insecticides [**23-26**]. Malheureusement, cette résistance est un handicap à la lutte anti- vectorielle depuis quelques années, suite à la baisse de sensibilité observée chez *An. gambiae* vis-à-vis des pyréthrinoïdes. En effet, Les pyréthrinoïdes utilisés par les maraîchers sont les mêmes que ceux utilisés en santé publique pour combattre les moustiques adultes. Or, ces produits sont les seuls insecticides recommandées par l'OMS pour l'imprégnation des matériaux imprégnés et constituent aujourd'hui la principale arme de protection individuelle et collective contre les piqûres de moustiques [**27-28**]. Parmi ces pyréthrinoïdes, la Deltaméthrine reste sans doute le produit le plus utilisé dans l'imprégnation des moustiquaires mais aussi celle qui est la plus utilisée par les maraîchers.

Il s'avère nécessaire et indispensable de penser à une meilleure utilisation des pesticides chimiques en agriculture maraîchère pour limiter non seulement les effets nocifs de ces derniers sur l'environnement mais aussi sur la santé humaine.

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REFERENCES

[1] BIT (Bureau International du Travail). (2000). Sécurité du revenu et protection sociale dans un monde en mutation. In: *BIT (Ed.)* Rapport sur le travail. Genève, Suisse. p. 18.

[2] Winters, C. (1983). The classification of traditional African cities. Journal of Urban History 10 (1), pp. 3-31.

[3] FAO (Food and Agriculture Organisation of the United Nations). (1996). Stratégie nationale de sécurité alimentaire. Production alimentaire durable et sécurité alimentaire au Togo.

[4] Cissé, G., Kientga, M., Ouédraogo, B. & Tanner, M. (2002). Développement du maraîchage autour des eaux de barrage à Ouagadougou: quels sont les risques sanitaires à prendre en compte. *Cahiers Agricultures* 11 (1), 31-38.

[5] Dijk van, & Pieter M. (1995). Le secteur informel dans les villes et sa contribution positive à leur développement ». *Le Courrier*, n° 149, p.73

[6] Alexandratos, Nikos. (1995). World agriculture towards *2010*, étude de la FAO, J. Wiley & Sons, Chichester, UK, et FAO, Rome, 1995, 488 p.

[7] Assogba-Miguel, V. (1999). Agriculture urbaine et périurbaine à Cotonou. *Bulletin de la Recherche Agronomique du Bénin* n°27. pp 14-26

[8] Hounkpodoté M. et Tossou C. (2001). Profil des interactions entre la problématique foncière et le développement de l'agriculture urbaine dans la ville de Cotonou et environs. (*Ré. Nat. PAU*), Bénin. 61p.

[9] Union Communale des Producteurs de Cotonou. (2000). La problématique du maraîchage à Cotonou, Bénin. Rapport final du séminaire atelier.

[10] Editorial, Magazine agriculture urbaine. (2001). Entre les impacts positifs et négatifs. Magazine publié par le Centre d'information sur l'agriculture urbaine et la foresterie.
[11] Hounkponou, K. S. (2003). Agriculture et Urbanisation : Analyse de la pression foncière sur les activités de maraîchage dans le Sud du Bénin. Cas de Cotonou, Ouidah et Grand-Popo. Thèse d'Ingénieur Agronome, Faculté des Sciences Agronomiques, 10p.
[12] Dongmo, T., Gockowski, J., Hernandez, S., Awono, L.D.K. & Mbang à Moudon, R. (2005). L'agriculture périurbaine à Yaoundé : ses rapports avec la réduction de la pauvreté, le développement économique, la conservation de la biodiversité et de l'environnement. *Tropicultura* 23 (3), 130-135.
[13] J. Dossou-Yovo, J. M. C, Doannio, S, Diarrassouba & G. Chauvancy. (1998). Impact d'aménagements de rizières sur la transmission du paludisme dans la ville de Bouaké, Côte d'Ivoire. *Trop Med Parasitol,* 1984, (64) 135-158.
[14] Yadouléton AW, Asidi A, Rousseau FD, Braïma J, Agossou CD, Akogbeto MC. (2009). Development of vegetable farming: a cause of the emergence of insecticide resistance in populations of *Anopheles gambiae* in urban areas of Benin. *Malaria Journal*, 8:103.
[15] Yadouléton AW, N'Guessan R, Allagbé H, Asidi A, Boko M, Osse R, G. Padonou, Gazard K, Akogbéto M. (2010). The impact of the expansion of urban vegetable farming on malaria transmission in major cities of Benin. *Parasites & Vectors*, 3:118.
[16] Akogbéto,M., Djouaka R; & NOUKPO H. (2005). Use of agricultural insecticides in Benin. *Bulletin de la Société Pathologie Exotique*. 98, 400–405.
[17] Corbel V, N'Guessan R, Brengues C, Chandre F, Djogbenou L, Martin T, Akogbéto M, Hougard JM, Rowland M. (2007). Multiple insecticide resistance mechanisms in *Anopheles gambiae and Culex quinquefasciatus* from Benin, West Africa. *Acta Trop*. 101:207-216.
[18] PADAP. (2003). Programme d'Appui au Développement Agricole Périurbain du Sud Bénin. Rapport de l'´etude Diagnostic: demande, offre et marchés et système de production; *Tome 2, Agrisud Internationl*, 148 p.
[19] Adotevi JohnBosco. (1997). Les maraîchers sont sur le sable. *Revue Grain de sel*, N°7, p. 9.
[20] Eveline Klinkenberg, PJ McCall, Wilson DMichael, Amerasinghe PFelix, Donnelly JMartin. (2008). Impact of urban agriculture on malaria vectors in Accra, Ghana. *Malar J*, 7:151.
[21] Akogbéto, M., Djouaka RF, & Kinde-Gazard DA. (2006). Screening of pesticide residues in soil and water samples from agricultural settings. *Malaria Journal*. 5, 22.
[22] Yadouleton A, Martin T, Padonou G, Chandre F, Asidi A, Djogbenou L, Dabiré R, Aïkpon R, Boko M, Glitho I, Akogbeto M. (2011). Cotton pest management practices and the selection of pyrethroid resistance in *Anopheles gambiae* population in Northern Benin. *Parasit Vectors* , 4:60
[23] Aïkpon R, Aïzoun N, Sovi A, Ossè R, Oussou O, Govoetchan R, Oké-Agbo F, Akogbéto M. (2014). Increase of *Ace-1* resistance allele in the field population of *Anopheles gambiae* following a large scale indoor residual spraying (IRS) implementation using bendiocarb in Atacora region in Benin, West Africa. *J cell Anim Biol*, 8(1):15-22.
[24] Ossè R, Aikpon R, Padonou G, Oussou O, Yadouléton A, Akogbéto M. (2012). Evaluation of the efficacy of bendiocarb in indoor residual spraying against pyrethroid resistant malaria vectors in Benin: results of the third campaign. *Parasit Vectors*, 5:163
[25] Akogbéto MC, Padonou GG, Gbénou D, Irish S, Yadouleton A. (2010). Bendiocarb, a potential alternative against pyrethroid resistant *Anopheles gambiae* in Benin. *West Africa. Malar J*, 9:204.
[26] Agossa F, Aïkpon R, Azondekon R, Govoetchan R, Padonnou GG, Oussou O, Oke-Agboa F, Akogbeto M. (2014). Efficacy of various insecticides recommended for indoor residual spraying: pirimiphos methyl, potential alternative to bendiocarb for pyrethroid resistance management in Benin, West Africa. *Trans R Soc Trop Med Hyg*, 108:84-91.
[27] Mouchet, J. Mini-review. (1988). Agriculture and vector resistance. *Insect Science and its Applications*. 9, 297-302.
[28] Zaim M, Aito A & Nakashima N. (2002). Safety use of pyrethroid treated nets. *Med Vet Entomol*, 14, 1-5

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Biological control of the larval mosquito *Culex pipiens* Say using bio-pesticide *Bacillus thuringiensis israelensis* and growth regulator Dimilin

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ABSTRACT: This study was conducted at the Research Laboratory / Animal House Animal / College of Science / Mustansirhiya University to evaluate the efficiency of the growth regulator Dimilin chitin synthesis inhibitor by three different concentrations of 0.5, 1.0 and 1.5 ppm and efficiency of bacteria *Bacillus thuringiensis israelensis* concentrations 6.25×10^9, 6.25×10^{10} and 6.25×10^{11} spores / ml at different instars larval mosquito *Culex pipiens*. Highest mortality was 100% of the growth regulator at 1.5 ppm for a period of 48 hours and lowest mortality was 26.67 % for the 12-hours period of concentration of 0.5 ppm for the first instar larval, respectively. The highest mortality was 86.67 % of the growth regulator at 1.5 ppm within 48 hours and lowest mortality was 20 % during the 12-hours concentration of 0.5 ppm for the second instar larval, respectively. The results showed that the highest mortality was 73.33 % during the 48-hours concentration of 1.5 ppm and lowest mortality was 33.33 % of the concentration of 1.0 ppm during the 12 hours of third instar larval respectively. The highest mortality of the fourth instar larval reached 80% within 48 hours and lowest mortality was 26.67 % of the two concentrations 0.5 and 1.0 ppm for growth regulator.

The results showed that the highest mortality of bio-pesticide Bti was100% of the first instar larval at 6.26×10^{11} spores / ml within 24 to 48 hours and lowest mortality was 40% of the concentration of 6.26×10^9 spore / ml within 12 hours. The highest mortality of second instar larval was 100% for two concentrations 6.25×10^{10} and 6.25×10^{11} spores / ml within 24 and 48 hours, respectively, and lowest mortality was 53.33% of the concentration of 6.25×10^9 spore / ml within 12 hours and the highest mortality of the third and fourth instar larval 100%, respectively, during the 48-hours concentration of 6.25 × 1011 spores / ml, and lower ratios for killing concentration 6.25 × 109 spore / ml was 40% and 33. 33% for the two ages, respectively, within 12 hours.

KEYWORDS: Biological control, larval mosquito Culex pipiens Say, bio-pesticide Bacillus thuringiensis israelensis, growth regulator Dimilin.

INTRODUCTION

The mosquitoes of the enemies of man as the father of his transmission serious diseases such as malaria and Filarial, yellow fever and other and led to death. In 2008, the number of people diagnosed with malaria in the world's 243 million people, almost 863,000 people has died (Howard et al; 2010).

Mosquitoes spread mainly in Iraq from the far north and south, even as there are in Iraq 16 species of Anopheles. Some of *Anopheles spp* which have not previously registered in Iraq and 18 species of Culex belongs to the family of Culicidae, one of the most important families in the rank of bilateral wings Diptera. The family includes under Culicinae belongs to this family of many races and is Aedes, Anopheles, Culex As for the genus Culex fitted with many types of the most important of Culex pipiens and called this kind *Cx. Complex* because it has three subspecies are:

Cx.pipiens pipiens, Cx.pipiens molestus, Cx pipiens quinquefasciatus, spreading mosquitoes *Cx.pipiens quinquefascitus* in Iraq in abundance in the central and southern regions, either *Cx.pipiens molestus* Venture in northern Iraq, particularly in the area of Mosul, *Cx.pipiens pipiens* it spreads different areas of Iraq, including Baghdad, especially in homes and breed in

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different environments, such as waste water and sewer openings and small ponds and pots and cans and abandoned pools of rain water and tunnels and wells (Abu Alhab.1979).

Have used many chemical pesticides to combat mosquitoes and various insects and harmful aquatic including mosquitoes despite chemical pesticides have the great successes in eliminating the causes of insect-borne diseases to humans , animals and plants and kill other types of beneficial insects (Al-Adel.1979) , but the control these diseases has become very difficult due to increased insect resistance to pesticides in spite of its significant contribution to the control of the disease , they have the ability to water pollution , soil and food their presence to change the attributes of quality to the atmosphere of the Biosphere (Rajkumar and Jebanesan, 2005).

Can get rid of the larvae and adult mosquitoes also through prevention and control , prevention is meant to reduce mosquito breeding by removing the drinking water for mosquito breeding and filling ponds and poured the remaining water in pots and drums and not allowed to assemble and disposal and cleaning of beaches , sewage and streams and the edges of the channels , while the adult can be taken away and to prevent its arrival to humans and animals , using metal grille with small openings for windows and doors and exposing rooms to the light and prevent moisture and fogging squares and large halls (Abu Alheb.1979) .

The failure to find new groups of pesticides has led many scientists to the discovery of new studies to look for ways to the vitality and economic alternative (Shalaan et al; 2006).

THE AIM OF THE STUDY

The present study aims to use unconventional means to combat the mosquito larvae of *Culex pipiens* by examining :

1- Effect of growth regulator Dimilin on the larval instars of mosquito *Culex pipiens* .
2- Effect of growth regulator Dimilin on larval different ages and compared with bio-pesticide *Bacillus thuringiensis israelensis*.
3- Study the impact of bio-pesticide as means anti-chemical alternative for reconstruction of different larval mosquito Culex pipiens using bio-pesticide *Bacillus thuringiensis israelensis*

MATERIALS AND METHODS

Collecting and breeding mosquito *Culex pipiens* Say:

Collected larvae of the mosquito Culex pipiens Say from Center for Disease transitional / Ministry of Health / Andalus Square / Baghdad- Iraq in the month of April 2013. Has larval rearing in laboratory/ House Animal / Department of Life Sciences / College of Science / Mustansirhiya University where developed larvae in the basins of the plastic 500 mL container over water tap 150 ml exposed to the sun up to 72 hours to get rid of the chlorine in the water normal (Hill and John 2007).

These larvae feed and fishmeal Fish consisting of (protein 35%, fat 2.5%, fiber 2.5%, 0.9-2% calcium, phosphate 0.8 -1.8%) with water basin notice Substituted from 4-3 days in order to avoid rot water and after turning the larvae to pupae and placed in wooden cages cubic shape, especially for the breeding of insects., and adult placed in the pot 500 mL of 150 ml tap water for up to 72 hours, and put pots inside cages breeding wooden dimensions (30 × 30 × 30 cm) closed Clamp metal from four sides and is covered with a cloth cylinder from one side, and the base of the timber and put cages in incubator at temperature 27 ± 2 C˚, and Lighting 12 hours a day, after the emergence of adult fed males using cotton swabs saturated with a solution of 10% concentration of sugar and placed in a glass dish inside the cage,

The females were fed using a dove (Pigeon) feather plucking them from the chest area and put the dove above the cage after tying their wings, and legs all night (Overnight) so that the female can get blood meal easily (Sivagnanme and Kalyanasundaram, 2004).

After 2-3 days collected Boats eggs (Egg rafts) set by the female feeders on blood transferred boats by a soft brush to basins clean glass with water forsaken for 72 hours, taking into account not move the boat to avoid the disintegration and break it, reared colony for three generations before initiate a treatments for the purpose of getting rid of the remnants of chemical and biological pesticides used to control them (al-Bandar 2013).

Preparation peptone water:

Peptone water attended peptone water of 15 grams of powder peptone to 1 liter of distilled water after sterilization by autoclave for 15 minutes under the temperature of 121 ° C and pressure of 1 atmosphere pH has 7.2 consisting of 10.0 g of peptone and 5.0 g sodium chloride.

Prepare nutritious media Nutrient agar:

Attended media appropriate and nutritious is Nutrient Agar by the manufacturer's recommendations (England, Basingstoke, Hampshire) using 28 g of the media in one liter of distilled water and then sterility device Autoclave at 121 ° C for 15 minutes, and pressure 1 atmosphere, and poured in Petri dishes, Bti planted isolation by way of strip by sterile Loop, and incubated at 37 ± 2C° for a period of 24 hours for bacterial growth was observed in all pure isolates.

Development and activation of the bacterium *Bacillus thuringiensis israelensis:*

The process of activating the bacteria by adding 1 g of powdered bacteria to 9 ml of peptone water, and planting nutrient agar dishes, sterile Petri to feed the bacteria and then planted in a manner of striking by Loop sterile, and put the sterilizer dishes in an incubator at a temperature of 37 $\pm$ 2 C° for 24 hours, observed the growth of bacteria and harvested by Loop sterile L-shaped to prepare different concentrations for the treatment of mosquito larvae of *Culex pipiens*, where isolation photographed using a compound microscope and the use of a digital camera.

Prepare concentrations and calculate the number of spores of the bacteria Bti:

Added 5 ml of distilled and sterilized water to the bacterial prepared on the media nutritious Nutrient agar in dishes with the addition of 0.2 ml of Tween-20 concentration of 0.20%, and harvested spores by the glass rod-shaped L, and filtered the contents by the suppression of a glass contains a piece of sterilized gauze with the addition of 5 ml of distilled and sterilized water to ensure filtering of all bacteria spores. And collect the filtrate in a glass beaker containing 10 ml of distilled water and suspended bacterial spores, is a suspended Stock suspension.

To calculate the number of spores bacterial been using a slide count Haemocytometer own to count the white blood cells where Added 1 ml of the stock solution to 99 ml of sterile distilled water. Then put 0.1 ml of it on a slide count after placing cover slide was counting the number of spores, according to the following equation (Aube and Gagnon, 1969).

Number of spores (spore / ml) = rate of spores × dilution factor × 25 x 10^4

Study the effect of the concentrations of spores' bacteria Bti in the different instars of *Culex pipiens* larvae:

To study the effect of three concentrations of bacteria Bti on first, second, third, fourth stage larvae and concentrations were(6.25×10^9, 6.25×101^{10}, $.256 \times 10^{11}$ spore / ml) where took 5 larvae of every stage and put in a pot winy 250 mL put 150 ml tap water up to for 72 hours, add 3 ml of each concentration of suspended bacterial Bti ml, with the addition of 1.5 g of fish diet for the purpose of feeding larvae repeated the experiment with three replicates per concentration.

Covered all the treated pots with pieces of cloth tulle linked bond rubber, and took reading after 12, 24 and 48 hours, to determine the percentage of mortality for each stage of larvae and Note distortions occurring in the larvae and the proportion of the emergence of the adult (Ishii and Ohba 1993).

The control was placed 5 larvae for each stage in the basin winy 250 mL, put 150 ml tap water up to 72 hours with the addition of an aqueous solution with Tween-20 concentration of 0.02% and with three replicates for each instars larval and each concentration.

Study the effect of growth regulator Dimilin in mosquito larvae *Culex pipiens*:

Obtained growth regulator Dimilin from the College of Agriculture - University of Baghdad to control mosquito larvae *Culex pipiens* after transferred 5 larvae for each stage and placed in a pot of wine 250 mL, put 150 ml of water, the usual exhibition of the sun and prepared already, and added different concentrations of this growth regulator which were 0.5, 1.0 and 1.5 ppm for all larval instars, With the addition of 1.5 g of diet fish in order to feed the larvae and repeated the experiment three times for each concentration and each instar larval, either the control treatment and placed 5 larvae of every instar in the pot of 250 ml, put 150 ml of water normal sun-exposed in advance with the addition of aqueous solution with Tween-20 concentration of 0.02%, and repeated treatment to control three times for each instars larval and each concentration and covered all the treatments and control cover cloth tulle and tied in the bond of rubber were followed larvae were recorded after 12, 24 and 48hours, to determine the percentage of mortality for each larvae instars, Note distortions occurring in the larvae and The percentage of adult emergence.

RESULTS AND DISCUSSION

1 - The effect of different concentrations of growth regulator Dimilin in first larvae instar of the *Culex pipiens*:

Showed results in Table (1) the effects of the concentrations of growth regulator Dimilin 0.5, 1.0 and 1.5 ppm and the time in the mortality of first instar larvae *Cx. pipiens* and notes that the highest mortality was100% for concentration1.5 ppm after 48 hours and lowest mortality for the same concentration reached 73.33% ppm after 12 hours, The highest mortality was 73.33% for the concentration0.5 ppm after 48 hours of treatment and lowest mortality was 26.67% after12 hours while the highest mortality was 86.67% at concentration 1.0 ppm either lowest mortality was 53.33% for the same concentration during the 12 hours of treatment.

The table shows the sensitivity of first instar was increasing according to increasing the concentration of Dimilin and increasing the period of treatment, as is evident in the picture (1) the highest mortality Compatible to the highest concentration 1.5 ppm and for long a period 48 hours and lowest mortality harmonious with lowest concentration 0.5 ppm and with less period 12 hours and Affect growth regulator on the occurrence of abnormalities in the larvae deformation of the wall of the body and chitin layers as set out in the picture (1). Statistical analysis showed significant differences between the concentrations and time of the mortality.

The results come consistent with (Hadley et al 1987) when exposed to the immature stages to growth regulator Dimilin get distortions of the larvae's body, which depends on the concentrations as the first and second larval instars more sensitive than third and fourth larval instars. And agree with (Najwa et al 2004) that the mortality for mosquito larvae *Cx.pipiens* commensurate with the concentration and reached mortality to 90% at concentration of 40 ppm after 3 days of treatment.

Table1: Effect of times and different concentrations of growth regulator Dimilin in mortality to the first instar larvae of Culex pipiens.

LSD	The periods / Hours			Concentrations Ppm
	48	24	12	
	Mortality %			
0.00	0.00 ± 0.0	0.00 ± 0.0	0.00 ± 0.0	0.0
* 23.07	6.67 ± 73.33	6.67 ± 53.33	6.67 ± 26.67	0.5
* 23.07	6.67 ± 86.67	6.67 ± 73.33	6.67 ± 53.33	1.0
* 18.83	0.0 ± 100.00	6.67 ± 86.67	6.67 ± 73.33	1.5
---	* 18.83	* 23.07	* 23.07	LSD
(P<0.05)				

** Indicate the presence of significant differences between the different treatments at the level of the probability (P <0.05), according to test less significant difference (LSD)*

2 - Effect of time and different concentrations of growth regulator Dimilin in second instar of the *Culex pipiens*:

Results in table (2) Showed the highest mortality at concentration of 0.5 ppm was 73.33% within 48 hours and less mortality was 20% within 12 hours, and the highest mortality at concentration 1.5 ppm was 86.67% within 48 hours and less mortality reached 60% within12 hours after treatment, Statistical analysis explained significant differences between the various above concentrations and the times, either at 1.0 ppm concentration reached highest mortality 60% and less mortality reached 46.67%, The statistical analysis shows no significant differences for different times. We note little resistance to the second instar larvae meaning it is less sensitive to the first instar larvae to growth regulator Dimilin notes have not been achieved mortality of 100%.

These vary results to (Mohsen et al 1989), where the sensitivity of larvae increases with exposure to growth regulator as well as the highest mortality larvae *Cx.pipiens* was 96% and 100% at concentrations of 1.3 and 3.23 ppm for growth regulator Dimilin after 3 days of exposure respectively.

These findings are consistent with Mulla (1995) in the same effect on *Cx. quinquefasciatus* where the mortality was 74.4% at the concentrations of 0.1 ppm, which causes a delay in the development of the immature stages.

Table 2: Effect of times and different concentrations of the growth regulator Dimilin in the mortality of second instar larvae of Culex pipiens.

LSD	The periods / Hours			Concentrations ppm
	48	24	12	
	Mortality %			
0.00	0.00 ± 0.0	0.00 ± 0.0	0.00 ± 0.0	0.0
* 18.63	6.67 ± 73.33	6.67 ± 53.33	0.00 ± 20.00	0.5
29.78	11.5 ± 60.00	6.67 ± 46.67	6.67 ± 46.67	1.0
* 18.63	6.67 ± 86.67	6.67 ± 66.67	0.00 ± 60.00	1.5
---	* 29.78	* 23.07	* 13.31	LSD
(P<0.05)				

** Indicate the presence of significant differences between the different treatments at the level of the probability (P <0.05), according to test less significant difference (LSD)*

3: the effect of time and the different concentrations of growth regulator Dimilin in the mortality to the third instar larvae of the *Culex pipiens*:

The table (3) show the results to the highest mortality of third instar larval when the concentration 0.5 ppm the mortality was 53.33% of the time 48 hours and less mortality was 40% of the time 12 hours and shows the statistical analysis, no significant differences for different times, The highest mortality was 73.33% at the concentration of 1.5 ppm for the time of 48 hours and less mortality was 46.67% for the 12 hours' time, and the highest mortality was 66.67% and the lowest mortality was 33.33% for the 12 hours' time when the concentration 1.0 ppm shows the statistical analysis to the presence of significant differences of concentrations 1.5 and 1.0 ppm and of different times.

These results are consistent with what it says (Duel et al 1978) that the compounds of growth regulators Not occur a quick death, but urges the inhibition of the synthesis of chitin and separated from the Epidermal through a process of molting.

These results differ to the findings by (Najwa et al 2004) show that growth regulator had a fatal effect against larvae *Cx.pipiens*. Had attributed the difference in results to the time difference and different environmental conditions and method of making treatments.

Table 3: Effect of times and different concentrations of growth regulator Dimilin in the mortality of the third instar larvae of the Culex pipiens.

LSD	The periods / Hours			Concentrations ppm
	48	24	12	
	Mortality %			
0.00	0.00 ± 0.0	0.00 ± 0.0	0.00 ± 0.0	0.0
18.63	6.67 ± 53.33	6.67 ± 53.33	0.00 ± 40.00	0.5
* 23.07	6.67 ± 66.67	6.67 ± 46.67	6.67 ± 33.33	1.0
* 23.07	6.67 ± 73.33	6.67 ± 66.67	6.67 ± 46.67	1.5
---	* 23.07	* 23.07	* 18.83	LSD
(P<0.05)				

** Indicate the presence of significant differences between the different treatments at the level of the probability (P <0.05), according to test less significant difference (LSD)*

4 - Effect of times and different concentrations of growth regulator Dimilin in mortality of fourth instar larvae of *Culex pipiens*:

Shown in Table (4) that the highest mortality was 80% at the concentration of 1.5 ppm in 48 hours and less mortality was 53.33% for the 12-hour time and the statistical analysis, there were no significant differences to concentrations and times, either higher mortality to the concentrations 1.0 and 0.5 ppm were 66.67 and 53.33%, respectively, within 48 hours, and lowest mortality was equal to the above concentrations was 26.67% during 12 hours, and the statistical analysis shows that there was significant differences for two concentrations and different times. Note for abnormalities superficial and obvious change such as in the trunk of the body of treatment adult emerging and deformation of the head and be thinner than the adult of non-treatment for third and fourth instars larval, as shown in the picture (5) (B, C, E). These results conform to the findings by(Prakash 1993) proved that where the growth regulator toxic effect used to control mosquito larvae *Cx.pipiens*.

(Mulla 1995) found that the compounds of growth regulators urging quick death, and when the larvae treatment with a growth regulator will lead to kill larvae during the moult and this note the absence of pupae Incidence distortions to both the larvae and pupae and adult, as shown in the picture (1), And thus will fail larvae and pupae in the removal of the old cuticle, and He explained the mortality of *Cx.quinquefacium* larvae reached 74.4% at a concentration of 0.1 ppm for growth regulator Dimilin.

This may be attributed the difference in the results of this study to the method of testing and the difference in the type of mosquitoes as well as the difference in the factors of environmental conditions.

Table 4: Effect of times and different concentrations of growth regulator Dimilin in mortality of the fourth instar larvae of Culex pipiens.

LSD	The periods / Hours			Concentrations ppm
	48	24	12	
	Mortality %			
0.00	0.00 ± 0.0	0.00 ± 0.0	0.00 ± 0.0	0.0
* 23.07	6.67 ± 53.33	6.67 ± 46.67	6.67 ± 26.67	0.5
* 29.78	6.67 ± 66.67	11.5 ± 40.00	6.67 ± 26.67	1.0
35.24	11.5 ± 80.00	11.5 ± 60.00	6.67 ± 53.33	1.5
---	* 29.78	* 35.24	* 23.07	LSD
(P<0.05)				

** Indicate the presence of significant differences between the different treatments at the level of the probability (P <0.05), according to test less significant difference (LSD)*



(B)



(A)



(D)



(C)

Image (1) (A): describes the larva is a natural not treatment with growth regulator Dimilin
B): larva growth regulator treatment note biodegradable layer cuticle
C): Image shows the decomposition of the larva's body is fully
D): A photo showing the deformation of the head of the larva treatment
Power magnification (40X)

5- The effect of times and different concentrations of the bio-pesticide *Bacillus thuringiensis israelensis* (Bti) in the mortality of the first instar larvae of *Culex pipiens*:

The results showed in Table (5) to the highest mortality reached 100% at the concentrations of 6.25×10^{11} spores / ml of the time 48 hours, and less mortality of the same concentration was 73.33% for the 12 hour time, and the highest mortality of two concentrations 6.25×10^{9} and 6.25×10^{10} spores / ml was 86.67% for the 48hour time, Less mortality reached 40% at a concentration of 6.25×10^{9} spore / ml, and less mortality was 53.33% at the concentration 6.25×10^{10} spores / ml for 12hour time, and statistical analysis shows significant differences between the different treatments and different times.

These effects as a result of the deadly toxic effects caused by bacteria Bti and agree this result to (Ibrahim 1990) larvae mortality of *Culex pipiens* reached to100% within 3 days when the bacteria Bti concentration 1.6×10^{3} spore / ml.

As well as agree on what it says (Shoukry 1986) to the deadly toxin produced by the bacteria Bti treatment where larvae affect the physiological processes within the gastrointestinal tract, leading to kill the larvae.

Table 5: Effect of times and different concentrations of the bio pesticide Bacillus thuringiensis israelensis (Bti) in the mortality of first instar larvae of Culex pipiens.

LSD	The period / Hours			Concentration Spore/ml
	48	24	12	
	Mortality %			
0.00	0.00 ± 0.0	0.00 ± 0.0	0.00 ± 0.0	0.0
* 29.78	6.67 ± 86.67	6.67 ± 73.33	11.5 ± 40.00	6.25×10^{9}
* 23.07	6.67 ± 86.67	6.67 ± 73.33	6.67 ± 53.33	6.25×10^{10}
* 13.31	0.0 ± 100.0	0.0 ± 100.00	6.67 ± 73.33	6.25×10^{11}
---	* 18.83	* 18.83	* 29.78	LSD
.(P<0.05) *				

** Indicate the presence of significant differences between the different treatments at the level of the probability (P <0.05), according to test less significant difference (LSD)*

6- The effect of times and different concentrations of the bio-pesticide *Bacillus thuringiensis israelensis* (Bti) in the mortality of the second instar larvae of *Culex pipiens*:

Indicates Table (6) to the lower resistance and high mortality to second instar larval, the mortality was100% for two concentrations 6.25×10^{10} and 6.25×10^{11} spore / ml within 24 hours and less mortality was53.33% at the concentrations of 6.25×10^{9} spore / ml during the 12hour and 93.33% at concentration 6.25×10^{11} spore / ml during the same period.

The statistical analysis indicates significant differences for two concentrations 6.25×10^{9} and 6.25×10^{10} spore / ml and the no significant differences for the concentration of 6.25×10^{11} spore / ml .

The results were consistent with the results of (Lee et al 2003) that the bacteria Bti cause mortality ranging from 85-100% against larvae of *Culex pipiens*, and the results had proven the researchers (Poopathi and Abidha 2010) which showed mortality was 96% of the *Culex pipiens* larvae.

Table 6: Effect of times and different concentrations of the bio pesticide Bacillus thuringiensis israelensis (Bti) in the mortality of second instar larvae of Culex pipiens.

LSD	The period/ Hours			Concentration Spore /ml
	48	24	12	
	Mortality %			
0.00	0.00 ± 0.0	0.00 ± 0.0	0.00 ± 0.0	0.0
* 18.83	0.0 ± 100.0	6.67 ± 93.33	6.67 ± 53.33	6.25×10^9
* 23.07	0.0 ± 100.0	0.0 ± 100.0	11.5 ± 60.00	6.25×10^{10}
13.31	0.0 ± 100.0	0.0 ± 100.0	6.67 ± 93.33	6.25×10^{11}
---	* 10.00	* 13.31	* 29.78	LSD
P<0.05				

** Indicate the presence of significant differences between the different treatments at the level of the probability (P <0.05), according to test less significant difference (LSD)*

7- The effect of times and different concentrations of the bio-pesticide *Bacillus thuringiensis israelensis* (Bti) in the mortality of the third instar larvae of *Culex pipiens*:

Table 7 indicates significant differences for the concentrations and different periods. The highest mortality reached 100% at the low concentration of the bio pesticide 6.25×10^9 spore / ml for a period of 48 hours exposure, as well as for two concentrations 6.25×10^{10} and 6.25×10^{11} spores / ml for the same period of exposure.

Less mortality was 40% for the concentration of 6.25×10^9 spore / ml within 12 hours, and the less mortality for two concentrations 6.25×10^{10} and 6.25×10^{11} spores / ml were 53.33 and 80% within 12 hours., And equal mortality 73.33% for two concentrations 6.25×10^9 and 6.25×10^{10} spores / ml for 24 hours' time.

We notice the results of the effect for the Bti bacteria in third instar larvae these results were compatible with the (Jamil 2007) found the mortality was within the range 91-100% using different concentrations of local isolates of Iraq against the third instar larvae of the mosquito *Cx pipiens*.

Table 7: Effect of times and different concentrations of the bio pesticide Bacillus thuringiensis israelensis (Bti) in the mortality of third instar larvae of Culex pipiens.

LSD	The period / Hours			Concentration Spore / ml
	48	24	12	
	Mortality %			
0.00	0.00 ± 0.0	0.00 ± 0.0	0.00 ± 0.0	0.0
* 13.31	0.0 ± 100.0	6.67 ± 73.33	0.00 ± 40.00	6.25×10^9
* 18.83	0.0 ± 100.0	6.67 ± 73.33	6.67 ± 53.33	6.25×10^{10}
* 13.31	0.0 ± 100.0	6.67 ± 93.33	0.00 ± 80.00	6.25×10^{11}
---	* 10.00	* 23.07	* 13.31	LSD
P<0.05				

** Indicate the presence of significant differences between the different treatments at the level of the probability (P <0.05), according to test less significant difference (LSD)*

8- The effect of times and different concentrations of the bio-pesticide *Bacillus thuringiensis israelensis* (Bti) in the mortality of the fourth instar larvae of *Culex pipiens*:

The results shown in the table (8) for the fourth instar larval that the highest mortality was 100% of the two concentrations 6.25×10^9 and 6.25×10^{11} spore / ml for 48 hours' time. The lowest mortality was 33.33 and 73.33% of the

concentrations 6.25×10^9 and 6.25×10^{11} spore /ml respectively, within 12 hours. We note at the time 24 hours had equal mortality for two concentrations 6.25×10^{10} and 6.25×10^{11} spore / ml while the highest mortality was 93.33% of the concentration of 6.25×10^{10} spore / ml and 48-hour time.

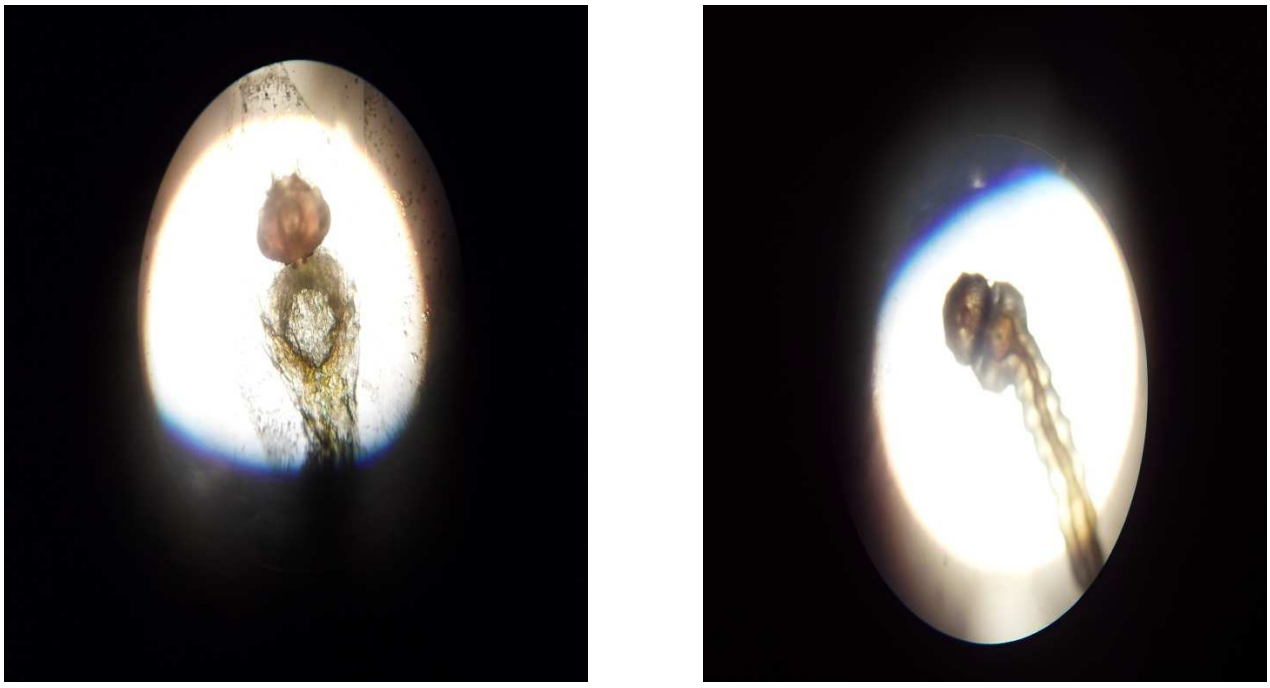
The larvae treated with bacteria Bti leads to a deformation in the body and deformation of the gastrointestinal tract as shown in the picture (2), The larvae remaining and converts it to the pupae they die when developed to adults as a result of the deformation, which happens to body of the adults, and this result was conformity with (Zayed and Bream 2004), where they noticed the effect of bacteria Bti on the pupae at the emergence of adults where noted deformities size for adults where the size of the adult abnormal, leading to her death when emerge directly.

The results identical with each of (Hafez 2000) and (Lima et al 2005) where the mortality was 95% of the mosquitoes *Cx.quinquefasciatus* during periods 24 and 48 hours when exposed to bacteria Bti during the fourth instar larvae.

Table 8: Effect of times and different concentrations of the bio pesticide Bacillus thuringiensis israelensis (Bti) in the mortality of fourth instar larvae of Culex pipiens.

LSD	The period / Hours			Concentration Spore / ml
	48	24	12	
	Mortality %			
0.00	0.00 ± 0.0	0.00 ± 0.0	0.00 ± 0.0	0.0
* 18.83	0.0 ± 100.0	6.67 ± 66.67	6.67 ± 33.33	6.25×10^9
* 18.83	6.67 ± 93.33	0.0 ± 80.00	6.67 ± 66.67	6.25×10^{10}
* 13.31	0.0 ± 100.0	0.0 ± 80.0	6.67 ± 73.33	6.25×10^{11}
---	* 13.31	* 13.31	* 23.07	LSD
P<0.05				

** Indicate the presence of significant differences between the different treatments at the level of the probability (P <0.05), according to test less significant difference (LSD)*



(B) (A)

Image (2): (A): larva does not treatment of bio-pesticide Bti (Control).
(B): larva treatment of bio-pesticide Bti note decomposition guts.
The power of magnification (40 x)

CONCLUSIONS

1. The study showed the effect of growth regulator Dimilin on the mortality of *Culex pipiens* larvae, especially for the high concentration of 1.5 ppm and the mortality was100%.
2. Effect of growth regulator on the composition chitin layers where Dimilin chitin synthesis inhibitor treatment is during larval development, leading to deformation of the larvae of different instars larval and thus deformation for pupae resulting from treated larvae and the adult emerging from pupae.
3. The results show that all concentrations of biological pesticide *Bacillus thuringiensis israelensis* used in the study are more effective than the effect of growth regulator Dimilin.

REFERENCES

[1] Abu Alhab, J.K. 1979. Insects of medical and veterinary in Iraq (theoretical section) Press Baghdad. 450p.

[2] Al-Bender, E. H. (2013). Evaluate the efficiency of the bacteria Bacillus thuringiensis locally isolated and bio-pesticide in the control mosquitoes. Culex quinquefasciatus Say (Diptera: Culicidae), Master's thesis – College of Agriculture - University of Baghdad.

[3] Al-Adel, K. M. 2006. Pesticide basic concepts and their role in the fields of agriculture and health. First edition, College of Agriculture, University of Mosul. Iraq. 422p .

[4] Jamil, G.M. 2007. Evaluating the efficiency of the bacteria Bacillus thuringiensis isolated locally as biocide on insects. Doctoral thesis. College of Agriculture. University of Baghdad.

[5] Aube, C. and Gangnon, C. (1969). Effect of carbon on and nitrogen nutrition on growth and sporulation of Trichoderma viride. Pers. Exfires, Canadian J. Microbial, 703 – 706.

[6] Deul, D.H.; Dejong, B.J. and Jam, K. (1978) Inhibition of chitin synthesis by two 1-(2, 6- disubstituted benzoyl) -3-phenylurea Insecticides. Pesti. Biochem. Physiol. 8: 98-105.

[7] Hadley, W. M. ; Scoott, W. B. ; Thomas, D. M. ; John, P. T. ; Clair, M. h. ; Jerry, A. W .; Phillip, W. D.; Mitchell, B. F. and Raymond, E. S. 1987. Five – Month Oral (Diet (Toxicity Infectivity Study of Bacillus thuringiensis Insecticides in Sheep. Toxicological Sciences. 8 (2): 236–242.

[8] Hafez, G. A. (2000) Extended effect of Bacillus thuringiensis H-14 on Culex pipiens adults surviving larval treatment. J. Egypt. SOC. Parasitol., 30(2): 377-386.

[9] Hill , C. and John , N .2007 . Entomology department at Purdue University. J. Public health & Med . Entomol: 1-12.

[10] Howard, A. F. V.; Koenraadt, C. J. M.; Farenhoorrst, M.; Knols, B. O. J. and Takken, W. (2010). Pyrethroid resistance in *Anpheles gambiae* leads to increased susceptibility to the entomopathogenic fungi Metarhizium *anisopliae* and *Beauveria bassiana*. Malaria Journal, 9:168.

[11] Ibrahim, I. (1990) Factors affecting performance of Bacillus thuringiensis H-14 on Culex pipiens larvae (Diptera: Culicidae) with preference to its Joint action with four insecticides. Bull Ent. Egypt. Econ. Ser. 18:59-71. J. Sanitary Zoo. 28 (3): 333-336.

[12] Ishii , T. and Ohba , M. 1993 . Diversity of *Bacillus thuringiensis* environmental isolates showing Larvicidal activity Specific for mosquito. Journal of General Microbiology 139:2849–2854.

[13] Lee, L.; Saxena, D. and Stotzky, G. 2003. Activity of free and Clay bound insecticidal proteins from *Bacillus thuringiensis* sub. *Israelensis* against the Mosquito *Culex pipiens*. Appl. Environmicrobiol, 69(7): 41-45.

[14] Lima, J. B.; Nilsson. V. de Melo and Denise, V. 2005. Residual effect of tow *Bacillus thuringiensis var israelensis* Products Assayed against Aedes aegypti (Diptera : Culicidae) in Laboratory and outdoors at Rio de Janeiro, Brazil. Rev. Inst. Med. trop. S. Paulo. 47(3): 125 –130.

[15] Mohsen, Z. H.; Ouda, N. A.; Mehdi, N. S.; Zaiya, H. H. and Al–Chalabi, B. M.. 1989. Toxicity of various larvicides and formulation against larvae and pupae of *Culex quinquefasciatus* and other non-target arthropods. Proc. Sci. Conf. Baghdad 7-11 Oct. 1989. Sci. Res. Con. Vil. 5, Part 2: 113– 115.

[16] Mulla, M. S.1995.The future of insect growth regulators in vectors control. J. Am. Mosq. Control Assoc., 11(2): 269-273.

[17] Negwa, E. A.; Mohsen, M. N.; Lubna, M. E. and Hanem, F.K.2004. The effect of two insect growth regulators and *Bacillus thuringiensis* on *Musca domestica* and *Culex pipiens.1rst* Ann. Confer. , FVM., Moshtohor: 22-42.

[18] Parakash, A. (1993). Differential susceptibility of various life stages of mosquitoes to certain chitin synthesis inhibitors. Entomon.18 (3 and 4): 151-157.

[19] Poopathi , S. and Abidha, S. 2010 . Mosquitocidal Bacterial toxins (*Bacillus sphaericus* and *Bacillus thuringiensis* serovar *israelensis*) Mode of action , cytopathological effects and Mechanism of resistance. Journal of Physiology and Pathophysiology. 1(3): 22 – 38.

[20] Rajasekar , S. and Jebanesan , A. 2012 . Efficacy of IGRs Compound Novaluron and Buprofezin against *Culex quinquefasciatus* Mosquito larvae and pupal Control in pools, drains and tanks . International Journal of Research in Biological Sciences.5:5-15.

[21] Shaalan, E. A. and Canyon, D. V. (2009). Review paper aquatic insect predators and mosquito control. Tropical Biomedicine, 26(3): 223-261.

[22] Shoukry, M. A. (1986). Effect of the biological insecticide, *Bacillus thuringiensis* serotype H-14 on mosquito transmission of diseases. Ph. D. Degree Entomol. Dep. Fae. Science Ain Shams Univ.; Cairo.

[23] Sivagnaname , N. and Kalyanasundaram , M . 2004. Laboratory Evaluation of methanolic extract of Atlantia monophlla (Family : Rutaceae) against immature stages of mosquito and Non – target organisms . J. Mem. Inst. Oswaldocruz. 99 (1): 115- 118.

[24] Zayed, M.E. and Bream, A.S. 2004. Bioassay of some Egyptian isolates of Bacillus thuringiensis against Culex pipiens (Diptera: Culicidae). Common Agric. Appl. Biol. Sci . 69 (3): 219 – 228.

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Alkaline Extraction of Starch from Broken Rice of Pakistan

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ABSTRACT: Six types of broken rice were chosen such as KSK-133, Basmati-86, Basmati Super, Kaynaat, IRRI-6, KS-282 then after the market survey, got its prices and also got its initial compositions of starch then one type of broken rice KSK-133 was selected due to economical point of view because its initial composition of starch was 70.3% and its price was 34 rupees per kilogram. The low quality rice processed to produce the rice starch. The production process of the rice starch from low quality rice KSK-133 investigated. The starch extracted from rice by alkaline extraction technique. The main objective is to obtain high starch content from KSK-133 and compare with starch content of other two types which are even more economical such as IRRI-6 and KS-282 at best extraction condition of KSK-133. The independent variables are types of broken rice. In a steeping process, used distilled water with grinded flour sample of rice and set the operating conditions. 0.1M caustic soda solution was used for set the test pH. Maximum rice starch has been recovered up to 95.4% from KSK-133. In comparison of starch content with other two types, KSK-133 starch content 89.95%, IRRI-6 starch content 86.64% and KS-282 starch content 87.52% has been achieved at best extraction condition.

KEYWORDS: Alkaline Extraction, Pakistani Rice, Recovery of Starch, Broken Rice, Economical Types of Rice

1 INTRODUCTION

Starch is a central component of human diet and it is acquired from different sources such as wheat, maize, rice, potato etc. [1]. Potato and tapioca are high in starch but contain very high moisture. Due to which their storage is extremely expensive. In food industry, it is used in different products such as starch hydrolysates, glucose syrups, fructose, maltodextrin derivatives or cyclodextrins by means of chemical and enzymatically processing. It is a polymer of glucose and consists of two type glucose polymers such as amylose and amylopectin [2], [3]. These polymers have different structures and properties. Polymers of starch are linked with each other through the glycosidic bond. Particle sizes range from 2-100 micrometer [4]. The starch granules are dense and insoluble in cold water. In order to dissolve the starch granule, heat has to be applied. Rice is a staple food for a large part of the world's population, especially in Asia and the West Indies [5]. Due to economic reasons the rice starch is extracted preferably from broken rice which is most valuable for numerous industries like food and cosmetic industry [6]. It is also demanding because of its unusual characteristics like small particle size, white color and neutral taste. The rice starch is primarily valuable for starch processing industry. There are several methods for producing rice-starch. They

are alkaline-steeping method [7] high-intensity ultrasound and surfactant [8], [9] Guraya method [10], protease digestion [11], [12] and alkaline-protease methods [13]. These methods show different characteristic and also shows different extraction efficiencies and functional properties. The alkaline steeping-method [7] is the simplest method for starch production. This method is applied easily in a simple apparatus system. The advantage of this method is high purity of produced starch. At ideal extraction conditions, extracted components have little or negligible structural changes. In starch, depolymerization or change (damage) to its crystalline phase is detrimental the detail mechanism of rice protein extraction into alkaline solution has not yet been clearly defined. The mechanism is probably based on the protein solubilization in the alkaline solution without chemical changes. The extraction process continues and stops when the equilibrium is reached. This assumption is based on the protein extraction process in the animal tissue [14]. The soluble protein can be isolated effectively. Alkaline solutions are generally employed for isolation of rice starch, because high portions of rice protein consist of alkali-soluble and high molecular weight glutelins.

The present study is carried out to enhance the good recovery of starch. The different types of Pakistani broken rice were directly obtained from the market and milled in the dry condition without any treatment. The produced starch has the quality as good as the available commercial rice starch. There is dire need in our country to focus on the other crops for the extraction of starch rather than maize which will be helpful to meet the demands of industries and economical.

2 MATERIALS AND METHODS

2.1 PROCUREMENT OF RAW MATERIALS

Six types of broken rice were procured from Rice Research Institute Kala Shah Kako Lahore Pakistan such as KSK-133, Basmati-86, Basmati Super, Kaynaat, IRRI-6 and KS-282.

2.2 PROXIMATE ANALYSIS

Preliminary trails were conducted to determine the proximate composition of different types of Pakistani broken rice.

2.3 STARCH EXTRACTION

The whole process involves for starch extraction is depicted from fig.1 (1) grinding (2) mixing of rice flour with alkaline solution (3) digesting of the protein, (4) primary filtration, (5) washing with water, (6) Vacuum filtration (7) drying the starch cake. The production apparatus were grinder, steep, 325 mesh screen, vacuum flask, beaker, filtration cup, filter paper, pH meter and thermometer. Firstly took the rice sample, and then grinded the rice with the help of grinder. Steeping solution prepared in a steep. Here took the grinded rice flour sample with distilled water. Then set the pH by using the 0.1M caustic soda solutions. During washing kept the flour to water ratio 1:3 while during extraction it was 1:10. From protection of bacteria and its growth used 0.01% sodium metabisulphite weight to volume ratio. The steep solution was continually circulated. For this purpose, steep's pump was operated at 2800 rpm for 22 hrs.

For the protein recovery, the peak lipid film was removed from the surface. Un-bonded protein was separated with the help of water. After every two hours the pH of the steep solution was checked and set to the test pH with the help of 0.01M caustic solutions.

Primary filtration was done after every two hours. For primary filtration, 325 mesh screen was used and this step was called primary filtration. Then steep solution was poured on the screen, the tiny particles passed from screen. Then over size particles again sent back to the steep for further recovery of starch. But test conditions were kept same.

The extracted starch was collected and given residence time for 90 min. in a beaker. The separated residue was collected and recycled in a steep. The recovered starch was again washed with water in the ratio of 1:3 respectively. At this time all the remaining residue was separated for protein recovery. The separated starch was isolated onto a filter paper. Then this filter paper was fixed on a vacuum flask for vacuum filtration for removal of water. This step was called vacuum filtration. All the partially wet recovered starch was collected on the filter paper. Then it was kept in atmosphere for air-dried at room temperature for 48 hrs.

Then dried starch weight was measured. This weight was compared with the initial weight of starch which was present in the rice and calculated the starch recovery (%).

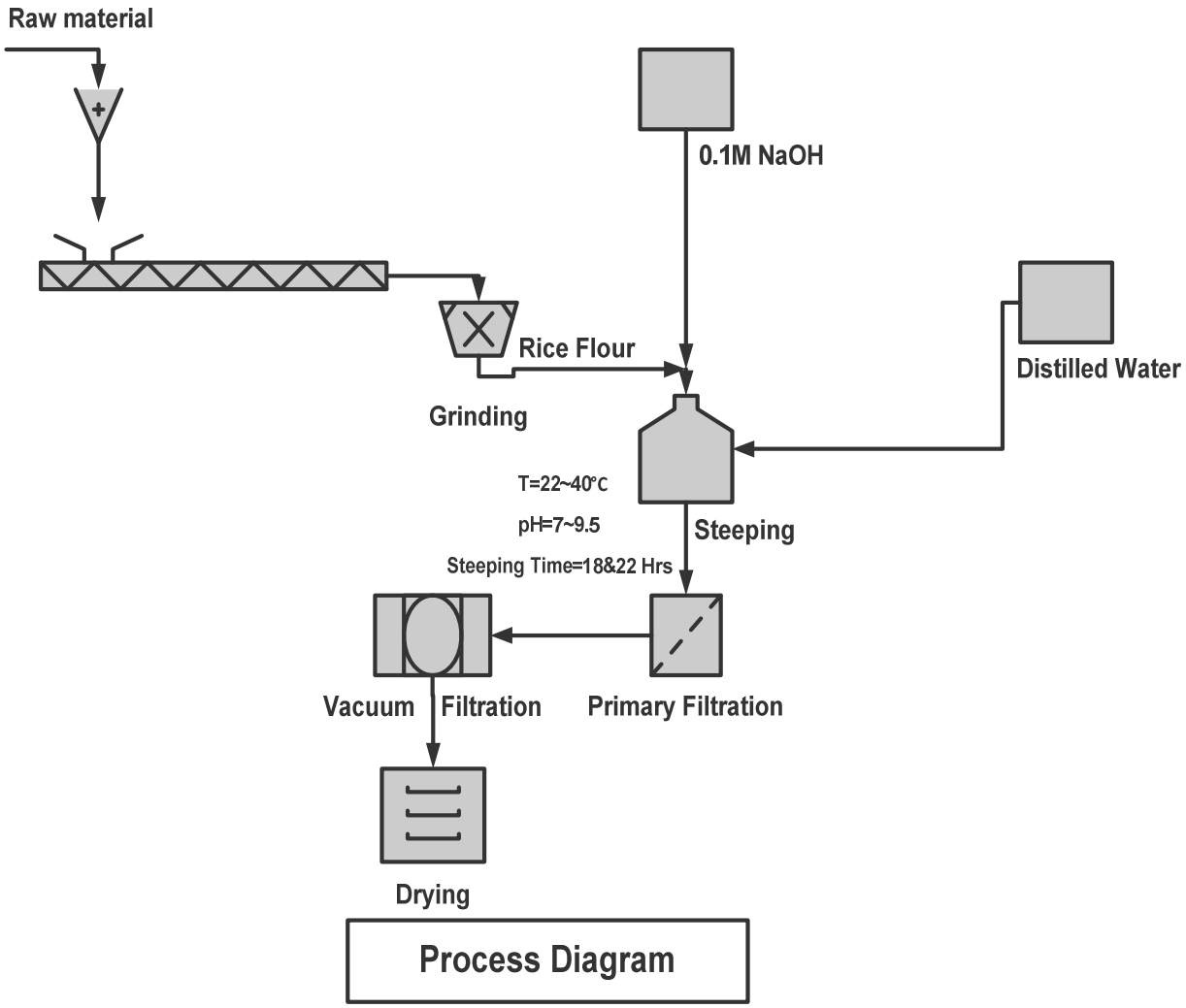


Figure-1: Process Flow Sheet

3 RESULTS AND DISCUSSION

Initially compositions were found. A market survey was also conducted, to get the prices of all chosen types then selected the economical type.

Table 1 Economical Comparison of Different Types of Rice

Types Of Broken Rice	Price (Rs.)/Kg	Moisture (%)	Protein (%)	Initial Starch (%)
*KSK- 133	*34	12.80	5.60	*70.30
Basmati-86	40	13.60	5.70	67.30
Basmati Super	44	13.00	6.70	70.0
Kaynaat	70	11.50	6.30	65.60
IRRI-6	36	13.50	6.20	68.60
KS-282	40	12.70	5.80	68.20

After the economical comparison the KSK-133 which was the most feasible and economical type because it has a highly initial starch % and also has a low price. On the basis of preliminary trials conducted on proximate composition like moisture, protein%, and starch%. The rice variety was selected for further analysis.

Table-2: Starch Recovery %age at Different pH and Temperatures

Sr. No.	Temp (°C)	22	25	30	35	40
	pH	Starch Recovery (%)				
1	7.0	73.60	74.20	75.20	75	80.95
2	8.0	86.10	87.13	88.85	89.85	92.15
3	8.5	88.15	88.50	89.10	89.95	93.15
4	9.0	88.25	88.79	89.70	90.25	93.30
5	9.5	89.50	89.66	89.95	92.90	95.40

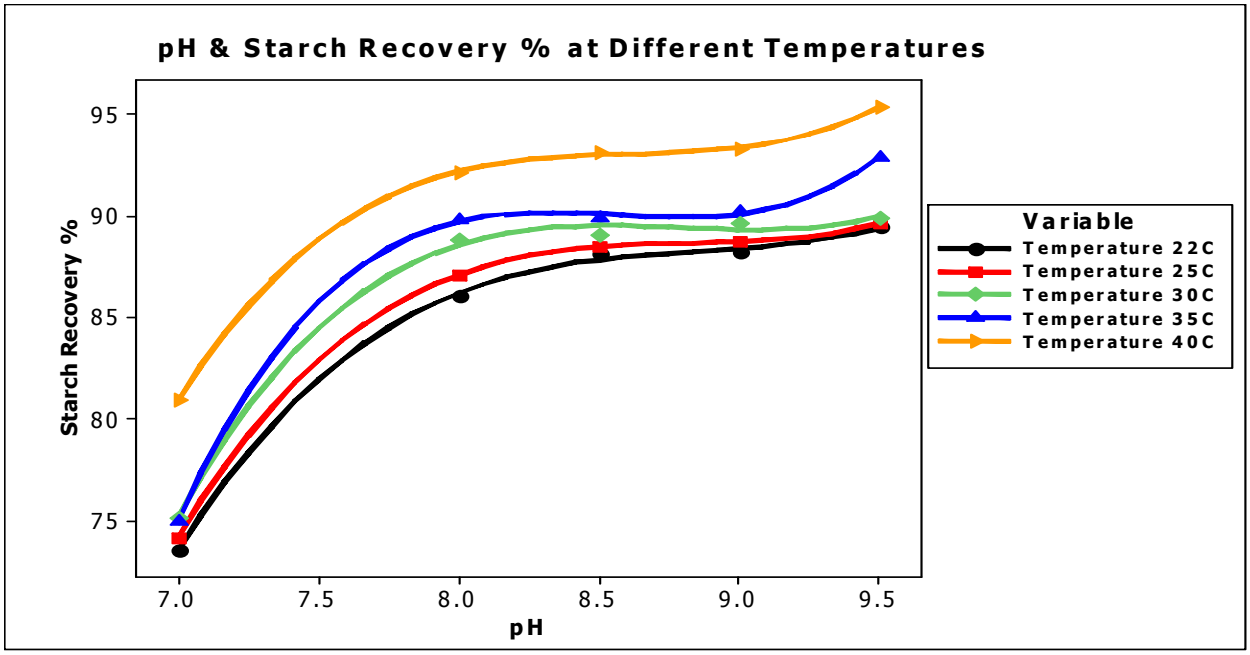


Figure-2: pH & Starch Recovery % at Different Temperatures

Fig.2 depicted that if we compared all the graphical lines then it is cleared that the maximum starch recovery has been achieved 95.4% at 9.5pH and at 40°C. The minimum starch recovery has been achieved 73.6% at 7pH and at 22°C. This showed that temperature was kept constant and pH changed. The pH and temperature are directly proportional with each other.

The protein content is the second response variable to determine the quality of the rice starch. The protein content must be kept as low as possible to meet the specification of high quality rice starch. High content of protein could spoil the sticky and gristly characteristic of the rice starch.

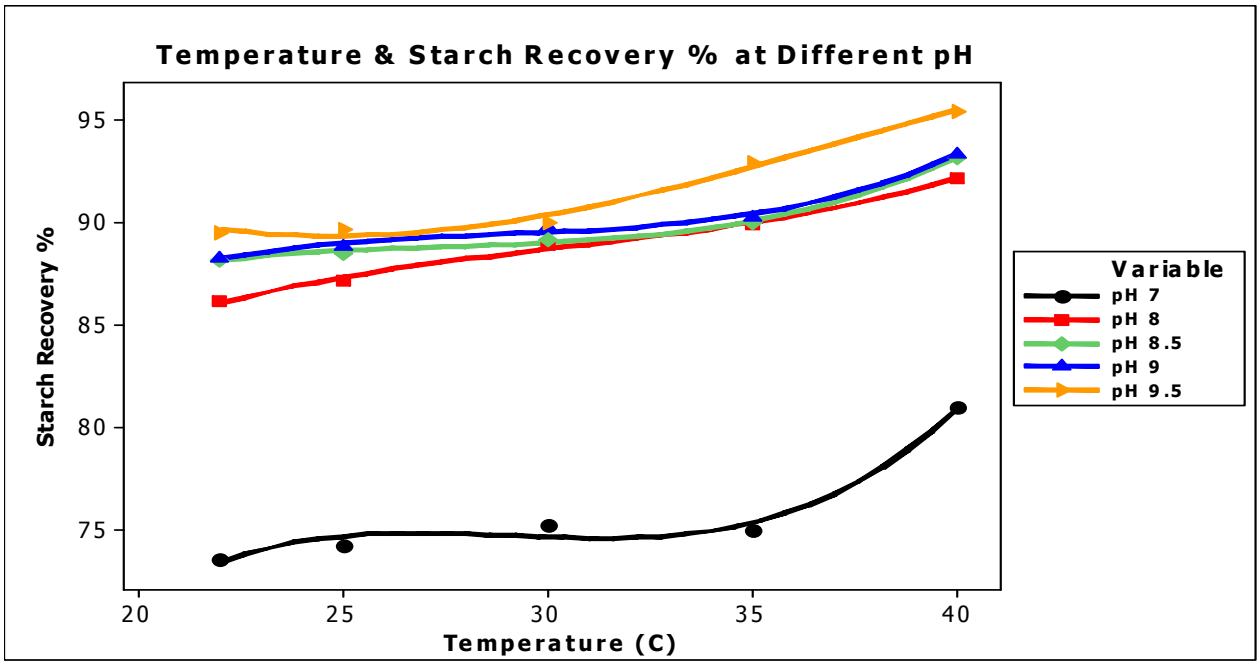


Figure-3: Temperature & Starch Recovery % at different pHs

From fig.3 it was concluded that extraction temperature did not affect the residual protein content when the extraction temperature was higher than 25°C although the difference between 20°C and 25°C was significant. The adverse effect by raising the extraction temperature might be associated with changes in starch structure which are induced by heat and alkali.

The alkaline conditions could leads to undesirable protein modification as well as molecular cross linkage and rearrangements resulting in the formation of toxic compound. On the other side at the high temperature starch gelatinization is started.

The quality of produced starch is indicated by higher starch content. The starch content increases with temperature and pH. The maximum starch recovery and extracted starch weight has been achieved 95.4% and 67.07gm respectively at 40^{o}C and 9.5pH.

Optimum condition is determined by the variables. The optimization objective is to have the starch content as high as possible with good quality. According to the data obtained above, the optimum condition to produce a high quality rice starch from the raw material of low quality rice with the alkaline method at 35^{o}C and at 8.5pH.

3.1 Comparison of Different Types of Broken Rice at Best Extraction Conditions IN PRESENT WORK

After performed the experiment, two more types of broken rice selected which is less economical than KSK-133 and performed the experiment to found the recovery percentage at best extraction conditions. There is several research results reported in the literatures about the rice starch production for different types. Each of them gives different results. These differences are caused by some factors, such as starch content, protein content, moisture content and others.

Table-3: Comparison of different types of broken rice at best extraction conditions

Broken Rice	Initial Starch (%)	Amount Of Rice (gm)	Temperature (^{o}C)	pH	Steeping Time (Hrs)	Amount of Starch On D.B (gm)	Starch Recovery (%)
KSK-133	70.3	100	35	8.5	22	63.23	89.95
IRRI-6	68.6	100	35	8.5	22	59.44	86.64
KS-282	68.2	100	35	8.5	22	59.69	87.52

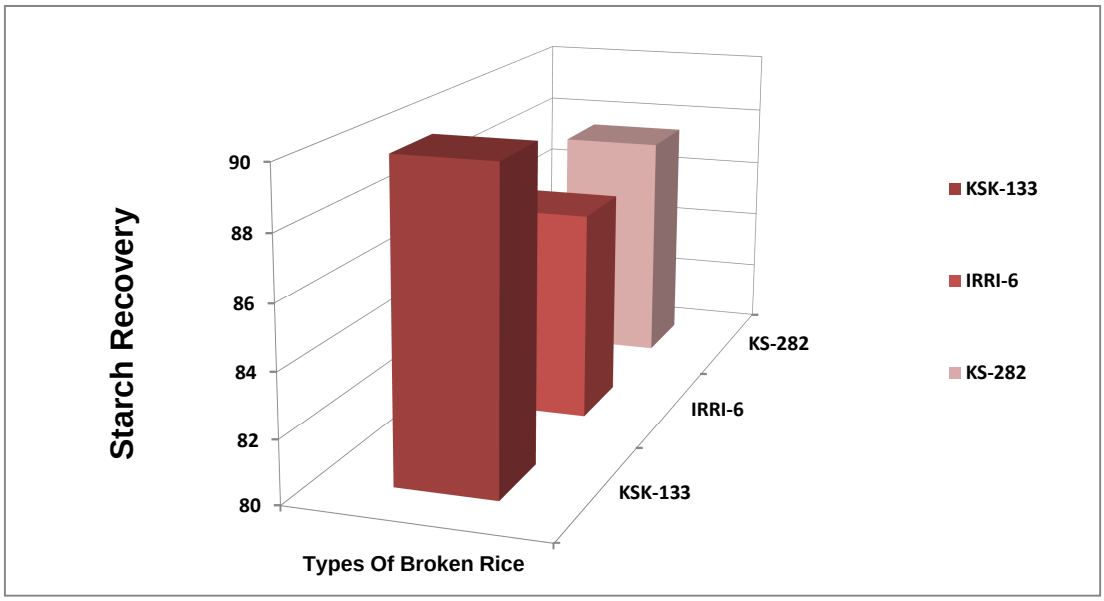


Figure-4: Types of Broken Rice & Starch Recovery %age

From fig.4 it is cleared that KSK-133 given the maximum starch recovery rather than the other two types. KSK-133 starch content 89.95%, IRRI-6 starch content 86.64% and KS-282 starch content 87.52% has been achieved at best extraction condition.

The produced starch in this work contains 95.4% starch contents. This result is higher by comparing to other research work. The variation in results may be caused by the difference of material and with no pretreatment of rice. The present work uses broken rice that contains higher protein and moisture contents and impurities while other researchers used selected and pretreated rice. High quality rice's color is bright white. This is a sign that it contains less protein than the broken and low quality rice.

Bindar, Efan and Rahim [15] extract starch from low quality rice IR64 grade 3 which contained 89.72% starch contents. They kept the steeping time 7 hours and used enzyme, but in this work Pakistani broken rice used such as KSK-133 and kept the steeping time 22 hours and only used the NaOH instead of NaOH and enzyme digestion technique and extract 95.4% starch content. This makes the process economical and in alkaline extraction digestion method used the enzyme increased the cost of process and made it expensive.

4 CONCLUSIONS

It is concluded that alkaline method was successfully implemented to produce the better quality rice starch from broken rice KSK-133. High portion of rice protein is easily soluble in alkaline solution. Alkaline method has a good recovery and low residual protein content due to high molecular weight glutelins. Maximum recovery of starch from KSK-133 rice has been achieved up to 95.4%. In comparison of starch content with other two types, KSK-133 starch content 89.95%, IRRI-6 starch content 86.64% and KS-282 starch content 87.52% has been achieved at best extraction condition. Further improvements are needed to produce high quality rice starch that meets the international starch standard. The future research should emphasize on using different enzymes.

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REFERENCES

[1] W. Vorwerg, S. Radosta, and E. Leibnitz, "Study of a preparative-scale process for the production of amylase," *Carbohydr. Polym*, vol. 47, pp. 181-189, 2002.

[2] J-Y. Li, and A-I. Yeh, "Relationships between thermal, rheological characteristics and swelling power for various starches," *J. Food Engineering*, vol. 50, pp. 141-148, 2001.

[3] N. Singh, J. Singh, L. Kaur, N. Singh Sodhi, and B. Singh Gill, "Morphological, thermal and rheological properties of starches from different botanical sources," *Food Chem,* vol. 81, pp. 219-231, 2003.

[4] S. Jobling, "Improved starch for food and industrial applications," *Curr. Opin. Plant Biol*, vol. 7, pp. 210-218, 2004.

[5] Fred F. Shih, "An update on the processing of high protein rice product," *Nahrung/Food,* vol. 47, pp. 420– 424, 2003.

[6] James N. BeMiller, *Roy L. Whistler, Starch Theory: chemistry and Technology*, 3rd Ed. Academic Press, 2009.

[7] C. Yang, H.M. Lai, and C. Y. Lii, "The modified alkaline steeping method for the isolation of rice starch," *Food Science,* vol. 11, pp. 158–162 ,1984.

[8] L. Wang and Y.J. Wang, "Application of high intensity ultrasound and surfactants in rice starch isolation,"*Cereal Chemistry,* vol. 8, pp. 140-144, 2004.

[9] L. Wang and Y.J. Wang, "Comparison of protease digestion at neutral pH with alkaline steeping method for rice starch isolation," *Cereal Chemistry,* vol. 78, pp. 690–692, 2001.

[10] H.S. Guraya and C. James, "Deagglomeration of rice starch- aggregates by high-pressure homogenization," *Starch/Stärke,* vol. 54, pp. 108–116, 2002.

[11] B.O. Juliano, "Rice starch Production, properties and wheat flours," *Journal of Cereal Science,* vol. 13, pp. 145-152, 1991.

[12] G.H. Zheng and R.S. Bhatty, "Enzyme-assisted wet separation of starch from other seed components of hull-less barley," *Cereal Chemistry,* vol. 75, pp. 247–250, 1998.

[13] N. Lumdubwong and P. A. Seib, "Rice starch isolation by alkaline protease digestion of wet-milled rice flour," *Journal of Cereal Science,* vol. 31, pp. 63–74, 2000.

[14] A. J. Alpert and M.J. Schmerr, "Method and kit for Extracting Prion Protein" *World Intellectual Property Organization*, PCT/US2000/00045, (2000).

[15] Y. Binder, A. Efan and Rahmi, "Sodium hydroxide (NaOH) concentration and steeping time duration effects on starch production from dry-milled low quality rice IR 64 grade 3 flour using alkaline-protease enzyme digestion method," *International Food Research Journal,* vol. 20, no. 3, pp. 1353-1358, 2013.

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Analysis of Wear Rate of Ceramic Material for Total Joint Arthoplasty

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ABSTRACT: In Total Joint Replacement (TJR), ceramic surfaces offer a major benefit of drastically reduced wear rates and excellent long-term biocompatibility with the bone tissue. Among the available ceramic materials for load bearing bio-implant applications, silicon carbide is superior for its better biocompatibility, which can increase the longevity of prosthetic joints. The major cause of revision surgery and implant failure is Osteolysis (aseptic loosening of the prosthetic joint). The product of bearing wear, microscopic particulate debris in the joint space leads to implant loosening. Prosthetic joint mainly consists of acetabular cup, acetabular lining and femoral head. The best material for manufacturing acetabular cup is nickel – base alloy. For manufacturing acetabular lining and femoral head, silicon carbide is the best chosen material. The acetabular cup or knee cap is prone to catastrophic failures due to walking, stumbling etc. A sliding distance test was performed on polished surface of silicon carbide and nickel-base alloy (mirror- like finish, 1µm) by using Reciprocating Friction Monitor (Courtesy; National Institute of Technology, Srinagar) for the evaluation of wear volume and wear coefficient by standard test procedures and equation outlined in ASTM F 603. The test was carried out in ambient temperature. The results obtained showed drastically reduced wear rates. The experiments on Reciprocating Friction Monitor for Silicon carbide and nickel – base alloy showed that the best choice for prosthetic joint replacement would be a combination of two materials; silicon carbide for femoral heads and acetabular lining, and nickel-base alloy for acetabular cup.

KEYWORDS: Prosthetic joint; Wear rate, Aseptic loosening, Silicon Carbide, Nickel base alloy.

1 INTRODUCTION

The tribological properties of low friction, high wear resistance and good biocompatibility make ceramic material the most attractive in hip replacement surgery at the present time. In long term follow up after implantation. the ceramic couple bearings show the lowest wear rate in many reports, which means low wear debris and less osteolysis [1]. The purpose of this paper is to analyse the wear rate properties of silicon carbide and nickel base alloy. Both categories of Ceramics can be used for TJR either oxide ceramics or non-oxide ceramics. In oxide ceramics like aluminium oxide and zirconium oxide can be used. But these show low temperature degradation.While as non-oxide ceramics offer a major benefit of drastically reduced wear rates and excellent long term biocompatibility with the human tissue. The advantage of ceramic on ceramic (COC) was shown by in vitro analysis to reduce wear debris particles that cause osteolysis. The important property of ceramic that caused a lower wear rate was its being hydrophilic[2].Ceramic's hydrophilic properties facilitate an increased wettability of the surface because of the strong hydrogen bonds between the ceramic surface and synovial fluid that results in the synovial film being more uniformly distributed [3].

Silcon carbide has a higher strength, high elastic modulus, ultra low wear rates and to resist deformation when subjected to the loads in the body. SiC has high corrosion resistance of bioinertness and biocompatibility with the human tissue than other oxide and non-oxide ceramics. The superior material properties of SiC offer a new possibilities for eliminating implant failures. The biocompatibility tests performed according to ISO 10993 indicates that Silicon Carbide is biocompatible and did not elicit any adverse effect like acute toxicity, chronic toxicity, mutagenicity, allergenicity, carcinogenicity or localized tissue toxicity to the Prosthetic Joint [4]. Silicon carbide has high hardness and good surface finish for long term wear resistance(low wear) and low friction [5]. Good wetting between the synovial fluid and bearing surface for good lubrication in the body [6].

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The wear characteristics of samples of Silicon carbide was determined by using Reciprocating Friction Monitor (Courtesy; Maintenance lab National institute of Technology, sgr). Wear rate as a function of sliding distance were examined to interpret the behaviour of Silicon carbide. Analysis of the experimental results showed that in Prosthetic Joint Replacement, Silicon Carbide offers a major benefit of drastically reduced wear rates and friction stabilization, which can increase the longevity of Prosthetic Joints.

Nickel Base alloy is a nickel and beryllium-free chrome/cobalt alloy.The strong oxide provides optimum metal/ceramic bonding and is suitable for open melting, as well as for the high frequency casting process. One of the remarkable features is the high corrosion resistance. It is cleaned in ultrasonic bath or with a steam cleaner. The composition has been well established for many years and is now commercially available. Wear characteristics of samples of Nickel base alloy was determined by using Reciprocating Friction Monitor. Wear rate as a function of sliding distance were examined to interpret the behaviour of Nickel base alloy. Analysis of the experimental results showed that wear rate in case of nickel base alloy is comparatively higher than Silicon carbide. But the advantage of Nickel base alloy is that it has higher fracture toughness than silicon carbide and can be used for making of acetabular cup, where ductility of the material is of major concern [7].

2 SAMPLE PREPARATION OF SILICON CARBIDE

The silicon carbide, doped with C and B, is prepared through tape casting. The processing method involved several steps: slurry preparation, tape casting, solvent evaporation & sintering. Boron and carbon were also added in order to aid the final sintering treatment and due to them fracture toughness increases. Thin sheets were produced by casting the slurry on a moving Mylar support [8].

3 POLISHING OF SILICON CARBIDE SAMPLES

Silicon Carbide samples are polished by using emery papers of various grit sizes. Firstly, the silicon carbide samples are polished by using an emery paper of Grit size 60. The 60 sized emery paper took all the higher asperities away when rubbed against silicon carbide billets. The SiC samples were cleaned with acetone solution, after drying them in ambient temperature, the samples were rubbed with an emery paper of grit size 80. The 80 sized emery paper took away the asperities which were lying beneath the surface, the samples were once again cleaned in acetone solution and were rubbed against an emery paper of grit size 100. The same processs was repeated by using emery papers of grit size 120, 150, 180, 200, 220 etc.

Figure .1 shows the optical images of polished Silicon Carbide [9]. Figure 1(a) shows smooth surface, the pits are intrinsic holes. Figure.1(b) shows some grains are polished faster than others Figure.1(c) shows surface has waviness. Figure.1(d) tiny scratches exist due to grains felling out. Figure.1(e) shows dry sliding, rough surface with scratches**.**

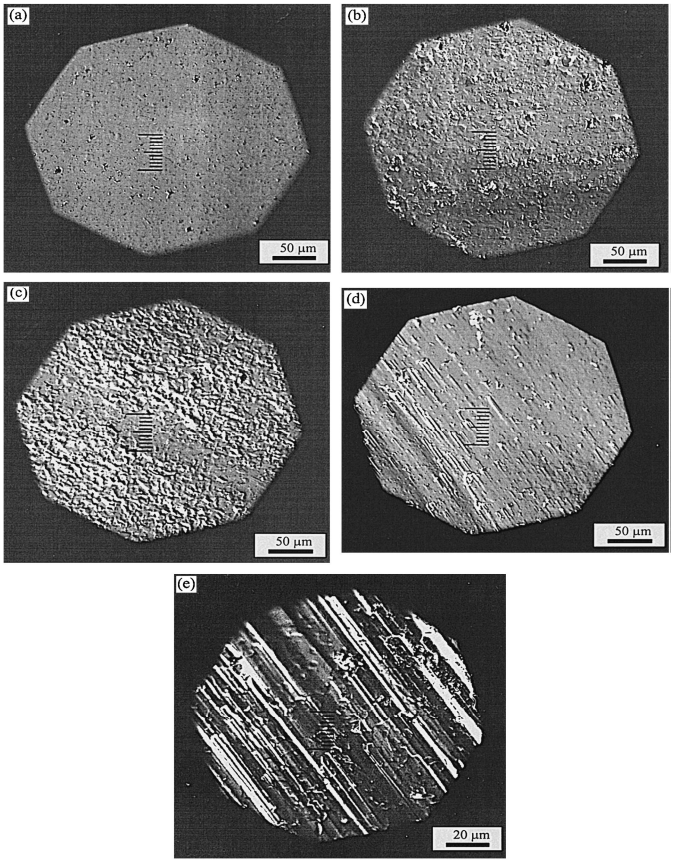


Fig.1: Predicts Nomarski interference optical images of polished SiC surfaces [9]

4 EXPERIMENTAL PROCEDURE

Sliding Distance test was performed on polished surface of ceramics (mirror-like finish, 1µm diamond polish) using Slider Reciprocating Moniter. For the evaluation of Wear volume, standard test procedures and equation outlined in ASTM F 603 is used. The test was carried out in ambient temperature.

A. Experiment No 1: Wear volume and Sliding distance (Ni-Base Alloy)

By using Pin on Disc experiment on Reciprocating Friction Slider (Courtesy Tribology Lab, NIT, Sgr.). The specifications of the Reciprocating Friction Slider is given below:

Spindle speed = 1200rpm

Specimen 1 = SiC Disc

Specimen 2 = Ni-base alloy Pin

Normal Load = 20N

Stroke length = 2mm

Specimen temp = 35ºC

Oil drip temp.= 50ºC

Frictional Force trip = 250ºC

Normal load trip = 350ºC

Test frequency = 20 Hz

Test Specifications

Mass of pin before test = 4.3700g

Mass of pin after test = 4.3687g

Δm = 0.0013g

Sliding distance in this case would be:

N =1200rpm

T = 20min

Velocity of slider= (1200×4)/60 = 0.080m/s

Sliding Distance = Velocity ×time

= 0.08×20×60 = 96m

Wear volume = m/ρ

= 0.0013/6.45

= 2.01×10^{-4} mm^3.

Repeated tests were performed for various sliding distances and wear volume for nickel base alloy was calculated.

Table. 1: Data of wear volume Vs Sliding distance for Ni base alloy:

S.No	Sliding Distance(m)	Wear Volume (mm^3)
01.	96m	2.01×10^{-4} mm^3
02.	144m	3.21×10^{-4} mm^3
03.	192m	3.67×10^{-4} mm^3
04.	240m	4.23×10^{-4} mm^3
05.	288m	4.75×10^{-4} mm^3
06.	336m	5.22×10^{-4} mm^3

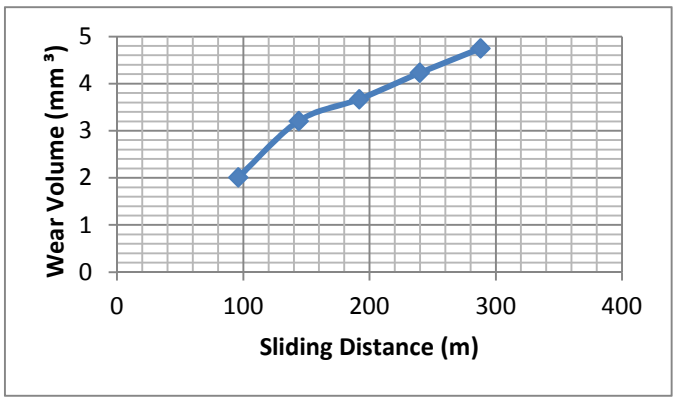


Fig. 2:Variation of Wear volume with sliding distance in Ni-Base alloy

(B) Experiment No 2 Wear Volume And Sliding Distance For Sic

By using Pin on Disc experiment on Reciprocating Friction Slider (Courtesy Tribology Lab, NIT, Sgr.). The specifications of the Reciprocating Friction Slider is given below:

Spindle speed = 1200rpm

Specimen 1 = SiC Disc

Specimen 2 = Ni-Alloy Pin

Normal Load = 20N

Stroke length = 2mm

Specimen temp = 35ºC

Oil drip temp.= 50ºC

Frictional Force trip = 250ºC

Normal load trip = 350ºC

Test Specifications

Mass of SiC Disc before test = 3.8745g

Mass of SiC Disc after test = 3.8744g

Δm = 0.0001g

Sliding distance in this case would be:

N =1200rpm

T = 20min

Velocity of slider= (1200×4)/60 = 0.080m/s

Sliding Distance = Velocity ×time

= 0.08×20×60 = 96m

Wear volume = m/ρ

= 0.00001/3.11

=3.2×10^{-5} mm^3

Table.2: Data of wear volume Vs Sliding distance for SiC

S.No	Sliding Distance (m)	Wear volume (mm^3)
01.	96m	3.21×10^{-5} mm^3
02.	144m	6.2×10^{-5} mm^3
03.	192m	7.1×10^{-5} mm^3
04.	240m	9.21×10^{-5} mm^3
05.	288m	10.1×10^{-5} mm^3
06.	336m	12.1×10^{-5} mm^3
07	380m	13.2×10^{-5} mm^3

Repeated tests were performed for various sliding distances and wear volume for silicon carbide was calculated.

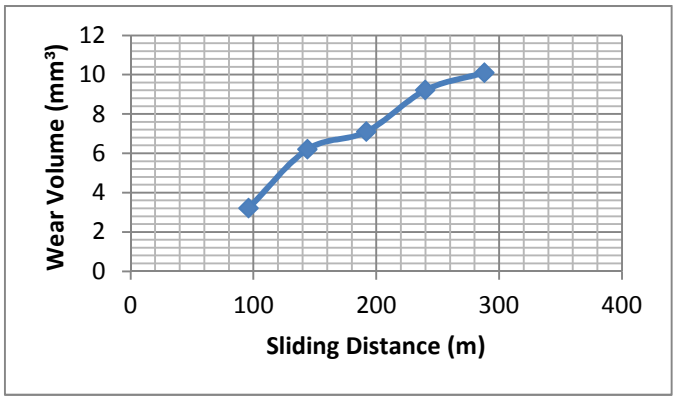


Fig. 3: Variation of Wear volume with sliding distance in SiC.

5 CONCLUSION

The major cause of concern for total joint replacement (TJR) is Osteolysis (loosening of prosthetic Joint). Osteolysis is a significant cause of aseptic loosening and is the biggest cause of revision surgery. The aim of the project is to introduce a non oxide ceramic material- Silicon Carbide, which have good biocompatibility with the human tissue and considerably less wear rates. The femoral head could be made of silicon carbide-because maximum rubbing during any human activity occurs between femoral head and inner acetabular lining. The acetabular cup could be made up of Nickel base alloy- because it has much higher toughness as compared to Ceramics. Outer cup or acetabular cup made of nickel base alloy would be less prone to breakage, due to its higher fracture toughness. While as inner lining or acetabular lining and femoral head made of silicon carbide would result in drastically reduced wear rates.

REFERENCES

[1]. Willert HG, Bertam H, Buchhorn GH. Osteolysis in Alloarthroplasty of the hip: The role of ultra- high monolecular weight polyethylene wear particles. *Clin Orthop Relat Res* 1990;258:95-107.
[2]. Ceramic on ceramic bearing Sukree khumrak, Bangkok medical journal vol.4.
[3]. Capello WN, D'Antonio JA, Feinberg JR, et al. Ceramicon- ceramic total hip arthroplasty: update. *J Arthroplasty*
[4]. Chevillotte C, Pibarot V, Carret JP, et al. Hip squeaking: A 10 years Follow up Study. *J Arthroplasty* 2012;27: 1008-13
[5]. Nevelos JE, Ingham E, Doyle C, et al. Wear of HIPed and non-HIPed alumina-alumina hip joints under standard and severe simulator testing conditions. *Biomaterials* 2001;22:2191-7.
[6]. Hannouche D, et al. Ceramics in Total Hip Replacement. *Clin Orthop Relate Res* 2005;430:62- 71.
[7]. Chevillotte C, Trousdale RT, Chen Q, et al. Hip Squeaking : A Biomechanical study of Ceramic-on- Ceramic Bearing Surfaces. *Clin Orthop Relat Res* 2010;468:345-50.
[8] Walter WL, Insley GM, Walter WK, et al. Edge loading in third generation alumina ceramic-on- ceramic bearings: stripe wear. *J Arthroplasty* 2004;19:402-13.
[9]. Tribochemical polishing of silicon carbide in oxidant solution Zhize Zhu), Viktor Muratov, Traugott E. Fischer.Department of Materials Science and Engineering, Steĺens Institute of Technology, Hoboken, NJ 07030, USA .

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Effect of Atmospheric pressure glow discharge plasma on the surface modification and the printing properties of Wool/polyamide blend

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ABSTRACT: In this study, atmospheric pressure glow discharge plasma was used to modify the surface properties of wool/polyamide fabric, the effect of air plasma treatment on the printing properties of wool/polyamide blend was also discussed. Three dyes were used namely acid dye, basic dye, and reactive dye. Different exposure time and discharge current of air plasma treatment were investigated to impart changes in wool/polyamide properties, such as whiteness, wettability, tensile strength, elongation, felting shrinkage, color intensity, and fastness properties. The surface characterization was performed using FTIR and SEM analysis. The plasma treatments enhance the colour strength of the wool/polyamide blend with acid, basic, and reactive dyestuffs as well as the fastness properties, and represent an approach to printing the blend with single dye.

KEYWORDS: Atmospheric pressure, plasma, printing properties, Wool/polyamide blend.

1 INTRODUCTION

Plasma technologies play a vital role in materials processing especially in textiles treatment and biomedical industries. Chemically reactive plasma discharges are widely used for etching, thin film deposition, surface activation and bio-sterilization. Recently, there has been increased interest in using atmospheric pressure plasmas for textiles processing[(1)]. These plasmas do not require vacuum systems and are suitable for continuous in-line processing,. Plasma surface treatment used to modifying the functional properties of fibers possesses advantages in comparison with traditional techniques[(2)]. Plasma includes less water usage and energy consumption, with a very small fibre damage, then making plasma process very attractive. It will be used to enhance the quality of textile products in fabric preparation and in dyeing and finishing methods. As the plasma is a medium that contains ions and excited atoms besides free radicals with free electrons and photons and ultraviolet waves, all these conditions help in activation the surface of the treated textile.

Wool/polyamide is a very popular blend for woven apparel and carpets. It can show the complementary properties compared to pure polyamide or wool fibers in terms of crease recovery, durability, abrasion resistance, fast drying, and dimensional stability. Wool/polyamide blends could be printed with disperse dyes in conjunction with another class of dyes, but background staining of the fabric and poor fastness properties frequently occurs[(3)]. The use of mixtures of different types of dye can introduce difficulties in colour matching, particularly when blend properties are varied [(4)]. Acid, metal complex, reactive and basic dyes, these dyes are all theoretically suitable for printing wool/polyamide blends, application is mainly limited to acid and metal complex dyes. Acid dyes must be selected to obtain acceptable light and wet fastness for each end use, in addition to the desired brilliance of hue[(5)].

It is necessary to use metal complex dyes to get very high fastness properties, but these dyes usually produce dull prints on polyamide fiber[(3)]. Basic dyes can provide extraordinary brilliance in some cases, but do not show adequate fastness,

when selecting reactive dyes, attention must be paid to staining of the ground during washing off[5].Different studies have therefore been made to improve colour fastness of anionic dyes on both polyamide [6-14]and wool[15-20] fabrics, as well as wool/polyamide blends[4,21-22].

Atmospheric pressure plasma techniques have been investigated and used for wool[23-30] and polyamide[31-41] surface modifications by several researches, but only a few concern with wool/polyamide blends[42-43].

In the present study, Atmospheric pressure glow discharge plasma is applied on wool/polyamide blend fabrics to improve their physical properties concerning on enhancing their printability with acid, reactive and basic dyes to impart maximum fixation of dyes as well as colour strength.

2 EXPERIMENTAL DETAILS

2.1 PLASMA SET UP

A glow discharge generator was employed for the plasma treatment of the wool/ polyamide. The generator that is shown in Fig. (1) consists of two parallel steel electrodes, of diameter about 20 cm, covered with two porous alumina sheets of thickness 2 mm as hold as dielectric barrier. It was proved that the porosity of the barriers are very important for obtaining glow discharge plasma rather than obtaining the filamentary discharge plasma[44]. The discharge plasma generator is operated in open air under atmospheric pressure and powered by AC source of frequency 50 Hz. The textile is placed in the gap between the two dielectric barriers as shown in Fig. (1).

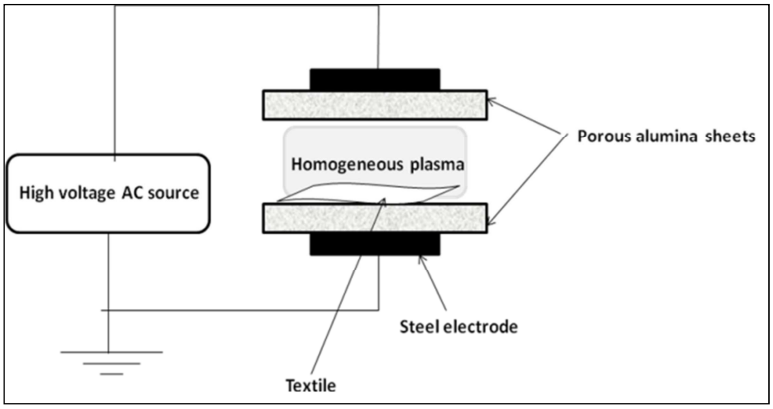


Fig. 1. Schematic diagram of the plasma generator

The consumed power of the plasma generator doesn't exceed tens of watts. In order to calculate the consumed power in the plasma generator, Voltage –current waveforms should be plotted as shown in Figure (2). From the figure (2) it can be noticed that the current represents relatively smooth humps of duration time about 5 m sec that is the evidence for obtaining the homogenous glow discharge plasma. There was small filaments that are superimposed on the glow component of the current however, the peak and the duration of these filament is relatively small and don't affect the behavior of the discharge and also cannot harm the textile. Also it can be noticed that the discharge current increased by increasing the applied voltage between the electrodes.

The reactor mean power has been evaluated by plotting the voltage versus the current the result is parallelepiped shape called Lissajous figure. The area of Lissajous figure is directly proportional to the consumed energy per one cycle. The average consumed discharge power for the plasma reactor at different applied voltages is shown in the Table (1). From the table it can be stated that the plasma reactor don't consume large power.

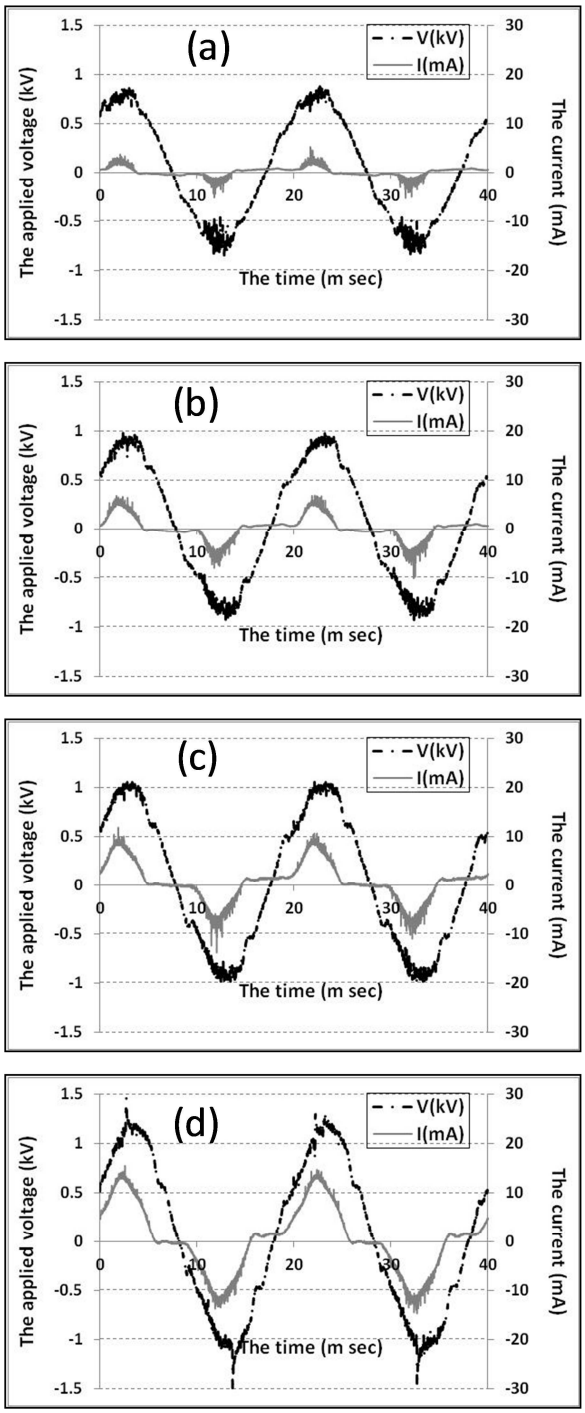


Fig. 2 I-V wave forms at different applied voltage

Table 1 The consumed power of the glow plasma reactor at different applied voltage.

Voltage (V)	Power (Watt)
650	0.088
690	0.25
720	0.41
740	0.55
780	0.88
860	1.8
950	2.5

2.2 MATERIALS

Substrate

wool/polyamide 20/80, mill scoured fabric weigth of square meter 240g/$m^{2,}$ supplied by Golden Tex Company, Egypt.

Dyestuffs

Three different types of dyes were selected and used namely: Setazol S2B (Setazol Kimya Co., reactive dye), Ginacryl Red Violet 3RN (basic dye), Suncid Blue N-RH, C.I. Acid Blue 260, supplied from ICI Co., Egypt.

Thickening agent

Mepro gum T-8 supplied by Danisco Company, Switzerland, and Guar gum, supplied by Morgan Co. Egypt. were used as thickening agents.

Auxiliaries

trichloroacetic acid, was supplied by Riedel Haen (Germany), acetic acid, citric acid, benzyl alcohol, urea, thiourea, and ammonium sulfate, all reagents were commercial grade of purity, supplied by Al-Nasr Company, Egypt.

Scoural CA, non ionic detergent, supplied by Daico Co., Egypt, was used for washing off process for the printed samples.

-Kieralon AE 3D, (BASF),non-ionic wetting agent.

2.3 PRINTING

Samples were printed after plasma treatment by using the recipes as shown below:

Recipe (1):

30 gm basic dye (Ginacryl Red Violet 3RN 200%)

20 gm benzyl alcohol

15 gm acetic acid 30%

500 gm mepro gum

5 gm citric acd

X gm water

1000 gm

The prints were then air dried and steamed at 105°C for 30 min.

Recipe (2)[(4)]:

30 gm reactive dye (Setazol Red S2B)

3 gm trichloroacetic acid

500 gm meypro gum T-8

50 gm urea

10 gm non-ionic wetting agent

X gm water

1000 gm

The prints were then air dried and steamed at 120°C for 15 min.

Recipe (3):

30 gm acid dye (Suncid Blue N-RH)

50 gm thiourea

50 gm urea

5 gm ammonium sulfate

500 gm guar gum

X gm water

1000 gm

The prints were then air dried and steamed at 105°C for 30 min.

Washing off

The prints were washed with cold water and soaped at 60ºC for 15 minutes with 2g/l Scoural CA, then rinsed with hot and cold water and air dried.

2.4 MEASUREMENTS

2.4.1 WHITENESS AND COLOR STRENGTH

The colour strength (K/S) and the degree of whiteness of the printed samples were evaluated by Ultra scan pro spectrophotometer, Hunter Lap, by light reflectance technique and The K/S values of the prints were automatically calculated according to Kobelka-Munk equation.[45]

2.4.2 WETTABILITY

water-drop test was applied according to AATCC test method 39-1980[46]. The time required for the drop of water to be absorbed into the fabric will be referred to as absorbency values.

2.4.3 SCANNING ELECTRON MICROSCOPE (SEM)

The SEM photomicrographs were recorded using JEOL, JXA-840A Electron probe microanalyzer, to study the changes in the surface morphology of plasma treated fabrics.

2.4.4 INFRARED

Infrared (IR) microscopic analysis was carried out by using Nicolet 380 FT-IR, crystal ZnSe, Thermo electron corporation , using Attenuated total reflection to obtain transmission IR spectra.

2.4.5 TENSILE STRENGTH

The tensile strength test was carried out according to the ASTM standard test method D1294-95a[47]. On a tensile strength apparatus (model H5KT, Tinius Olsen Company).

2.4.6 FELTING SHRINKAGE

A felting shrinkage test was carried out according to

the ISO/FDIS 6330 method (IWTO-20-69, 2000) glow plasma treated and untreated fabrics.

Felting area shrinkage Sa (%), was obtained as follows:

$$Felting\ shrinkage\ (Sa) = \frac{(OM - FM)}{OM} \times 100$$

Where OM= original measurements (before felting), FM= The measurements after felting.

2.4.7 FASTNESS PROPERTIES

The colour fastness to washing, crocking, and perspiration, were determined according to the AATCC test method 61-1996, AATCC test method 8-1996, and AATCC test method 15-1997[46] respectively.

3 RESULTS AND DISCUSSION

3.1 THE TEXTILE SURFACE PROPERTIES

3.1.1 WHITENESS

The whiteness measurements as a function of the treatment time at discharge currents I=5 and 10 mA, are shown in figure (3).

It is obvious that there is a significant improvement in the whiteness degree for plasma treated samples as it compared by the untreated sample. This enhancement in whiteness increases by increasing the treatment time at discharge current 5, this behavior is attributed to the cleaning effect of plasma on the surface of wool/polyamide fabric from any contaminations by the bombardment of the ions and the excited species that are formed inside the plasma reactor. While by using 10 mA discharge current, the whiteness decreases gradually by increasing treatment time, but the values are still higher than untreated sample, higher discharge current and longer exposure time during plasma treatment may be leads to oxidation of disulphide linkage (i.e. systine bond) in wool structure[48] result in increase yellowing of blend fabric.

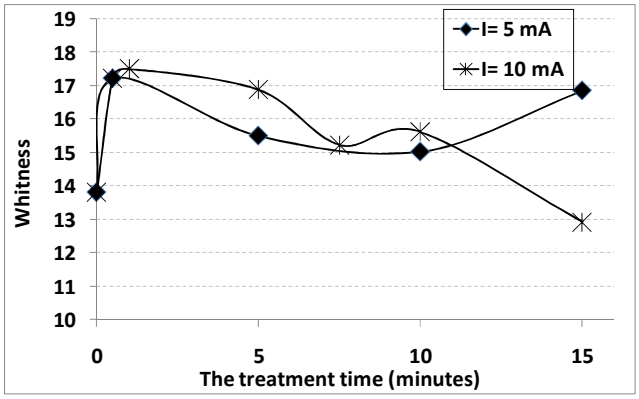


Fig.3 Effect of air plasma treatment on whiteness index of wool/polyamide fabric in relation to discharge current and exposure time.

Furthermore, this behavior may be due to increase of the surface roughness , since reflection of light of the rough surface is less than smooth ones[49].

Also the improving in the whiteness increase by increasing the discharge current i.e 5-12 mA for 10 min. as it is shown in figure (4).

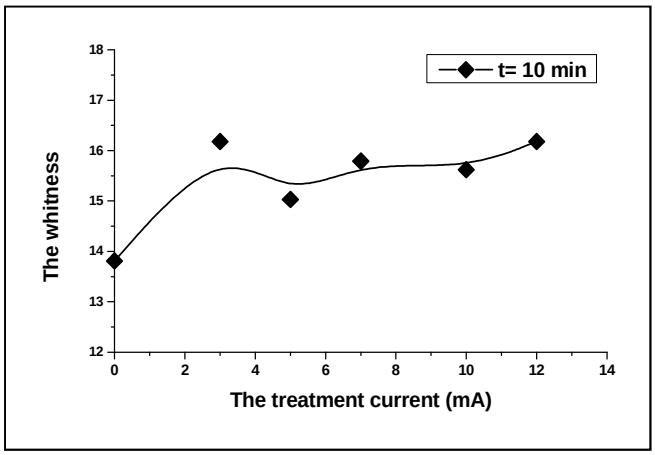


Fig.4 Effect of air plasma treatment on whiteness index of wool/polyamide fabric as a function of discharge current.

3.1.2 SCANNING ELECTRON MICROSCOPE (SEM)

The SEM images of untreated wool/polyamide fabric and plasma treated fabric are shown in fig.(5). The change in the surface morphology of plasma treated wool/polyamide fabric is shown in figs. (b, c), the etching and roughening effect caused by the active species bombardment of air plasma on the surface of polyamide fiber in the blend is observed in fig. (b), also remove the scales of the cuticle cell by the etching effect of plasma makes the wool fibers look more smooth than untreated one. It can be noticed from fig. (c), that the cuticle layer of treated wool is partially removed and visible holes and cracks are formed.

3.1.3 FTIR ANALYSIS

Surface chemical modifications induced by air plasma treatment of the wool/polyamide fabric are determined by an FTIR analysis. Figure (4) shows the FTIR spectra obtained for the untreated (a) and air plasma treated blend fabrics (b). In the spectrum of the air plasma treated fabric (b), some new absorption band with peak intensity at 1062.82 cm^{-1}, characteristic of –COOH carboxylic acid group, 1234.30 cm^{-1}, characteristic of asymmetric –C=O stretching vibration, and 3635.66 cm^{-1}, characteristic of primary alcohol OH stretch groups are observed. This result indicates that an oxidation process in the treated sample is occurred, and this attributed to the fast reaction between the radical ions and the fabric surface with air plasma treatment. So air plasma treatment is considers a high efficient process in incorporating oxygen on the fabric surface[(50)].In addition, a band with beak intensity at 3307.23 cm^{-1}, characteristic of aliphatic secondary amine NH stretch group, and the absorption at 1392.27 cm^{-1}, which due to ammonium salt NH_4 group were also observed

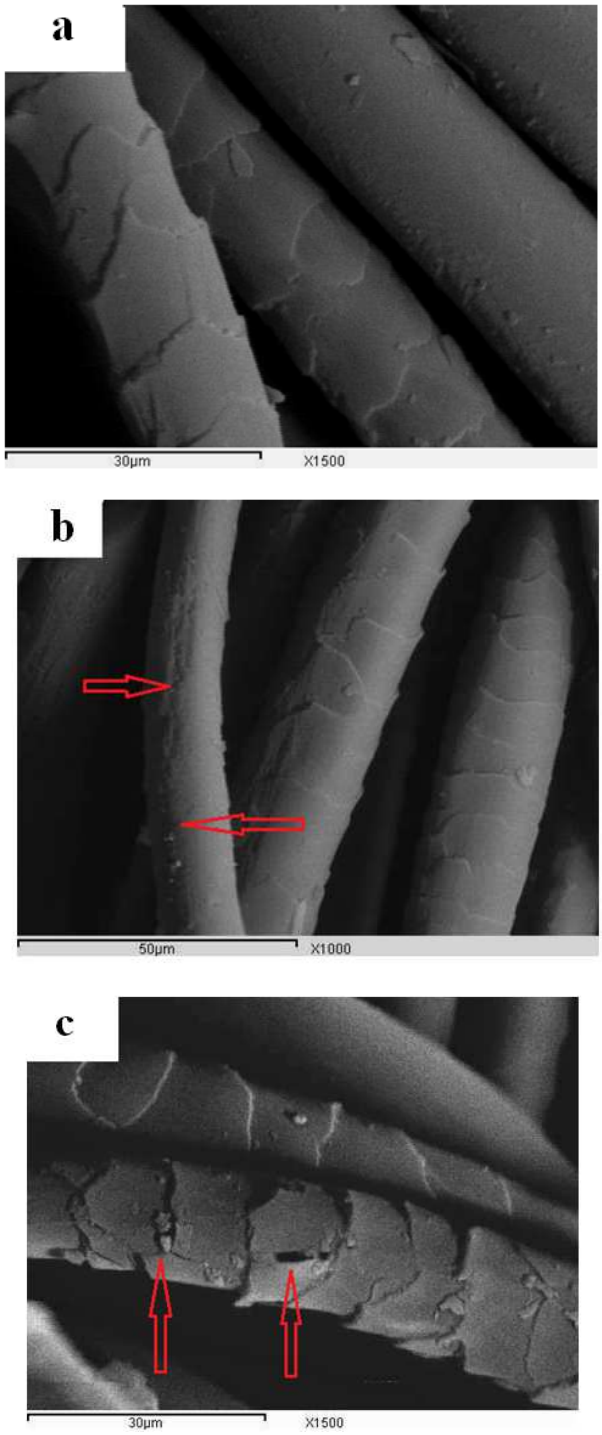


Fig.5 SEM pictures of (a) untreated, (b, c) air plasma treated wool/polyamide samples at 10 mA for 10 min.

3.1.4 TENSILE STRENGTH AND ELONGATION

Tensile strength and elongation to break of the wool/polyamide blend before and after plasma treatments are given in table (2) one can notice from the results that plasma treatment causes a slight decrease in the average tensile strength as compared to the untreated samples . This decrease is believed to be related closely to the inter- fiber inter- yarn frictional forces induce by the plasma treatment as reported by Yip,J.&el.[51] Both tensile strength and elongation are found to be discharge current and exposure time dependent, the maximum decrease in the tensile strength does not exceed than 13.78% by using 10 mA current for 10 min. Ren,Y.&el [52] has reported that a long DBD plasma treatment generates deep cracks on

the fiber surfaces leading to reduce the tensile strength of the fiber, furthermore, higher discharge current or longer treatment time during plasma treatment may lead to lose in tensile properties due to excessive etching[53].

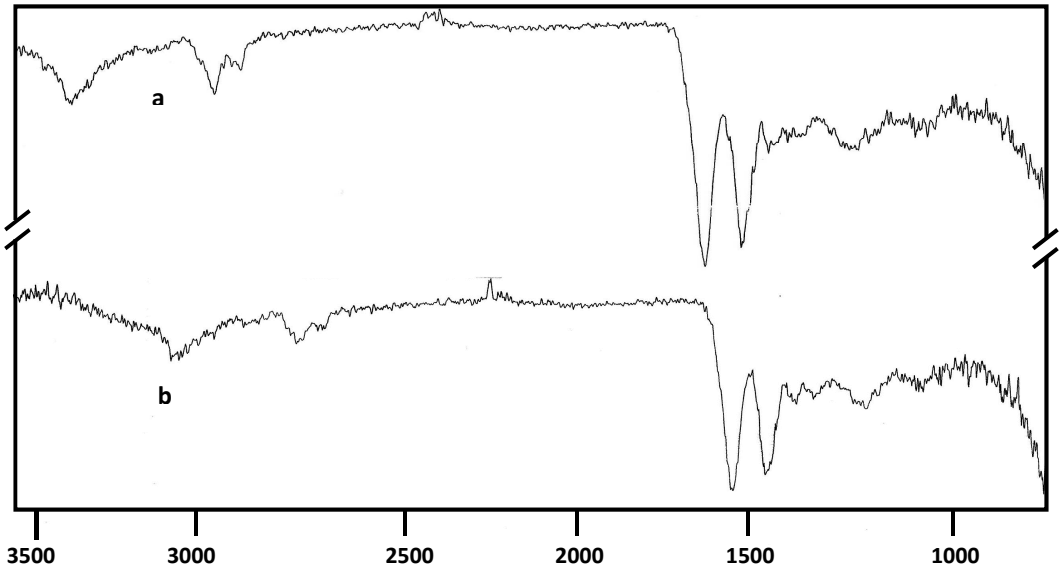


Fig.6 IR spectra of woo/polyamide fabric, (a) untreated, (b) air plasma treated fabric for 10 min., at 10 mA.

3.1.5 SHRINK RESISTANCE

Wool/polyamide blends fabrics show much lower shrinkage values than wool, due to the presence of polyamide in the yarn, the results shown in table (2) reveal that plasma treatments under different conditions of the treatment time and discharge current reduce the area shrinkage of wool/polyamide blend to about 1% with respect to untreated sample 2.5%, the shrink resistance effect induced by the DBD plasma is attributed to changes in the wool surface, such as progressive removal of fatty acids covalently bonded to the outermost surface of the fiber (Fatty layer)[54]and etching off the exocuticle that contains the disulfide linkages which increase cross linking and contribute towards shrinkage[55]. These changes could result in a reduction in the differential friction effect of the fibers and, hence, in a decrease of the natural tendency of wool to shrinkage.

3.1.6 WETTABILITY

The effect o plasma treatment on the wettability of wool/polyamide blend expressed by wetting time is investigated. The results are illustrated in table (2), it can be seen that the wetting time decreases with increasing the discharge power and also by increasing plasma treatment time. This improves in the wettability is attributed to the ion bombardment on the fabric surface which leads to formation of surface-free radicals and increase in the amount of active species formed on the surface[1]. The plasma also enhances the wetting properties by etching off the hydrophobic epicuticle from the wool surface, as well as introducing surface polar groups such as (-COH,-COO,-C=O,NH) as it is evident from FTIR analysis, in addition etching process increase the grooves on the fiber surface and hence enhance the wettability of fabrics[48].

Table 2 The physical properties of untreated and plasma treated wool/polyamide blend at different conditions of the current and the treatment time.

Condition of plasma treatment	Wettability (Sec.)	Tensile Strength of Wool fabric Kg/mm2	Elongation To Break %	Area Shrinkage %
Untreated	366.6	46.79	28.69	2.49
5 mA-7.5 min.	307.2	45.41	27.92	1.99
5 mA-10 min.	258.6	44.46	26.87	1.49
10 mA-7.5 min.	166.8	41.87	25.80	0.99
10 mA-10 min.	148.8	40.34	24.44	1.00

3.2 PRINTING PROPERTIES

3.2.1 COLOR STRENGTH

Figures 7-9 represent the effect of exposure time to the air plasma treatment at different discharge curents on the colour strength of treated wool/polyamide fabric printed with acid, basic, and reactive dyes respectively. The obtained results indicate that a significant increment in colour strength of plasma treated fabric was occurred, irrespective of type of dye used, this increase in the colour strength could be due to the following reasons: plasma treatments have a significant influence on the surface morphology and result in unsaturated and/or free radicals on the fibre surface and consequently enhance the fibre dyeability and printability. On the other side, plasma etching might open up newly accessible domains for the diffusion of dye molecules, which results in increased dyeability[56].

Printing of plasma pretreated wool/polyamide blend with acid dye:

The effect of air plasma treatment on the colour strength of wool/polyamide fabric printed with acid dye is presented in figure 7, It can be noticed that the colour strength increase by increasing the exposure time for both current used 5 mA, and 10 mA, this increase in the colour strength may be is due to the oxidation of the disulfide bonds and converts cysteine moieties in the lipid layer to cysteic acid [57,58,59]. And thus introduce NH_2 groups into the fibre, which reflects an increasing absorption of anionic dyes (acid dye), on the other hand, etching of the epicuticle layer by plasma, the partial removal of wool surface scales and the reduction in the amount of covalently bonded fatty acids, lead to an increase in the hydrophilicty and hence the printability of the fabrics.

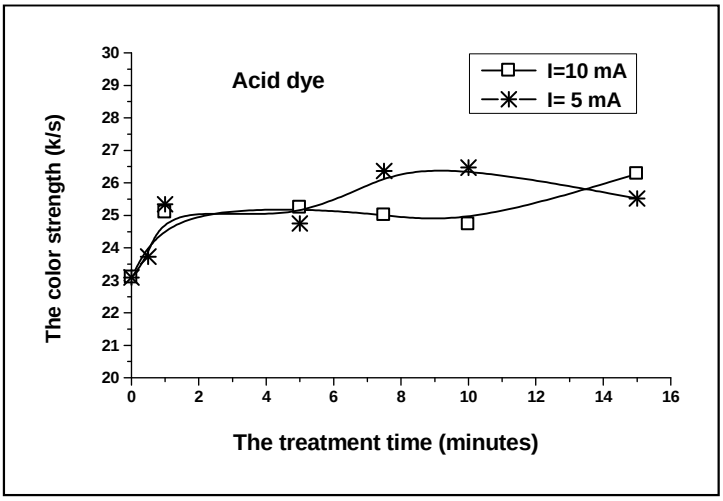


Fig.7 Effect of air plasma treatment time on the colour strength of wool/polyamide fabric printed with acid dye.

Printing of plasma pretreated wool/polyamide fabric with basic dye:

Figure 8 represent the relation between plasma exposure time and the colour strength of untreated and plasma treated wool/polyamide fabric printed with basic dye.

As in the case of acid dye, the K/S values increase as the exposure time of plasma treatment increases until it reaches 29.76% for 15 min. exposure by using 10 mA, these results can be explained in terms of wool surface modification, that is, an increase in the cysteic acid content of the wool fabric surface and thus increase sulphonate and carboxylic acid groups which act as active sites for basic dyes[60]. On the other side, plasma treatment cause the breaking of the chain molecules of polyamide, resulting an increase of carboxyl and amine end groups, the amino and carboxylic acid groups will be ionized, aionic attraction operating between basic dye and carboxylic acid groups of polyamide, also similar interaction observed between anionic acid dye and amino end groups of polyamide.

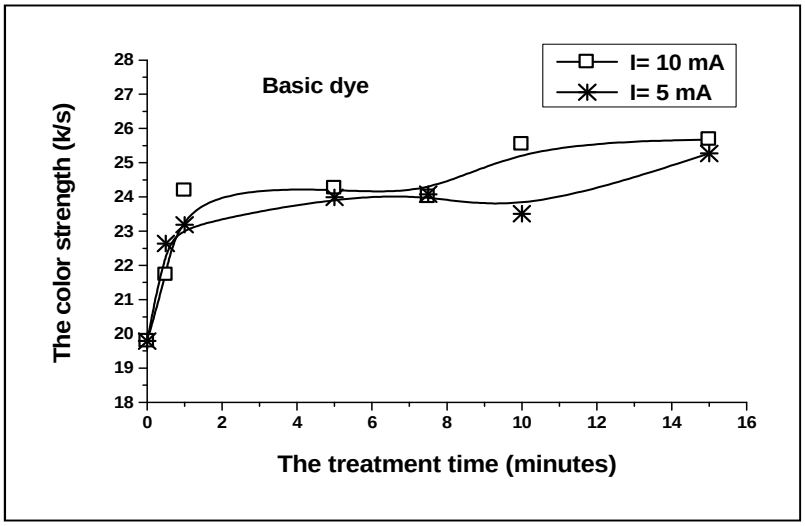


Fig.8 Effect of air plasma treatment time on the colour strength of wool/polyamide fabric printed with basic dye.

Printing of plasma pretreated wool/polyamide fabric with reactive dye:

The impact of plasma treatment time on the colour strength of wool/polyamide fabric printed with reactive dye is illustrated in figure 9, Similar to acid and basic dyes plasma treated wool/polyamide fabric printed with reactive dye gave higher K/S values than that of the untreated sample. This increase in the K/S values is correlated with the increase in exposure time of plasma treatment. This results may be attributed to the effect of air plasma treatment on increase the dye sites on the wool/polyamide fabric surface, which react with the dye and produce a variety of oxygenated functional groups[59], such as C=O, -OH and –OOH. Theses groups enhance the dye fibre interaction between the reactive dye sites and the wool/polyamide fabric by forming covalent ionic and hydrogen bonds.

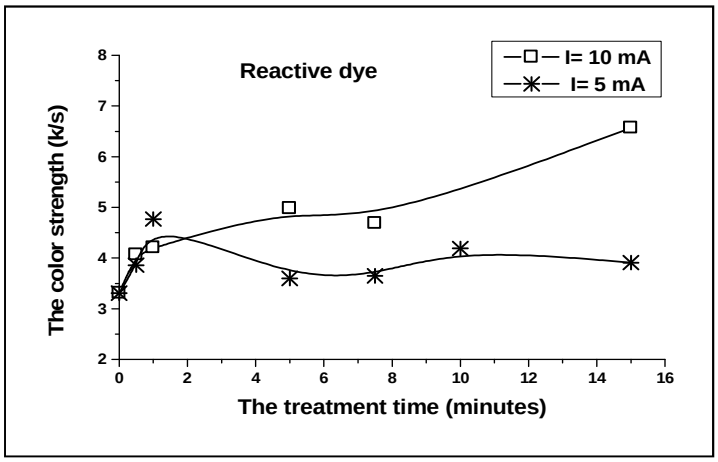


Fig.9 Effect of air plasma treatment time on the colour strength of wool/polyamide fabric printed with reactive dye.

The effect of discharge current of plasma treatment on the colour strength of treated wool/polyamide fabric printed with acid, basic, and reactive dyes is shown in figure 10, it can be concluded from the results that on using reactive dye there was a significant increase in the K/S value in comparison with acid, and basic dyes for the same discharge current, for example, the increase in the K/S for the sample treated with 7 mA for 10 min. was 14.59 %, 23.09 %, and 80.36 % for the samples printed with acid, basic, and reactive dyes respectively.

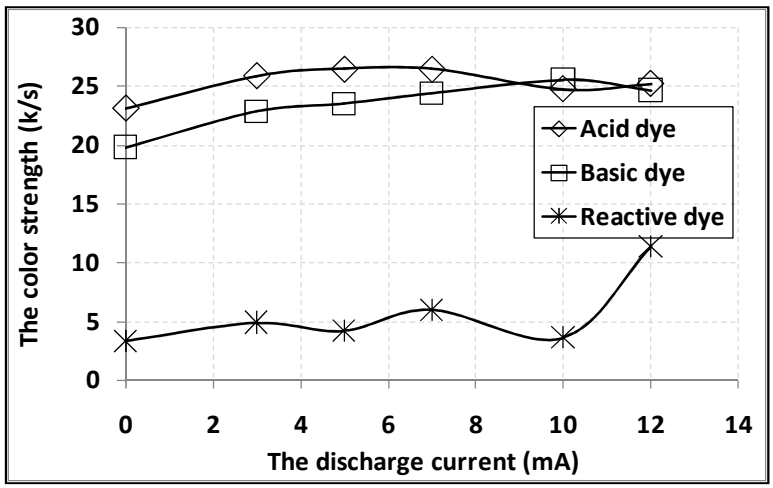


Fig.10 Effect of plasma discharge current on the colour strength of wool/polyamide fabric printed with acid, basic and reactive dyes.

3.2.2 FASTNESS PROPERTIES

The improvement in the colour fastness of the plasma treated and printed fabrics in comparison with the untreated ones is shown in table 3. It was observed that plasma treatment improves the washing and perspiration fastness of wool/polyamide fabric printed with acid, basic, and reactive dyes. Also the rubbing fastness show some enhancing after plasma treatment by using all the dyes under the investigation.

Table 3 Fastness properties of untreated and plasma treated wool/polyamide fabric under different conditions

Dyestuffs	Condition of plasma treatment	Wash Fastness			Rubbing Fastness		Perspiration Fastness					
							Alkaline			Acidic		
		Alt.	St.		Dry	Wet	Alt.	St.		Alt.	St.	
			Cotton	Wool				Cotton	Wool		Cotton	Wool
Acid dye	Untreated	5	3-4	3-4	4	2-3	4-5	3-4	4	4-5	4	4-5
	5 mA-7.5 min.	5	4	4-5	4-5	3	4-5	4	4-5	4-5	4-5	4-5
	5 mA-10 min.	5	4	4-5	4-5	3	4-5	4	4-5	4-5	4-5	4-5
	10 mA-7.5 min.	5	4	4	4-5	3	4-5	4	4-5	4-5	4-5	4-5
	10 mA-10 min.	5	4	4	4-5	3	4-5	4	4-5	4-5	4-5	4-5
Basic dye	Untreated	5	3-4	3-4	3-4	3	4-5	3	4	4-5	4	4-5
	5 mA-7.5 min.	5	4	4	4	3-4	4-5	3-4	4	4-5	4-5	4-5
	5 mA-10 min.	5	4	4	4	3-4	4-5	3-4	4	4-5	4-5	4-5
	10 mA-7.5 min.	5	4	4	4	3-4	4-5	3-4	4	4-5	4-5	4-5
	10 mA-10 min.	5	4	4	4	3-4	4-5	3-4	4	4-5	4-5	4-5
Reactive dye	Untreated	5	4-5	4-5	5	4	4-5	4	4-5	4-5	4-5	4-5
	5 mA-7.5 min.	5	5	5	5	4	4-5	4-5	4-5	4-5	5	4-5
	5 mA-10 min.	5	5	5	5	4-5	4-5	4-5	4-5	4-5	5	4-5
	10 mA-7.5 min.	5	5	5	5	4	4-5	4-5	4-5	4-5	5	4-5
	10 mA-10 min.	5	5	5	5	4	4-5	4-5	4-5	4-5	5	4-5

4 CONCLUSION

The influence of atmospheric pressure plasma treatment on the physical and printing properties of wool/polyamide blend fabric by using three dyestuffs; acid, basic, and reactive dyes, is studied. The results revealed that the plasma treatment was an effective technique to increase wettability, whiteness, colour strength of printed wool/polyamide fabric, these increase are discharge current and time exposure dependent. The results of SEM images provided a visual evidence that the plasma treatment can improve the wettability of wool/polyamide fabric because the surface etching and roughening effect, and partial removal of scales on wool fiber in the blend, The FTIR spectre indicated the presence of oxygen-containing functional groups and aliphatic secondary amine group, which enhance the dye fiber interaction. Also the tensile strength and elongation at break of the treated fabrics have slightly decreased, not exceed than 13.76%. Additionally , The fastness properties of treated wool/polyamide printed fabrics are enhanced irrespective of the dyes used under the investigation.

REFERENCES

[1] Hwang, Y.J., Cord, M.C., M.G., An,J.S., Kang,B.C., and Park, S.W., 2005, Effect of Helium atmospheric pressure plasma treatment on low stress properties of polypropylene nonwoven fabrics, Tex.Res.J.,75,11,771-778.

[2] Molina, R., Jovancic, P., Comelles, F., Bertran, E., and Erra, P., 2002, Shrink-resistance and wetting properties of keratin fibers treated by glow discharge. Adhesion Science Technology, 16, 1469–1485.

[3] Datye, K.V., & Vaidya, A.A. 1984,*'Chemical processing of synthetic fibres and blends'.* New York: John Wiley.

[4] Marie M.M., Salem A.A., El Zairy E.M.R., 2011, 'A novel printing method to enhance the fixation of reactive dyes on wool–polyamide fabrics', 102, 9, 790-800.

[5] Miles, L.W.C. 1994, Textile printing ,2nd ed.,. Bradford: Society of Dyers and Colourists.

[6] El-Molla M.M., Badawy N.A., AbdEl-Aal A.Y., El-Bayaa A.A. & G El-Shaimaa, H.M., 2011, 'Dyeability of cationised cotton and nylon 6 fabrics using acid dyes', Indian Journal of Fibre & Textile Research, 36,3, 88-95.

[7] Eivazzadeh E., Malek R.M.A. and Mazaheri F., 2008,'Aftertreatment of Polyamide 6 Printed with Anionic Dyes to Improve Staining', World Applied Sciences Journal, 5, 1, 39-41.

[8] Feiz M., Mallakpour S., Azizollahi M.A.,2007, 'Aftertreatment of direct dyes on wool and nylon 6 with syntans and a syntan/cationic system' Dyes and Pigments, 74, 2, 258-261.

[9] Antonio Navarro, Jose Cegarra, Jose Valldeperas, Dragan Jocic,2006, 'Influence of oxyethylenated alkylamines in the dyeing of polyamide 66 fibres' ,Dyes and Pigments, 69, 1–2, 40-44.

[10] Burkinshaw S.M., Kumar N., 2008, 'A tannic acid/ferrous sulfate aftertreatment for dyed nylon 6,6 ',Dyes and Pigments, 79, 1, 48-53.

[11] Soleimani-Gorgani A., Taylor J.A., 2006, 'Dyeing of nylon with reactive dyes. Part 1. The effect of changes in dye structure on the dyeing of nylon with reactive dyes 'Dyes and Pigments, 68, 2–3, 109-117.

[12] Mousa, A.A., Youssef, Y.A., Farouk, R., & El-kharadly, E.A. , 2006, 'Dyeing of nylon 6 fabric with a new bifunctional vinylsulphone reactive disperse dyes', Coloration Technology, 122, 6, 338–344.

[13] Lewis, D.M., Ho, Y.C., 1996, 'Improved fixation of dyes on polyamide fibres. Part 3: Using 2-chloro-4,6-di(aminobenzene-4'-vinylsulphone)-s-triazine [XLC-VS] as an after-treatment of nucleophilic aminoalkyl dyes', Dyes and Pigments, 30, 4, 301–314.

[14] Burkinshaw, S.M, Maseka, K.D, 2008, 'A tannic acid/ferrous sulfate aftertreatment for dyed nylon 6,6', Dyes and Pigments, 79, 1, 48-53.

[15] Haroun A.A., Mansour H.F., 2007, 'Effect of cationisation on reactive printing of leather and wool', Dyes and Pigments, 72, 1, 80-87.

[16] Karin Schumacher, Elisabeth Heine, Hartwig Höcker, 2007,' Extremozymes for improving wool properties ',Journal of Biotechnology, 89, 2–3, 23 281-288.

[17] Ibrahim N.A., Abdalla W.A., El-Zairy E.M.R., Khalil H.M., 2013,'Utilization of monochloro-triazine β-cyclodextrin for enhancing printability and functionality of woo' Carbohydrate Polymers, 92, 2, 15, 1520-1529.

[18] Esther Pascual, Maria Rosa Julià, 2001,'The role of chitosan in wool finishing' Journal of Biotechnology, 89, 2–3, 23, 289-296.

[19] J.I.N.R. Gomes, J. Griffiths, H.L.S. Maia, J.C.V.P. Moura, A.M.F. Oliveira-Campos, 1991,' A novel carboxy-dye reactive system of potential applicability to wool and nylon fibres. Part 1. Studies with model amines', Dyes and Pigments,

[20] 17, 4, 269‑278.

[21] Gonçalves, M.S.T., Oliveira-Campos, A.m.F., Moura, J.C.V.P., Maia, H.L.S., Gomes, J.I.N.R., Hrdina, R., 1998,' Reaction of carboxylic dyes with wool and polyamide. Part III: Effect of the activating agent', Dyes and Pigments, 36, 4, 16, 373‑379.

[22] Chalaya, N. E, Safonov, V. V., 2007, 'Dyeing of polyamide—wool fibre blend with acid dyes using α-cyclodextrin', Fibre Chemistry, 39, 3, 218-220.
[23] El-khateeb, H.S., 2013, 'Dyeing ofWool/Nylon Blend Fabric with Camphor Plant After Bio-Treatment with Brewers 'Yeast Suspension', International Design Journal,1, 143-152.
[24] Masukuni Mori, Volkmar von Arnim, Albrecht Dinkelmann, Mitsuo Matsudaira and Tomiji Wakida, 2011,'Modification of wool fibers by atmospheric pressure plasma treatment', The Journal of The Textile Institute, 102, 6, 2011, 534–539
[25] Wang, C.X. Qiu, Y.P., 2007, 'Two sided modification of wool fabrics by atmospheric pressure plasma jet: Influence of processing parameters on plasma penetration', Surface and Coatings Technology, 201, 14, 6273-6277.
[26] Kan, C.W., Yuen, C.W.M., Hung, O.N.,2013, 'Improving the pilling property of knitted wool fabric with atmospheric pressure plasma treatment', Surface and Coatings Technology, 228, Supplement 1, 15, 2013, S588-S592.
[27] Alberto Ceria, Fabio Rombaldoni, Giorgio Rovero, Giorgio Mazzuchetti, Silvio Sicardi,2010,'The effect of an innovative atmospheric plasma jet treatment on physical and mechanical properties of wool fabrics', Journal of Materials Processing Technology, 210, 5, 19, 720-726
[28] Wu Yu, Wang Shouguo, 2009,' The research about the time-effect of the wettability on the wool surface treated by the Ar plasma jet in the atmospheric pressure', Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms, 267, 18, 15 , 3137-3139.
[29] Cheng, S.Y., Yuen, C.W.M., Kan, C.W., Cheuk, K.K.L.,. Daoud, W.A, Lam P.L., Tsoi ,W.Y.I., 2010,' Influence of atmospheric pressure plasma treatment on various fibrous materials: Performance properties and surface adhesion analysis ', 84, 12, 25, 1466-1470.
[30] Saurabh Garg, Chris Hurren, Akif Kaynak, 2007,'Improvement of adhesion of conductive polypyrrole coating on wool and polyester fabrics using atmospheric plasma treatment', Synthetic Metals, 157, 1, 15, 41-47.
[31] Thomas H., 2007,'Plasma modification of wool', Plasma Technologies for Textiles, 228-246.
[32] Lu Zhu, Weihua Teng, Helan Xu, Yan Liu, Qiuran Jiang, Chunxia Wang, Yiping Qiu, 2008,' Effect of absorbed moisture on the atmospheric plasma etching of polyamide fibers', Surface and Coatings Technology, 202, 10, 15 1966-1974.
[33] Fernando Ribeiro Oliveira, Andrea Zille, Antonio Pedro Souto, 2014,'Dyeing mechanism and optimization of polyamide 6,6 functionalized with double barrier discharge (DBD) plasma in air ',Applied Surface Science, 293, 28, 177-186.
[34] Mather, R.R., 2009,' Surface modification of textiles by plasma treatments', Surface Modification of Textiles, 296-317
[35] Zhiqiang Gao, 2011,'Modification of surface properties of polyamide 6 films with atmospheric pressure plasma ',Applied Surface Science, 257, 14, 1 6068-6072.
[36] Zhiqiang Gao, Jie Sun, Shujing Peng, Lan Yao, Yiping Qiu, 2009,'Surface modification of a polyamide 6 film by He/CF4 plasma using atmospheric pressure plasma jet ',Applied Surface Science, 256, 5, 15 ,1496-1501
[37] Zhiqiang Gao, 2012,' Influence of environmental humidity on plasma etching polyamide 6 films Applied Surface Science, 258, 15, 15 ,5574-5578.
[38] Kan, C.W., Yuen, C.W.M., 2013,'Effect of atmospheric pressure plasma treatment on wettability and dryability of synthetic textile fibres ',Surface and Coatings Technology, 228, Supplement 1, 15 , S607-S610.
[39] Daphne Pappas, Andres Bujanda, J. Derek Demaree, James K. Hirvonen, Wendy Kosik, Robert Jensen, Steven McKnight, 2006,' Surface modification of polyamide fibers and films using atmospheric plasmas', Surface and Coatings Technology, 201, 7, 20 , 4384-4388.
[40] Lu Zhu, Chunxia Wang, Yiping Qiu, 2007,' Influence of the amount of absorbed moisture in nylon fibers on atmospheric pressure plasma processing', Surface and Coatings Technology, 201, 16–17, 21 , 7453-7461.
[41] Nai-Yi Cui, Deepesh J. Upadhyay, Colin A. Anderson, Norman M.D. Brown, 2005,'Study of the surface modification of a Nylon-6,6 film processed in an atmospheric pressure air dielectric barrier discharge', Surface and Coatings Technology, 192, 1, 1 , 94-100.
[42] Fernando Ribeiro Oliveira, Andrea Zille, Antonio Pedro Souto, 2014,'Dyeing mechanism and optimization of polyamide 6,6 functionalized with double barrier discharge (DBD) plasma in air ',Applied Surface Science, 293, 28 , 177-186.
[43] Cristina Canal, Ricardo Molina, Antonio Navarro, Enric Bertran, Pilar Erra, 2008, 'Effects of low temperature plasma on wool and wool/nylon blend dyed fabrics', Fibers and Polymers, 9, 3, 293-300.
[44] Ulesova, A. V., Grechko, A. A. , Sadova, S. F., 2008,' Continuous dyeing of wool fabric containing polyamide fibre and modified by plasma glow discharge', Fibre Chemistry , 40, I 2, 143-146.
[45] Garamoon, A.A., El-zeer, D.M., 2009, Atmospheric pressure glow discharge plasma in air at frequency 50 Hz', Plasma Sources Sci. Technol. 18, 3, 194–201.
[46] Judd, D.B. and Wyszecki, G., 1975, Color in business science and industry ,3 rd edn., John Wiley Sons, Cleveland, USA.
[47] American Association of textile chemists and colorists, AATCC, technical manual, research Triangle park, USA, 75(2000).
[48] American Society for testing and Materials, Annual Book of ASTM standards, section seven, textiles, USA, 07.02,(2000).

[49] Gawish S.M., Saudy M.A., Abo El- Ola S.M., Abou-ElKheir A., 2011, The effect of low temperature plasma for improving wool and chitosan treated wool fabric properties', The journal of the textile institute, 102, 2,180-188.
[50] El Katibe E.M., Raslan W.M, El Halwagy A.A, and Galab S., Effect of low temperature plasma treatment on the prosperities of wool/polyester blend,2013, RJTA, 17,1,124-132.
[51] El-Zeer, D.M., Salem, A.A, Rashed, U.M., Abd-Elbaset,T., Galab, S., 2014, Journal of engineering research and applications, 4, 3, 401-410.
[52] Yip,J.,Chang,K.,Sin,K.M., and Lau,K.S,2002,J.Mat. processing technology, 123,5.
[53] Ren,Y. Hng,Y.,Sun,j.,and Qiu,Y.,2008,Influence of treatment duration on hydrophobic recovery of plasma treated ultra high modulus polyethylene fiber surfaces, J.App.polymer Sci,110,995-1001.
[54] Kiran,H.Kale&Desai,A.N., 2011,Atmospheric pressure plasma treatment of textiles using non-polymerizing gases, Indian journal of fiber and textile research, 36,289-299.
[55] Saville,B.P.,2000, Physical testing of textiles, woodhead publishing Limited Cambridge,England,173-174.
[56] Kan,C.W., et al, 2010, plasma pretreatment for polymer deposition improving antifelting properties of wool, plasma science, IEEE transactions, 38,6,1505-1511
[57] Okuno,T.,Yasuda,T. and Yasuda,H., 1992, Effect of crystallinity of PET and Nylon 66 fibers on plasma etching and dyeability characteristics, Tex. Res. J.,62,8,474-480.
[58] El-Zawahry,M.M, Ibrahim,N.A., and Eid,M.A, 2006, The impact of nitrogen plasma treatment upon the physical-chemical and dyeing properties of wool fabric, polymer plastics technology and engineering, 45,1-10.
[59] Hocker,H.,2002, plasma treatment of textile fibers, Pure Applied Chemistry, 74,3,423-427.
[60] Kan,C.W., Yuen,C.W.M, 2007, plasma technology of wool, textile progress,39,3,122-176
[61] Shan J.N and Shah S.R, 2013, Innovative plasma technology in textile processing: A step towards green environment, Research journal of engineering sciences, 2,4,34-39.

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Effect of Selected Operating Parameters on the Photocatalytic Efficiency of Nitrogen-Doped TiO_2/WO_3 Nano-Composite Material for Photodegradation of Phenol Red in Aqueous Solution

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ABSTRACT: Crystal form of N-TiO_2/WO_3 Nano-Composite material was prepared from urea, commercial TiO_2 and WO_3 by simple solid phase reaction followed by calcination at a temperature of 400 ^{0}C for four hours at each step. The as-synthesized photocatalyst was characterized using XRD and Uv-Visible diffuse reflectance spectra. It was found that the absorption edge of N-TiO_2/WO_3 was well extended to visible light. The effect of catalyst loading and initial pH on the photocatalytic efficiency of the sample was tested using phenol red as a target pollutant. The photocatalytic degradation efficiency of the catalyst for the adsorbed phenol red was increased from 61.75-93.87% under visible and 48.01-75.74% under UV as the amount of the catalyst increase from 0.15 to 0.45 gram. Further increase in concentration was found to decrease the degradation efficiency. The photocatalytic degradation efficiency of adsorbed phenol red was increased from 55.88-95.23%, under visible and 44.18 -77.32%, under UV as the pH of the solution decreased from 5 to 3. But further decrease in pH was found to decrease the degradation efficiency. The assynthesized photocatalyst was highly efficient under visible irradiation than under UV irradiations.

KEYWORDS: Advanced oxidation processes, Catalyst loading, Operational-parameters, Photocatalysis, pH of solution.

1 INTRODUCTION

Environmental pollution on a global scale is proposed to be the greatest problem that chemical scientists will face in the 21st century and an increasing number of scientists are looking for new systems to solve this problem [1]. The chemical industries make products with much beneficial usage; however, they do also have negative impacts on human health and the environment. They release hazardous, calcitrant and toxic chemical substances such as phenolic compounds, high molecular weight polymeric surfactants, herbicides and pesticides from industrial wastewater effluent which are well known to be not easily biodegradable [20].These effects have become major concern within the international community because of the environmental issues addressed by the Environmental Protection Agency (EPA) to prevent pollution and contamination of groundwater and surface waters [48]. Traditionally, industrial wastewater treatments for these effluents include different techniques such as biological treatment, reverse osmosis and activated carbon adsorption. These techniques often utilize potentially hazardous or polluting materials and even most of them are non-biodegradable.

Therefore, the development of an effective treatment technique that can convert pollutants into non-toxic or less harmful materials is highly required. In recent years, there has been the emergence of voluminous literatures on the development of novel effective photocatalytic processes for the treatment of industrial wastewater effluents and municipal

wastes that contain toxic and recalcitrant pollutants. Photocatalysis is among the rapidly evolving and efficient technologies for purification of water. With this approach, harmful organic compounds are broken down in the presence of catalyst and ultraviolet (UV) irradiation without generating secondary harmful pollutants [16]. Semiconductors such as TiO2, Fe2O3, ZnO, ZnS and WO3 have been known to possess Photocatalytic character [15]. Among them, titanium dioxide has been extensively studied throughout the world and considered as reference photocatalyst in the degradation of organic pollutants, sewage treatment, air purification and disinfection due to its superior photocatalytic performance, non-selective degradation of various organics, deep mineralization rate, low cost, inert and non-toxic properties [7]. However, the wide band of TiO2 (anatase of 3.2 eV, rutile of 3.0 eV) limits the absorption wavelength less than 387 nm, which is only 3–5% of the sunlight energy and holds back the practical applications [26]. In addition, the high rate of electron–hole recombination on the surface and in the bulk phase of the catalysts and the low photoelectric conversion efficiency hamper the practical applications of TiO_2 as photo catalytic materials.

Therefore, doping TiO_2 with some transition-metal elements such as Co and Cu was used as the initial approach to shift the optical response of TiO_2 from the UV band to the visible band [46]. But even these metal-doped TiO_2 materials suffered from thermal instability and low-quantum efficiency because of increased carrier trapping after doping or require expensive facilities in the ion implantation case [2].

In contrast, better visible optical response of TiO_2 could be achieved by using nonmetal doping [24]. Kinds of nonmetal elements, including nitrogen, phosphorus, carbon, chlorine, and bromine were found to be capable of making doped TiO_2 respond to visible light [23]. In particular, the presence of substitutional Nitrogen atoms in the TiO_2 matrix enhanced the absorption in the visible band and then led to a corresponding photocatalytic activity [45]. It is found that nitrogen doping could reduce the band gap of TiO_2 and improve its photocatalytic activity in the visible light region [2].

The efficiency for photocatalytic degradation of pesticides and phenolic compounds is also largely dependent on parameters such as the solution pH, catalyst loading, types of catalyst and composition, organic substrate type and concentration, light intensity and wave length, types of solvent and calcinations temperature [38]. From both application and economic point of view for operational effectiveness of a photocatalyst, the effects of such parameters should be studied.

So, understanding the impacts of various parameters on the photocatalytic degradation efficiency of nitrogen-doped TiO_2/WO_3 nano-composite materials is of paramount importance from the design and the operational points of view. The photocatalytic degradation activity of $NTiO_2$/ WO_3 nano-composite materials have been reported (16]. But the effects of operating parameters on the photocatalytic degradation efficiency of N-TiO_2/WO_3 nanocomposite Materials have not been reported yet.

Therefore, the proposed project was aimed at studying the impacts of pH and catalyst loading on the photocatalytic efficiency of N-TiO_2/WO_3 nano-composite materials for photodegradation of phenol red in aqueous solution.

2 MATERIALS AND METHODS

2.1 EXPERIMENTAL SITE

The experiments such as synthesis of photocatalyst and the effect of parameters (pH and catalyst loading on the photodegradation efficiency of the samples) and part of the characterization of the as-synthesized photocatalysts (Uv-Vis) were carried out at Haramaya University Research Laboratory (HURL). XRD characterization was done in Addis Ababa Ethiopia Geological Survey Laboratory.

2.2 EQUIPMENT AND APPARATUS

The equipment and apparatus used in this study were: UV/vis spectrophotometer (Gullen kamp model SP 62), X-ray diffraction (Bruker D8 Advance XRD, AXS GMBH, Karisruhe, West Germany X-ray defractometre), glass reactor, pH meter (Mettler Tuledo MP220) , tungsten lamp (TORCH 40W) as visible light source, Uv lamp (254 nm) as Uv-light source , air (oxygen) pumper, , furnace, centrifuge, magnetic stirrer, and analytical balance.

2.3 CHEMICALS AND REAGENTS

In this study the following chemicals were used: commercial titanium dioxide (TiO_2) (scientific park, N.Y,U.S.A.), tungsten trioxide(WO3) (MW 231.84 gmol-1, SD fine chemicals, 99%), Phenol red ($C_{19}H_{14}O_5S$) (MW. 354.38 g/mol. 1, BLULUX), Ethanol (CH3CH2OH) (MW. 58.03 g mol-1, Park scientific, 99.8), Urea (MW 60.06 gmol-1, extra pure BLULUX)), 0.1M NaOH (MW. 40 g

mol-1 Assay: 98%) and 0.1M H2SO4 (MW. 98.08 g mol-1 Assay: 98%). All were analytical grade and used with no further purification.

2.4 EXPERIMENTAL METHODS

2.4.1 PREPARATION OF PHOTOCATALYSTS

2.4.1.1 PREPARATION OF N-DOPED TiO_2

20 g of TiO_2 and 60 g of urea (TiO2: urea = 1:3) were mixed and transferred to a mortar and well crushed using pestle. The obtained powder was then calcined at 400oC for four hours for solid phase reaction [6].

3.4.1.2. Preparation of N-doped TiO2/WO3 Nano-composite Material

10 g of N-TiO_2, which was synthesized in section 3.4.1.1.was mixed with 0.75 g of WO3 using 1:1 (v/v) of water and ethanol as solvent. This mixture was subjected to heating at a temperature of 110oC for drying. After cooling to room temperature, it was subjected to calcinations temperature of 400oC for four hours [6].

2.4.2 CHARACTERIZATION METHODS

The as-synthesized composite photocatalyst was characterized using XRD and Uv-Vis spectrophotometer. The crystal phase and crystallite size of the entire obtained composite was measured by Bruker D8 Advance XRD, AXS GMBH, Karisruhe, West Germany X-ray defractometre. The sample was measured in the angular range (2Θ) of 40-640 at a scan rate of 0.020 min-1 using Cu Kα radiation (λ = 0.154056 nm) operating at 40 kV and 40 mA accelerated voltage and applied current respectively. A Uv-visible spectrophotometer (Gullen kamp model

SP 62) was used to obtain the optical absorbance spectra of the sample.

2.4.3 PHOTOCATALYTIC DEGRADATION EXPERIMENT

Photocatalytic degradation of phenol red was carried out in a reactor tube made of glass with an effective volume of 500 ml and having an internal diameter of 8 cm with provision for air purging during photocatalysis and an outlet for the collection of samples from the reactor.

A known amount of the synthesized photocatalyst and 250 ml of PR (50 ppm) was taken in a reactor tube with a capacity of 500 ml and the suspension was stirred in dark for one hour in each experiment to obtain adsorption equilibrium before illumination of the reactor. Prior to illumination of the sample by visible or by UV, air (oxygen) was purged using hand purge into the solution in order to have homogeneous composition. During the reaction, the solution was maintained at room temperature and the distance of the lamp from the solution was kept to 9 cm and its light intensity was recorded to be 8.25mW/cm^2. 10ml of the sample was withdrawn each time at 20 minutes time interval for over the irradiation time of 3 hours. The suspension was centrifuged at 3500 rpm in order to settle down the catalyst particles at the bottom of the test tube before analysis. The absorbance of the clear solution was measured at a λ max of 432 nm for quantitative analysis using different amounts of catalysts and at different pH values.

To check whether the PR is easily degradable or not blank experiment (without addition of any catalyst) has also been done. Photocatalytic degradation experiment was conducted using the assynthesized photocatalysts (N-doped TiO2/WO3 nano-composite material).

2.4.3.1 EFFECT OF VARYING AMOUNT OF CATALYST ON THE PHOTODEGRADATION OF PHENOL RED

To evaluate the effect of the amount of catalyst loading on the photocatalytic efficiency of the prepared N-doped TiO2/WO3 nano-composite material on the degradation of phenol red under

UV and visible light; the experiment was carried out by varying the amount of catalyst to be loaded from 0.15-0.65 g. Similar range was taken to study the effect of the amount of catalyst loading on the photocatalytic efficiency of N-TiO_2 for the degradation of methyl orange in waste water [30]. The percentage degradation was calculated and other parameters were kept constant.

2.4.3.2 EFFECT OF VARYING PH OF SOLUTION ON THE PHOTODEGRADATION OF PHENOL RED

Some organic compounds are photocatalytically degraded at lower pH, while others do so at higher pH. Therefore to evaluate the influence of pH of the solution on the photocatalytic efficiency of the as-synthesized N-doped TiO2/WO3 nano-composite material on the degradation of phenol red under UV and visible light; the experiment was carried out by varying the pH within the range of 2-5.5 and at neutral pH .This pH range was limited by considering the nature of the dye (anionic) and Pzc of the catalyst [4]. Percentage degradation was calculated and other parameters were kept constant.

3 RESULTS AND DISCUSSION

3.1 CHARACTERIZATION OF THE PHOTOCATALYSTS

A fine powder of N-TiO_2/WO_3 was obtained following the above procedures and was characterized as follows.

3.1.1 X-RAY DIFFRACTION (XRD)

Calcinations of the sample at 400^{o}C for 4 hours brings transformation of the composite photocatalyst phase from amorphous to anatase as the XRD spectra shows maximum peak at average angle of 25.59o for N-TiO_2/WO_3[2]. There are also minor peaks at around 38o, 48o, 54o and 55o for the anatase phase. Similar result has been reported by other researchers for N-TiO2 [2]. For WO3 peaks at 130, 180 and 190 are observed.

The XRD pattern of the as-synthesized sample shows only anatase form of TiO_2 and monoclinic form of WO_3 indicating that WO_3 is well incorporated into TiO_2 [19]. As an XRD spectroscopic technique mimic about the structure of crystals, it can be confirmed from (Appendix Figure 1) that the crystallographic shape of the as-synthesized anatase is tetragonal, as studied by many scholars. This is because calcination of TiO_2 at 400oC for 4 hrs leads to the formation of anatase which is tetragonal [19]. As can be confirmed from the XRD spectra of the sample, the incorporation of the impurities into the crystal lattice of TiO_2 doesn't alter its crystal structure. The average crystallite size of the as-synthesized catalyst was estimated using Dubye Scherere equation which is given as:

$$d = \kappa\lambda/\beta\cos\theta \quad (3.1)$$

Where, d is crystallite size in nanometer K is shape factor constant, which is 0.9, β is the full width at half maximum in radians, λ is the wave length of the X-ray and Θ is the Bragg angle.

Therefore the average crystallite size of the photocatalyst (N-TiO_2/WO_3) was calculated based on Dubye Scherer equation at 2Θ (degree) value of 25.59 and β (radian) value of 0.0133 and found to be approximately 10.61 nm. As shown in Figure1, throughout the crystal of N-TiO_2/WO_3 appears to have no other phase other than anatase phase of TiO_2 and the monoclinic phase of WO_3. There was no particular peak resulted from nitrogen impurity in the composite catalyst (N-TiO_2/WO_3). This may be due to the uniform distribution of nitrogen possibly in the form of atom within the as-synthesized material [22].

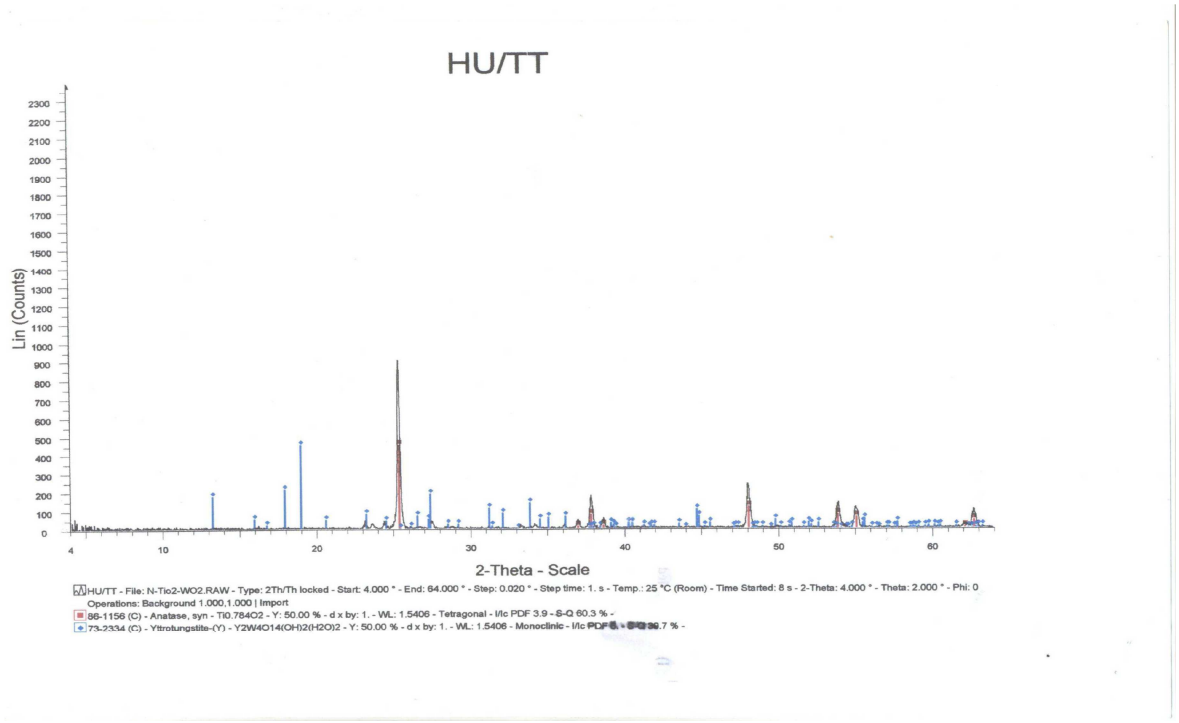


Figure1: XRD pattern of N-TiO_2/WO_3

3.1.2 UV/VIS DIFFUSE ABSORBANCE

The Uv–Visible diffuse reflectance spectrum of the prepared N-TiO2/WO3 nano-composite material is given in Figure 2. The diffuse absorbance is found to be at λ max of 538 nm and almost similar result was reported [19]. But the UV–Visible diffuse reflectance spectrum of the calcined TiO2 was reported to be at λ max of 397 nm [19]. From this measurement it can be seen that the absorption edge of N-TiO2/WO3 has shifted to the visible side compared to the non-doped calcined TiO_2. This indicates that in the Uv-vis diffuse reflectance of NTiO2/WO3, the absorption edge of the calcined TiO_2 can extend from 397 nm to 538 nm. This may be due to band narrowing of the calcined TiO_2 upon doping N and coupling it with WO_3.

Accordingly the bang gap energy of the as-synthesized photocatalyst can be calculated by the following equation:

$$Eg\ (eV) = 1240/\lambda \quad (3.2)$$

Where, Eg is band gap energy in electron volts and λ is the wavelength (nm) at the intercept of tangent line to the x-axis. Thus from Equation (3.2), the absorption edge of N-TiO_2/WO_3, can be calculated and was found to be 2.30 eV.

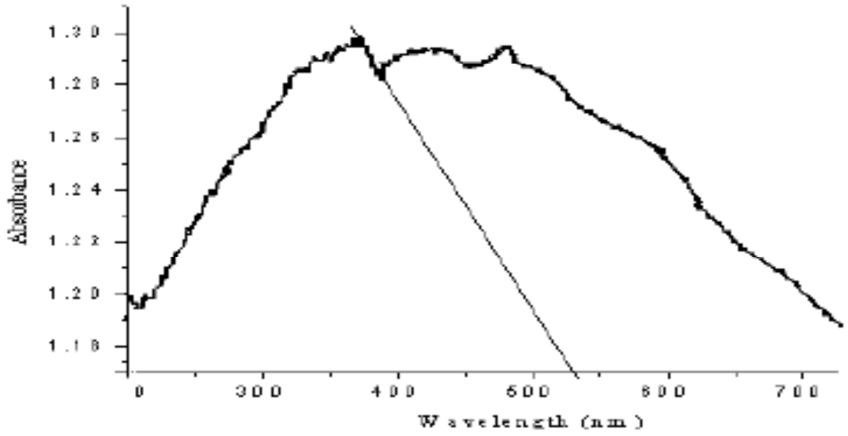


Figure.2. Uv- Visible absorbance of N-TiO_2/WO_3

3.2 PHOTOCATALYTIC ACTIVITY OF THE PHOTOCATALYST

To test the photocatalytic efficiency of the prepared nano-materials, photocatalytic degradation of PR was carried out both under UV and visible irradiations as well as in dark. The percentage degradation of PR was measured at every 20 minutes interval for over 3 hours. The percent degradation was calculated for each case using the following equation.

Degradation (%) = $[A_0-A_t / A_o] X 100$ (3.3) Where, A_o is the initial absorbance of the solution, A_t is the absorbance of the solution at time t in minutes

3.2.1 EFFECT OF OPERATING PARAMETERS

The amount of catalyst loading and pH value are among the major factors which influences the efficiency of degradation of PR [47]. For this reason the experiments were carried out to find optimum pH value and catalyst loading of the reaction mixture for the degradation of PR.

3.2.1.1 EFFECT OF CATALYST LOADING

Since there are various dyes which are degraded when exposed to direct UV or visible light in a short period of time even without the presence of catalyst, initial investigation ("blank" experiment without addition of any photocatalyst on to the solution of PR) was done in order to determine whether the PR solution is resistant to degradation under UV and Visible irradiation or not. However, insignificant changes were observed for the duration of 180 minutes (< 1%) both under UV and visible light sources. This showed that the organic compound in the solution was very stable and do not have self-destruct mechanism even if it was irradiated under UV or visible light for 3 hours [18]. Dark experiment has also been done to know the degree of photodegradation of adsorption of PR over the studied photocatalyst under non-irradiation.

The result obtained is given in the following Table1a with its respective figure3a

Table 1a.Percentage adsorption of PR under dark for different amount of N-doped TiO_2/WO_3

Amount of catalyst (gram)	% adsorption of PR ±
0.15	2.14
0.25	3.87
0.35	4.65
0.45	6.32
0.55	5.20
0.65	3.01

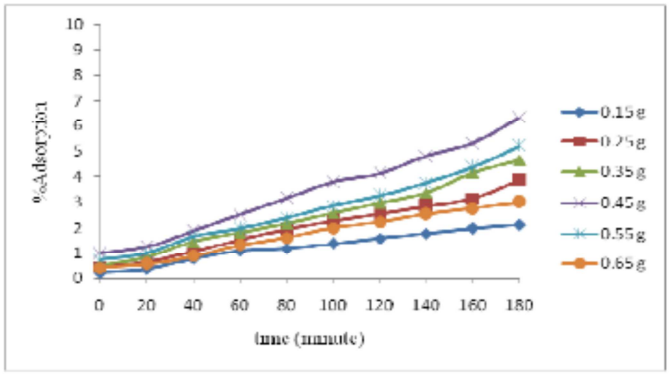


Figure 3 Percentage adsorption of PR under dark for different amount of N-doped TiO2/WO3

The results obtained for photocatalytic degradation of adsorbed PR under visible and UV irradiations are given in the following Table1b with their respective Figures3b and 3c

Table 2b. Percentage degradation of PR under Vis and UV irradiations for different amount of N-doped TiO2/WO3

A C(gram)	% degradation of PR ±	
	Vis	Uv
0.15	61.75	48.01
0.25	78.88	57.21
0.35	85.33	66.05
0.45	93.87	75.74
0.55	89.23	70.21
0.65	71.89	51.89

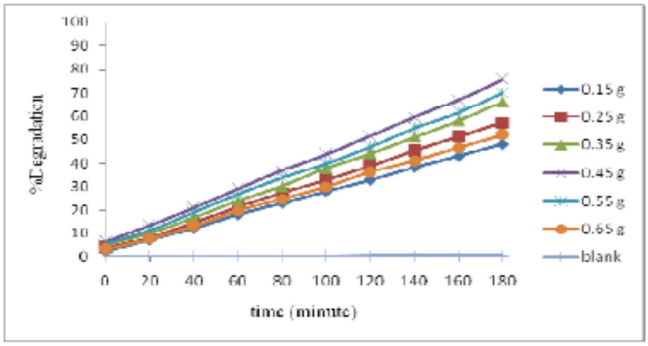


Figure 4. Percentage degradation of PR under UV irradiations for different amount of N-doped TiO_2/WO_3

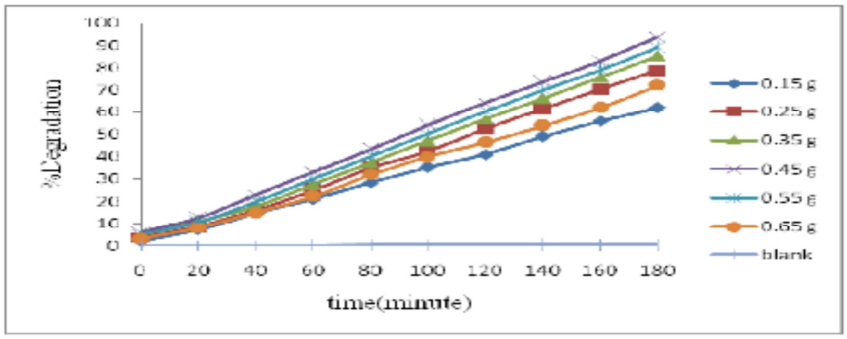


Fig3c. Percentage degradation of PR under visible irradiation for different amount of N-doped TiO2/WO3

The as-synthesized photocatalyst was highly active under visible irradiation than under UV irradiations. This may be due to the fact that the absorption edge of the modified TiO_2 particle shifts to visible light range [12].

The degradation efficiency of the as-synthesized catalyst increases with increasing the catalyst loading from 0.15 g - 0.45 g as shown in table1b above. But further increase up to 0.65 g was found to decrease the photocatalytic efficiency. Such patterned results have been reported from previous studies for different TiO2 based photocatalysts [13]. This observation can be explained by the photocatalyst optical properties as the main cause for the differences. Indeed, the total active surface area increased with increasing catalyst dosage, because of the penetration of UV and visible light into the suspension, which in turn increases the number of hydroxyl and superoxide radicals [27]

As can be seen from the above Tables1b the efficiency of degradation of the catalyst for the adsorbed PR increases from 48.01 to 75.74% under UV and from 61.75 to 93.87% under visible as the amount of the catalyst increase from 0.15 to 0.45 gram. Similar patterns have been reported for Fe^{3+}-TiO_2 [32]. But since the intervals are mostly independent, direct comparison cannot be made between similar catalysts as the type (geometry) and size of the photoreactor, working condition, intensity, and wave length and incident radiation flux are different [11]. Any further increase of the catalyst concentration beyond 0.45g was resulted in decrease in efficiency. This phenomenon can be explained by the light scattering

caused by the light proof catalysts, indeed with increasing catalyst loading the light penetration through the solution and hence the photoactivated volume of the suspension shrinks [14]. In such condition part of the catalyst surface probably becomes unavailable for photon absorption and dye adsorption, thus, this may bring little stimulation to the catalytic degradation . When the amount of TiO_2 increases above a saturation level this can lead to high turbidity state and as a consequence the light photon absorption coefficient will decrease radically [12].

Therefore, when the concentration of N-doped TiO2/WO3 catalyst increases above 0.45 g/250 ml the degradation efficiency seems to reach equilibrium value and decreases slightly. The photodegradation efficiency of PR for different concentration of the as-synthesized composite (N-doped TiO2/WO3) under UV, visible and dark reactions are shown in Figures 3a, 3b and 3c respectively. These figures shows that, under dark and both UV and visible light source, the degradation efficiency of the catalyst increase as the concentration increases from 0.15 g to 0.45g and then decreases on further increase in concentration.

3.2.1.2 EFFECT OF INITIAL PH

In order to determine whether the PR solution is resistant to degradation under basic or acidic media, an experiment was performed at neutral pH and the result was found to be 22.6%under visible and 18.87% under UV. Dark experiment was also done to know the degree of photodegradation of adsorption of PR over the studied photocatalyst under non-irradiation, but in different pH values keeping the other parameters constant. Figure 4a represents the results obtained during photodegradation of adsorption of PR over the studied photocatalyst under non irradiation (dark) at different pH values. The results are given in the following Table2a.

Table 3a. Percentage adsorption of PR dark for different values of pH

pH	% adsorption of PR ±
2	3.20
2.5	5.87
3	8.91
3.5	7.12
4	2.72
4.5	1.96
5	1.23

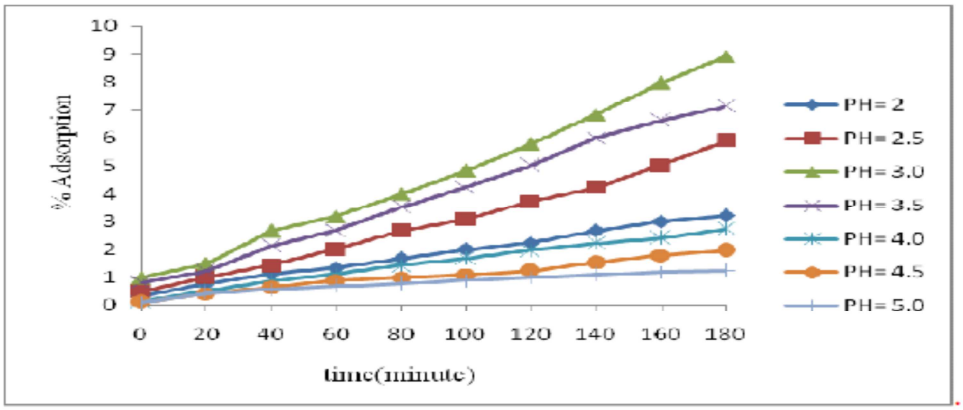


Figure 5. Percentage adsorption of PR under dark for different values of pH

The results for photocatalytic degradation of adsorbed PR under visible and UV irradiations are also given in the following Table2b with their corresponding Figures 4b and c

Table 4b. Percentage degradation of PR under Vis and UV irradiations for different values of pH

pH value	% degradation of PR ±	
	Vis	Uv
2	82.21	62.73
2.5	88.02	69.86
3	95.23	77.32
3.5	85	66
4	78.51	53.44
4.5	65.45	48.7

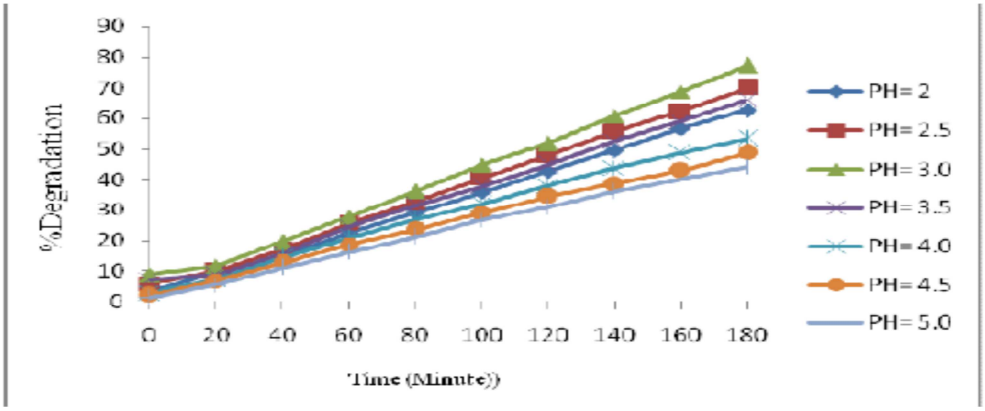


Figure 6. Percentage degradation of PR under UV irradiation for different values of pH

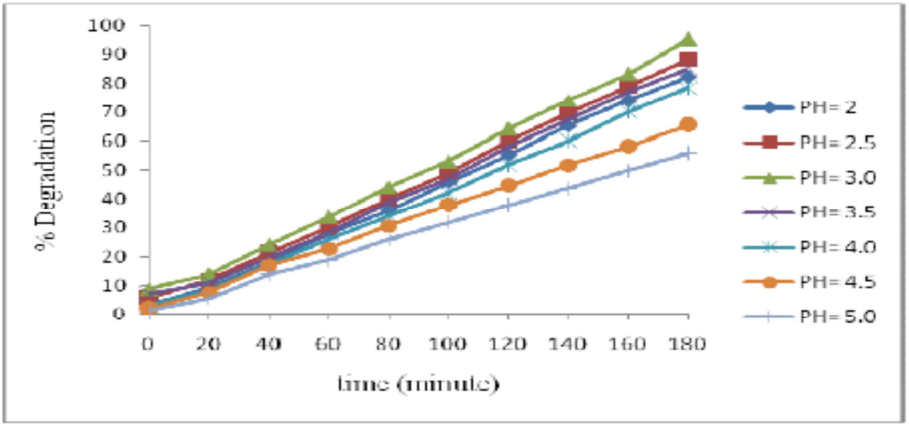


Figure 7Percentage degradation of PR under visible irradiation for different values of pH

Again the as-synthesized photocatalyst is highly active under visible irradiation than under UV irradiations. This may be due to the fact that the absorption edge of modified TiO2 shifts to visible light ranges [12]. The results shows that degradation efficiency is inversely proportional to pH i.e. degradation efficiency increases with decreasing the pH in each case but up to a certain value and such patterned results have been reported with previous studies for different TiO2 based catalysts [13]. The possible explanation for this result is that the amphoteric behavior of the semiconducting catalyst N-TiO2/WO3 and the change of surface charge properties of catalyst with change of pH value [4] around its Pzc according to the following reactions:

$TiOH + H+ \leftrightarrow TiOH2^{+}$ where pH < pHpzc

$TiOH + OH^{-} \leftrightarrow TiO- + H_2O$ where pH >pHpzc

The point of zero charge of the catalyst was reported to be between 5 to 6.25 [54]

So when pH < 6.25 (acidic) the surfaces of the nano-sized N-TiO2/WO3 particles are positively charged, so strong adsorption of the anionic PR on to the N-TiO2/WO3 particles is observed as a result of the electrostatic attraction of the positively charged surface of the N-TiO2/WO3 catalyst with the anionic PR. In this experiment the highest degradation efficiency was observed at pH = 3. Similar results for N-doped TiO2 nano-particles were found, i.e. degradation efficiency increases as the pH decreased from 5.0 to 3 [38]. Further decrease in pH up to 2.0 affected the photocatalytic activity of the catalyst negatively. The reason given for the adverse effect of low pH on the photocatalyst performance is that the possible increase of H+ concentration may cause dissolution [3] and thereby reduces the crystal size of the prepared N-TiO2/WO3 nano-particles. Again at higher pH value, the hydroxyl radicals are so rapidly scavenged that they do not have the opportunity to react with N-TiO2/WO3 [42].

On the other hand, when the pH of the solution is greater than 6.25 the surfaces of nano-sized NTiO2/WO3 particles are negatively charged so the adsorption of PR molecules which are negatively charged is expected to be scarcely adsorbed. This may be due to columbic repulsion between the two negative surfaces and as a result the efficiency of degradation is lower [42]. But when pH = Pzc of the catalyst the interaction between the photocatalyst particles and PR is minimum due to the absence of any electrostatic force as a result the degradation is not efficient. Therefore the photocatalytic activity of anionic dyes such as PR mainly sulphonated dyes reached max in acidic condition followed by decrease in pH [42].

4 CONCLUSION

In this piece of work, a nano-crystalline modified anatase TiO_2 photocatalyst (N-TiO_2/WO3) initiated from commercial TiO_2 has been synthesized in order to have efficient TiO2 based photocatalyst that works in visible light.

The effects of some selected operating parameters (effect of initial pH and effect catalyst loading) have been studied under visible, UV and dark. It was found that catalyst loading was directly proportional to the efficiency of degradation of the organic dye but up to a certain optimum value (0.45g/250ml) while pH was inversely related to the degradation efficiency for the prepared catalyst up to a fixed optimum pH value (pH = 3).

Therefore, optimizing the various operational parameters is of paramount importance from the design and the operational points of view as these could affect the degree of degradation efficiency of catalysts.

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REFERENCES

[1] Anpo, M., 2004. Applications of titanium oxide photocatalysts and unique second-generation TiO2 photocatalysts able to operate under visible light irradiation for the reduction of environmental toxins on a global scale, *studies in surface science and catalysis*,130 : 157–166,

[2] Asahi, R., T. Morikawa, T. Ohwaki, K. Aoki, and Y. Taga, 2001. Visible-light photocatalysis in nitrogen-doped titanium oxides, *Science*, 293: 269–271.

[3] Bahajady, M.A, N. Modrishahla and R. Hamzavi,2006.Kinetic study on photocatalytic degradation of C.I acid yellow 23 by Zno photocatalyst *.j.hazared. mater.B. 133:226-232*

[4] Bahnemann,D.W., J. Cunningham,M.A. Fox, E. Pelizzetti, P. Pichat, N. Serpone, in: R.G. Zepp, G.R. Heltz, and D.G. Crosby 1994. Aquatic Surface Photochemistry, *Lewis Publishers*, *Boca Raton*, 261.

[5] Baran, W., A. Makowski, and W. Wardas, 2008. The effect of UV radiation absorption of cationic and anionic dye solutions on their photocatalytic degradation in thepresence of TiO_2, *Dyes Pigm.* 76: 226–230.

[6] Beata Wawrzyniak, AntoniWaldemar Morawski, and Beata Tryba, 2006. Preparation of TiO2- Nitrogen-Doped Photocatalyst Active under Visible Light. *Inter. J. of Photoenergy*. 23:1-8.

[7] Burda .C., Y. Lou, X. Chen, A. C. S. Samia, J. Stout, and J. L. Gole, 2003, Enhanced nitrogen dopingin TiO2 nanoparticles, *Nano Letters*, 3 (8): 1049–1051.

[8] Cao,Y., H. Tan, T. Shi, T. Tang, and J. Li.,2008. Preparation of Ag-doped TiO2 nano particles of photocatalytic degradation of acetamiprid inn water. *J. Chem. Technol. Biotechnol. 83,546-552*

[9] Carp.O, Huisman.C, and Reller, 2004. Photoinduced reactivity of titanium dioxide; progress in solid state chemistry. *J.hazardeous materials*. 32:171-177.

[10] Chakrabarti, S. and B.K. Dutta, 2004, Photocatalytic degradation of model textile dyes in wastewater using ZnO as semiconductor catalyst, J. *Hazard. Mater*. B112, 269–278.

[11] Chen D and A.K Ray., 1999. photocatalytic kinetics of phenol and its derivatives over uv and vivisible irradiated TiO2 *appl. Catal.B. Environ*. 23: 143-157.

[12] Chen,J., D.,Wang, M Zhu,.and C Gao,.,2007.Photocatalytic degradation of dimethoate using nanosized TiO2 powder. *Desalination* 207:87–94

[13] Daneshvar,N. , D., Salari, ,A., Niaei and A.R Khataee,.,2006. Photocatalytic degradation of the herbicide erioglaucine in the presence of nanosized titanium dioxide: Comparison and modeling of reaction kinetics. *Journal of Environmental Science and Health Part B, 41:1273–1290*

[14] Epling G.A. and Lin C., 2002, Photo assisted bleaching of dyes utilizing TiO2 and visible light. *Chemosphere* 46:561-570)

[15] Fox, M.A.and M.T.Dulay,1993, Heterogeneous photocatalysis. *Chemical Reviews* 93:341-357

[16] Funda S., E.Sema, and A. Meltem., 2006, Photocatalytic performance of pure anatase nanocrystallite TiO2 synthesized under low temperature hydrothermal conditions, *Materials ResearchBulletin*,. 41 (12): 2276–2285.

[17] Gaya, U.I. and A.H. Abdullah, 2008. Heterogeneous photocatalytic degradation of organic contaminants over titanium dioxide: a review of fundamentals, progress and problems, *J. Photochem. Photobiol. C: Photochem. Rev*. 9: 1–12.

[18] Hay.J, W. Khan, and J.K.,Sugden, 1994. Photochemical decomposition of Phenol Red Phenol sulphonphtalein, *Dye and Pigments*, 24:305-312

[19] Hayelom Hiluf,2011. synthesis and chracterization of N-doped TiO2/WO3 materials for photodegradation of phenol red in aqueous solution. M.Sc theis

[20] Hoffmann,M., R., and S.T.Martin,1995. Environmental applications of semiconductor photocatalysis. *Journal Chemical Reviews* 95(1): 69-96

[21] Hsien Yu-Hsiang, Chi-Fu Chang, Yu-Huang Chen, and Soofin Cheng, 2001. Photodegradation of aromatic pollutants in water over TiO2 supported on molecular sieves. *Applied Catalysis B: Environmental. 31: 241–249.*

[22] Huang,M., C. Xu, Z. Wu, Y. Huang, J. Lin, and J. Wu, 2003. Photocatalytic dicolorization of organic dyes

[23] Ihara T., M. Miyoshi, Y. Iriyama, O. Matsumoto, and S. Sugihara. 2003.Visible-light-active titanium oxide photo catalyst realized by an oxygen-deficient structure and by nitrogen doping, *Applied Catalysis B*,.42(4):403– 409

[24] Irie H.,Y.Watanabe, and K. Hashimoto, 2003.Nitrogen concentration dependence on photocatalytic activity of TiO2-xNx powders. *Journal of Physical Chemistry B*,. 107: 23, 5483–5486,

[25] Keith L. H .and W. A. Telliard, 1979. Priority pollutants. I. A perspective view,"*Environmental Science and Technology*, 13(4): 416–423,

[26] Kisch H., E.A. Konstantinova, A.I. Kokorin, and K. Lips, 2003. C- and N-Doped TiO2: Visible Light Photocatalysis and EPR Investigation. *Institute of Chemical Physics*. 43: 126-128.

[27] Konstantinou, I.K, and T.A. Albanis, 2004. TiO2-assisted photocatalytic degradation of azo dyes in aqueous solution: kinetic and mechanistic investigations—A *review, Appl. Catal.* B:Environ. 49:1–14.

[28] Li D., H Haneda., S. Hishita., and Ohashi, 2005. Visible-light driven N-F-codoped TiO2 photocatalyst. Optical characterization, photocatalysis, and application to air purification.*Chemistry of materials*. 17:2596-2602

[29] Lin, J., Yun-Yue, Tsung-Hung Chu, Shao-Sian Li, Chia-Hao Chuang, Chia-Hao Chang, Wei- Fang Su, Ching- Pin Chang, Ming-Wen Chu, and Chun-Wei Chen, 2007. Interfacial Nanostructuring on the Performance of Polymer/TiO_2 Nanorod Bulk Heterojunction Solar *Cells.Journal of the American chemical society. 131:3644-364.*

[30] Liu,.S.J., H.Yang, and J.-H. Choy,2006. Microporous SiO2-TiO2 nanosols pillared montmorillonite for photocatalytic decomposition of methyl orange, *J. Photochem. Photobiol*. A: Chem. 179: 75–80.

[31] Maria.D, H Alonso, S Frenso, M. FSuarez.and J Coronado., 2009. Development of alternative photocatalysis to TiO_2: Challenges and opportunities; *Energy Enviro.Sci.* 45:98-102

[32] Nahar,M.S., K Hasegawa and S Kagaya, 2006.Photocatalytic degradation of phenol by visible light responsive iron-doped TiO2 and spontaneous sedimentation of the TiO2 particles. *Chemosphere* 65,1976-1983

[33] Ni, M., M. K. H. Leung, D. Y. C. Leung, and K. Sumathy, 2007. A review and recent developments in photocatalytic water-splitting using TiO2 for hydrogen production. *Renew. Sustain. Ener. Rev*. 11: 401-425.

[34] Obare S.O. and Meyer G.J., 2004. Nano-structured materials for environmental remediation of organic contaminants in water. *J. Environ. Sci. Health A*. 39: 2549–2582.
[35] Ohno, T., T.Mitsui, and M.Matsumura, 2003. Photocatalytic activity of S-doped TiO2 photocatalyst under visible light. *Chemistry letters*. 32:363-369.
[36] Radim and Beránek, 2007. Photoelectrochemistry with Surface-Modified TiO_2.*J.hazardeous materials*.32:56-59
[37] Radwan A. Al-Rasheed 2005. Water treatment by heterogeneous photocatalysis an overview1Saline Water Desalination Research Institute Saline Water Conversion Corporation Al-Jubail 31951, *Saudi Arabia Jeddah*,
[38] Sakthivel S., M.Janczarek, and H.Kisch, 2004. Visible light activity and photo electrochemical properties of nitrogen-doped TiO2. *Journal of physical chemistry*. 108:19384-19387

[39] Sathish M., B.Viswanathan, R.P.Viswanath and C. S.Gopinath, 2005. A simple method to synthesize visible light active N-doped anatase TiO2 Photocatalyst. *Chem. Mater*. 17: 6349
[40] Shaktivel,S., B.Neppolian, M.V Shankar, B Arabindo, M Palanicham ,and V Murugesan,2003. Solar photocatalytic degradation of azo dye: comparison of photocatalytic efficiency of ZnO and TiO2. *Solar Energy Materials Solar Cell* 77:65-82
[41] Sun, J., L. Qiao, S. Sun and G. Wang, 2008. Photocatalytic degradation of Orange G on nitrogen-doped TiO2 catalysts under visible light and sunlight irradiation, J. Hazard. Mater. 155: 312–319
[42] Tang W.Z, Z. Zhang, , H. An, M.O. Quintana and D.F. Torres. 1997. TiO2/uv photodegradation of azo dyes in aqueous solution. *Environmental technology*, 18. 1-12).
[43] Topoglidis E., A. E. G. Cass, B. O'Regan and J. R. Durrant, 2001. Immobilisation and Bioelectrochemistry of Proteins on Nanoporous TiO2 and ZnO Films," *Journal of Electro analytical Chemistry*, 517: 20-27.
[44] Tunesi,S.,and M. Anderson,1991. Influence of chemisorption on the photodecomposition of salicylic acid and related compounds using suspended titania ceramic membranes, *J. Phys. Chem. 95: 3399–3405.*
[45] Valentin, Di, G. Pacchioni, and A. Selloni, 2004. "Origin of the different photoactivity of Ndoped anatase and rutile TiO2,"*Physical Review B*, (l) 70, 8, 4
[46] Wang, D. W. Bahnemann, and J. K. Dohrmann, 2000. A novel preparation of iron-doped TiO2 nanoparticles with enhanced photocatalytic activity, *Chemical Communications*, 16:1539–1540
[47] Wang. Y 2000. Solar photocatalytiic degradation of eight commercial dyes in TiO2 suspension *wat Res* 34(3): 990-994
[48] Xing, W. and H. H. Ngo 2008. Physico-Chemical Processes for Landfill
[49] Yang H, K.Zhang, R.Shi, X.Li, X.Dong and Y.Yu ,2006. Sol–gel synthesis of TiO2 nanoparticles and photocatalytic degradation of methyl orange in aqueous TiO2 suspensions. *J. Alloys Compd.413: 302–306.*
[50] Yu, H., X. Zheng, Z. Yin, F. Tao, B. Fang and K. Hou., 2007. Preparation of nitrogen-doped TiO2 nanoparticle catalyst and its catalytic activity under visible light, Chin. *J.Chem. Eng*. 15 (6) 802–807
[51] Zaggout , F.R, 2006. Entrapment of phenol red pH indicator into a sol-gel matrix, *Mater. Lett.*, 60: 1026-1030
[52] Zhu,X., Yuan,C., Bao,Y., Yang,J. and Wu,Y.,2005. Photocatalytic degradation of pesticide pyridaben on TiO2 particles. *Journal of Molecular Catalysis: Chemical 229:95-105*

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EVOLUTION DE LA PREVALENCE DE LA SCHISTOSOMIASE A *Schistosoma mansoni* et *Schistosoma haematobium* DANS LA ZONE DE SANTE DE KATANA DE 2001-2011

[EVOLUTION OF THE PREVALENCE OF SCHISTOSOMIASIS DUE TO *Schistosoma mansoni* AND *Schistosoma haematobium* IN THE HEALTH ZONE OF KATANA FROM 2001-2011]

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ABSTRACT: Malacological and epidemiological investigations have been done in Katana Health Zone during the period from 2001 to 2011. The results shown that the schistosomiasis exists and constitutes a problem of health in this region. A total of 189,475 stools examinations and 11,000 of urines done during the ten years passed; 1,904 cases of schistosomiasis due to *Schistosoma mansoni* have been observed. That is a rate prevalence of 0. 95 % and 39 cases of *Schistosoma haematobium* have been recorded. That is a rate prevalence of 0.35 %. Methodical treatment *per os* of infested subjects by *Ambilhar* and the control of intermediate host by molluscicidal no toxic to human and environment are measures to take immediately.

KEYWORDS: Prevalence, *Schistosoma mansoni*, *Schistosoma haematobium*, Katana, DR Congo.

RESUME: Des nombreuses enquêtes, tant malacologiques qu'épidémiologiques, ont été faites dans la Zone de Santé de Katana durant la période de 2001 à 2011. Les résultats ont montré que la Bilharziose existe et constitue un problème de santé dans cette Zone. Sur un total de 189475 échantillons de selles et 11000 d'urines examinés pendant les dix ans passés, on note 1804 cas de schistosomiase à *Schistosoma mansoni* observés, soit un taux de prévalence de 0,95 % et 39 cas de *Schistosoma haematobium*, soit un taux de prévalence de 0,35 %. Pour cela, un traitement méthodique *per os* des sujets infestés par l'*Ambilhar* et la destruction des vecteurs par des molluscicides chimiques non toxiques pour l'homme et pour l'environnement sont des mesures à prendre sans délai.

MOTS-CLEFS: Prévalence, *Schistosoma mansoni, Schistosoma haematobium*, Katana, RD Congo.

1 INTRODUCTION

La bilharziose constitue un problème majeur de santé publique, et est reconnue comme l'une de principales maladies transmissibles avec impact socio-économiques majeurs dans les pays en développement et particulièrement dans les régions

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tropicales et subtropicales [1], [2]. On estime à 200 millions, le nombre de personnes actuellement infestées, dont 120 millions présentent les symptômes de la maladie et 20 millions sont atteintes d'une forme grave et invalidante. A l'heure actuelle, quelque 85 % de l'ensemble des cas, et la plupart des cas graves, se trouvent en Afrique [3]. Maladie chronique, infectieuse, elle est peu reconnue à ses stades précoces et menace le développement puisqu'elle touche les hommes et les femmes pendant leurs années les plus productives [4], [5]. Le nombre de personnes traitées pour la schistosomiase est passé de 12,4 millions en 2006 à 33,5 millions en 2010 [6].

En République Démocratique du Congo, les études récentes sur ce sujet sont très localisées si bien que la cartographie actuelle n'est plus à jour [7], [8], [9], [10]. La bilharziose intestinale à *Schistosoma mansoni* est très répandue en République Démocratique du Congo et plus particulièrement dans la plaine de la Ruzizi et le long du Lac Kivu [11], [12], [9]. Mais la schistosomiase à *Schistosoma haematobium* est localisée dans certaines zones du pays [13].

Dans la région de Katana (Zone de Santé de Katana), des cas de bilharziose à *Schistosoma mansoni et Schistosoma haematobium* avaient déjà été signalés et les foyers d'infestations sont le Lac Kivu, les marais aménagés, les ruisseaux et les étangs piscicoles [9], [14]. Les études parasitologiques menées dans la région montrent bien que le taux d'infestation de la schistosomiase à *Schistosoma mansoni* atteint 8 % dans certains villages. Mais aucun cas de schistosomiase à *Schistosoma haematobium* n'a été révélé à cette période d'étude [9].

Cependant, l'évolution de l'endémie de schistosomiase intestinale et urinaire dans la zone de santé de Katana au cours des dernières années est mal connue et les mouvements des populations humaines ont fait suspecter une recrudescence de la transmission et une extension du foyer à *Schistosoma mansoni* d'une part et l'apparition des foyers à *Schistosoma haematobium* d'autre part qui jadis n'a pas été signalé dans la région [15], [14].

Le présent travail a pour objet d'évaluer l'ampleur de l'endémie de la schistosomiase à *Schistosoma mansoni* et *Schistosoma haematobium* dans la Zone de Santé de Katana. Il s'intéresse également à la détermination de la prévalence de la schistosomiase dans les différents Centres de Santé à l'intensité de la maladie; à l'identification des principaux facteurs de risques liés à la transmission de la maladie et les points de transmission ou de contamination de l'infestation.

2 MATERIELS ET METHODES

2.1 PRÉSENTATION DE LA ZONE D'ÉTUDE

La région de Katana (Groupement de Irhambi et Bugorhe) est située autour du Centre de Recherche en Sciences Naturelles (CRSN/ Lwiro) sur la rive occidentale du lac Kivu (longitude de 28°45' Est - 28°85'Est, latitude 02°15' Sud - 02°30'Sud, altitude 1465 - 2200 m et de 141Km^2 superficie). Son climat est du type tropical humide, caractérisé par une importante pluviosité moyenne supérieure à 1500 mm par an et une température moyenne modérée variable entre 18 et 20 °C. On y distingue 2 saisons : une longue saison pluvieuse de Septembre à Mai et une courte saison sèche de juin à Août. Sa végétation est une savane cultivée qui a remplacé la forêt à *Albizia grandibracteata.* Cette région contient plusieurs types des systèmes aquatiques : des ruisseaux, des rivières, le lac, des marais et des étangs [14].

La Zone de Santé de Katana est limitée au Nord et à l'Ouest par la Zone de Santé de Kalehe, au Sud par la Zone de Sante Miti-Murhesa, à l'Est par le Zone de Santé d'Idjui. Elle dispose 26 Centres de Santé. 7 Centres de Santé (CS) ont été choisis pour cette étude à cause de la disponibilité des données et l'accessibilité aux Centres de Santé. Il s'agit de CS Mugeri, CS Mushweshwe, CS Birava, CS Luhihi, CS Kabushwa, CS Ciranga et CS Ihimbi. A ces 7 Centres de Santé, nous avons ajouté le CS de Lwiro. Le Centre de Santé de Lwiro se trouvant dans la Zone de Santé de Miti-Murhesa et a été choisi car il reçoit souvent les malades provenant des villages se trouvant dans la Zone de Santé de Katana. Le choix de ces Centres de Santé a été fait par hasard sur tirage au sort. Ces Centres de Santé desservent une grande partie de la population paysanne pour les soins de santé primaires plus de 300.000 habitants [16].

2.2 COLLECTE DES DONNÉES ÉPIDÉMIOLOGIQUES

L'étude porte sur l'ensemble des rapports mensuels d'activités et les registres de laboratoires des formations sanitaires produits pendant la période de 2001 à 2011 dans la Zone de Santé de Katana. Il s'agit alors d'un échantillonnage exhaustif de la population venue se faire soigner dans les Centre de Santé de la Zone de Santé de Katana. Les cas de schistosomiase à *Schistosoma mansoni* et *Schistosoma haematobium* diagnostiqués au laboratoire par an de 2001 à 2011 dans la Zone de Santé de Katana ont été comptés sur le total des examens de selles et d'urine réalisés. Le comptage a été fait par deux

enquêteurs formés pour la collecte des données dans les 8 Centres de Santé. Ces données ont été vérifiées dans le bureau central des archivages de la Zone de Santé de Katana.

En effet, dans les laboratoires des Centres de Santé, la recherche des œufs de *Schistosoma mansoni* était réalisée par microscopie directe sur une suspension de selles alors que les œufs de *Schistosoma haematobium* étaient recherchés dans le culot de centrifugation des urines. Dans chaque Centre de Santé, un échantillonnage aléatoire de 25 personnes d'âge variant entre 12 ans et au delà ont été interviewées pour déterminer le lieu de contact de la population avec les eaux infestées dans chaque village dont l'essentiel des questions étaient tournées vers les sites d'approvisionnement en eaux. Dans l'échantillonnage toute les catégories d'âge et de sexe entrant dans cette marge citée (12 ans et plus) ont été pris en compte car toute les personne utilise l'eau d'une manière ou d'une autre. Une descente sur le terrain était faite pour confirmer l'enquête. Le test de Khi- deux a été réalisé en utilisant le logiciel Gen Stat 13.

3 RESULTATS

3.1 PRÉVALENCE DE LA SCHISTOSOMIASE À *SCHISTOSOMA MANSONI* ET *SCHISTOSOMA HAEMATOBIUM* DANS LA ZONE DE SANTÉ DE KATANA

La prévalence de la schistosomiase à *Schistosoma mansoni et Schistosoma haematobium* a été évaluée dans 8 Centres de Santé depuis l'année 2001 à 2011. Pour un total de 189475 examens de selles et 11000 examens d'urines réalisés durant la période, un total de 1804 cas de schistosomiase à *Schistosoma mansoni* a été observé, soit un taux de prévalence de 0,95 % et 39 cas de Schistosomiase à *Schistosoma haematobium* a aussi été observé, soit un taux de prévalence de 0,35% (Annexe1). La figure1 présente l'évolution de la prévalence de la schistosomiase à *Schistosoma mansoni* suivant les années et par Centre de Santé.

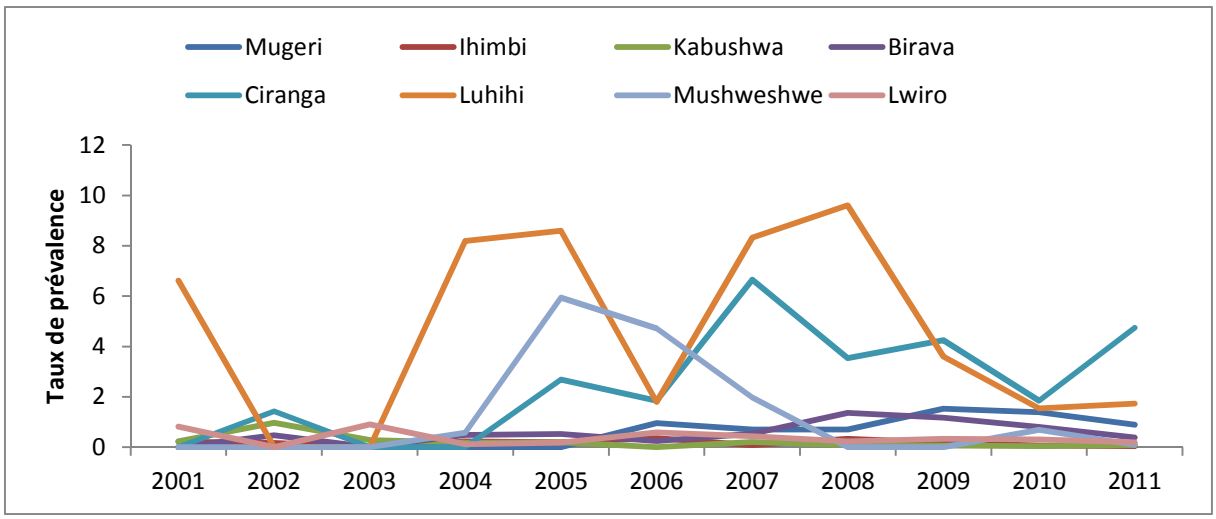


Figure 1. Evolution de la prévalence de la schistosomiase à Schistosoma mansoni suivant les années et par Centre de Santé

La situation actuelle de la schistosomiase à *Schistosoma mansoni* dans la Zone de Santé de Katana est préoccupante comme le montre la figure 2 qui présente la prévalence de la schistosomiase à *Schistosoma mansoni* dans les 8 Centres de Santé choisis dans cette étude (Figure 2).

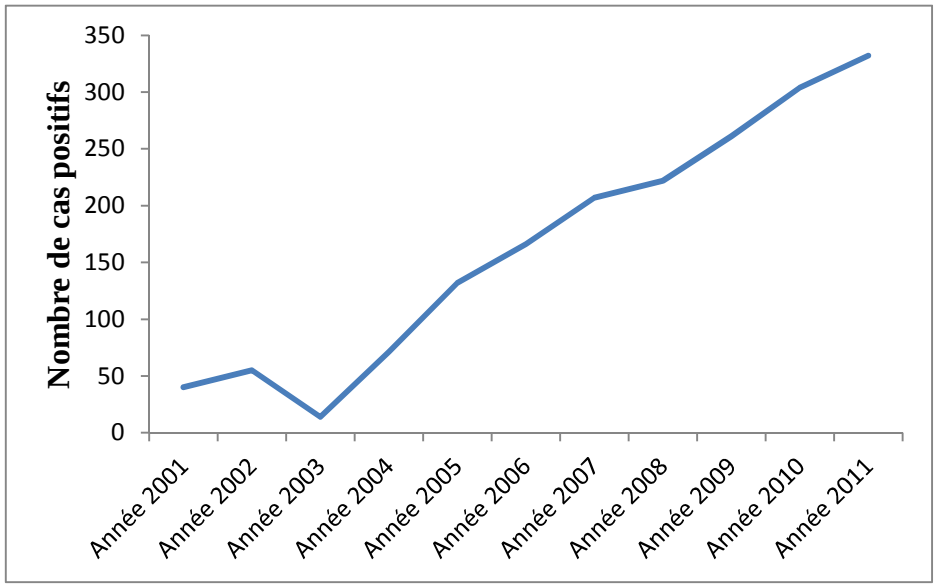


Figure 2. Evolution de la schistosomiase à Schistosoma mansoni dans l'ensemble des Centres de Santé étudiés dans la Zone de Santé de Katana, année par année.

Quand on compare le taux de prévalence de la schistosomiase durant les 11 ans (Figure 3); on constate que Ciranga et Luhihi restent toujours en tête, suivis de Mushweshwe et Mugeri, de Birava et Lwiro, enfin ceux d'Ihimbi et Kabushwa.

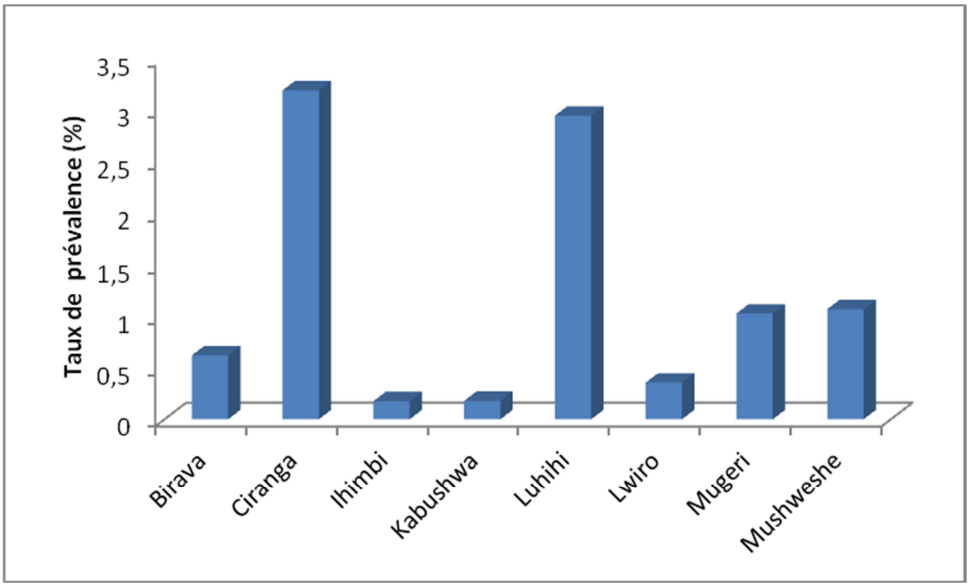


Figure 3. Prévalence de la Schistosomiase à Schistosoma mansoni dans les Centres de Santé étudiés dans la Zone de Santé de Katana durant 11 ans.

La répartition des cas positifs en fonction des tranches d'âge (Figure 4) montre que les adultes sont plus atteints de la schistosomiase que les enfants d'autres tranches d'âge, probablement parce que ce sont les adultes qui fréquentent le plus les foyers identifiés de Schistosome (Annexe 2).

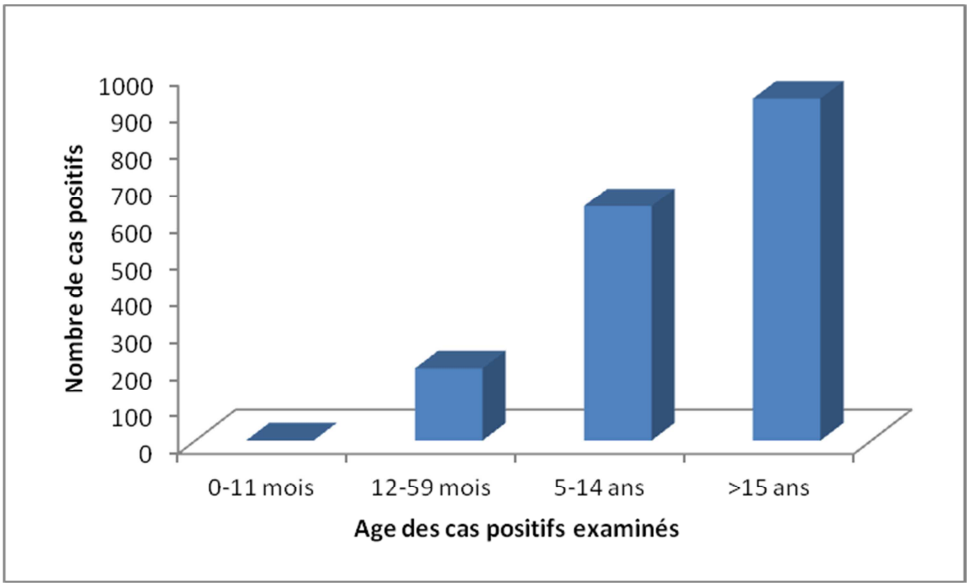


Figure 4. Répartition des cas de la schistosomiase à Schistosoma mansoni selon les tranches d'âge dans les 8 Centres de Santé durant les 11 ans d'étude

Pour la schistosomiase à *Schistosoma haematobium*, on observe qu'elle commence à apparaître dans la Zone de Santé de Katana. Les résultats de ce travail montrent que la parasitose commence à s'installer dans certains Centres de Santé (Tableau 1 ci-dessous).

Tableau 1. Nombre total d'examens, cas positifs et prévalence de la schistosomiase à Schistosoma mansoni pour chaque Centre de Santé.

	Centre de Santé		
	Birava	Ihimbi	Kabushwa
2007			
Nombre d'urines examinées	-	386	-
Nombre d'urines positives de *S. haematobium*	-	1	-
Prévalence (%)	-	0,25	-
2008			
Nombre d'urines examinées	-	-	-
Nombre d'urines positives de *S. haematobium*	-	-	-
Prévalence (%)	-	-	-
2009			
Nombre d'urines examinées	101	397	278
Nombre d'urines positives de *S. haematobium*	5	2	5
Prévalence (%)	5	0,5	1,79
2010			
Nombre d'urines examinées	-	-	-
Nombre d'urines positives de *S. haematobium*	-	-	-
Prévalence (%)	-	-	-
2011			
Nombre d'urines examinées	309	490	-
Nombre d'urines positives de *S. haematobium*	7	5	-
Prévalence (%)	2,26	1,02	-

3.2 IDENTIFICATION DES FACTEURS DE RISQUES LIÉS À LA TRANSMISSION DANS LES CENTRES DE SANTÉ DE LA ZONE DE SANTÉ DE KATANA

Les facteurs de risque liés à la transmission de la schistosomiase dans la Zone de Santé de Katana ont été observés dans chaque Centre de Santé. En effet, l'hôte intermédiaire de la schistosomiase est un mollusque dulcicole vivant dans les eaux douces. Cette observation concernait l'utilisation des points d'eau par la population dans la Zone de Santé de Katana. Ainsi, les systèmes aquatiques utilisés par la population ont été notés à savoir les rivières et ruisseaux, les étangs, le lac ainsi que les marais. La figure 5 présente le pourcentage des réponses d'utilisation des écosystèmes par la population dans les Centres de Santé.

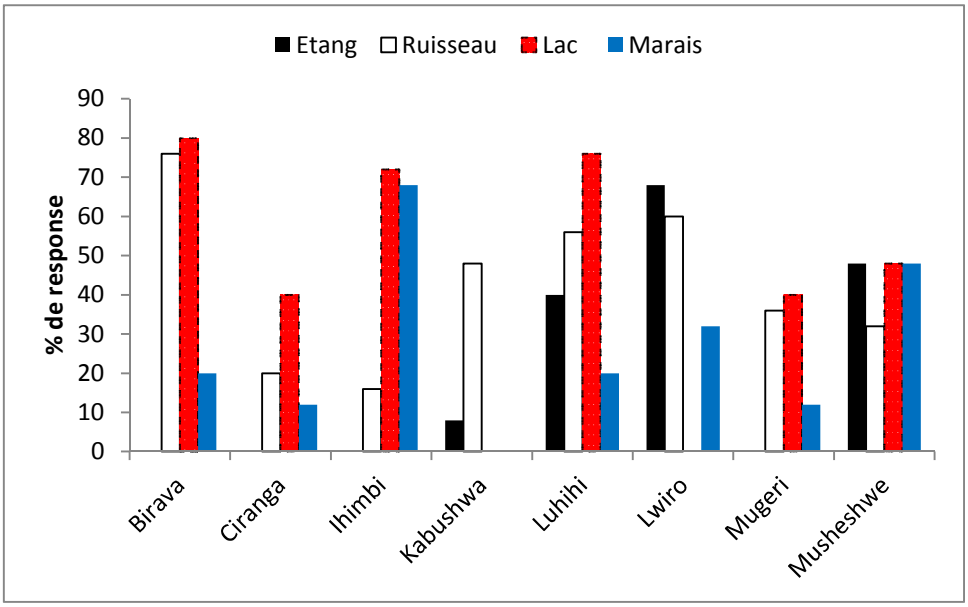


Figure 5. Pourcentage des réponses d'utilisation des écosystèmes aquatiques par la populations des Centres de Santé de la Zone de Santé de Katana.

4 DISCUSSION

Ce travail qui a consisté à l'étude de l'évaluation de la prévalence de la schistosomiase à *Schistosoma mansoni* et *Schistosoma haematobium* dans la Zone de Santé de Katana de 2001-2011 a révélé que le Centre de Santé de Luhihi a des taux de prévalence plus élevé que les autres Centres de Santé, suivi du Centre de Santé de Ciranga et Mushweshwe (Figure 1). Cette situation serait probablement due à leur rapprochement au niveau du Lac Kivu comme nous pouvons le constater dans les résultats présentés dans cette figure qui nous donne la situation générale de l'évolution de la prévalence de la schistosomiase à *Schistosoma mansoni* suivant les années et par Centre de Santé durant les 11 ans d'étude. En termes de prévalence seulement, pour le Centre de Santé de Ciranga, les résultats augmentent ces dernières années entre 2005 à 2011. Le maximum est enregistré en 2011. La prévalence maximale est enregistrée en 2007 et elle reste moyenne depuis cette année jusqu'en 2011. Quant au Centre de Santé d'Ihimbi, on observe une diminution de la prévalence contrairement au Centre de Santé de Ciranga. Le Centre de Santé de Kabushwa a une allure particulière comparativement aux autres Centres de Santé de la Zone de Santé de Katana. Le maximum de la prévalence est observé dans l'année 2002 et actuellement on remarque une diminution de la prévalence de la schistosomiase à *Schistosoma mansoni* dans ce Centre de Santé. Cette diminution serait due à l'assèchement des étangs piscicoles jadis installés dans ce milieu [14]. Dans le Centre de Santé de Luhihi, la prévalence augmente avec les années depuis 2006. Pour le Centre de Santé de Lwiro situé loin du Lac Kivu, le foyer important de la schistosomiase [11], [17], [18], la prévalence élevée a été observée en 2001 et 2003. Pour les autres années la prévalence est faible. Quant au Centre de Santé de Mugeri, les données sont disponibles depuis 2006. Le dépouillement des données montre que la prévalence élevée pour ce centre de santé a été trouvée en 2009. Quant au Centre de Santé de Mushweshwe où les données de la schistosomiase à *Schistosoma mansoni* retrouvée commencent en 2004, les résultats des données disponibles montrent que le maximum de la prévalence est observé en 2005 et diminue progressivement jusqu'en 2011. Cette diminution serait probablement due à la réduction des étangs piscicoles dans le milieu et au drainage des marais.

Parmi les Centres de Santé qui ont la prévalence élevée figurent ceux qui sont en relation directe avec le Lac Kivu notamment les Centres de Santé de Birava, Ciranga, Luhihi et Mugeri. En effet, le Lac Kivu est un foyer important de la schistosomiase [17], [19] et l'activité principale de la population dans ces Centres de Santé est surtout la pêche. Mais aussi, dans ces Centres de Santé, le problème d'approvisionnement en eau est crucial et la population est parfois obligée de se rendre au Lac pour la baignade, lessivage et même pour se procurer de l'eau de boisson. Selon le résultat de l'interview (voir figure 5), la population préfère aller au Lac et dans les rivières pour les activités des lessives, baignades et même pour se procurer de l'eau de boisson à cause de la distance pour s'approvisionner en eau et ces activités consomment beaucoup d'eau.

Les mollusques hôtes intermédiaires de la schistosomiase prolifèrent dans les endroits fréquentés par la population [20], [21], [22], ce qui augmente le risque de contamination surtout que cette population utilise rarement les toilettes et préfère déféquer dans l'eau et dans la brousse à cause des raretés des installations hygiéniques dans le milieu.

Dans la Zone de Santé de Katana, on observe une augmentation sensible et progressive des cas de la schistosomiase à *Schistosoma mansoni* durant les 11 années (Figure 2 et Annexe 1). Cette augmentation du taux de prévalence serait probablement favorisée par l'exploitation des marais pour les activités agricoles et les activités de pêches qui favorisent le contact homme – eau infestés dans le littoral du Lac Kivu. En effet, la population vivant sur les montagnes aux alentours du Parc National de Kahuzi-Biega, ayant fuit l'insécurité se retrouve en quête des terres cultivables dans les marais ou les facteurs de l'infestation sont favorisés par l'écologie des mollusques hôtes intermédiaires de la schistosomiase à *Schistosoma mansoni* [14].

Quand on compare le taux de prévalence de la schistosomiase durant les 11 ans (Figure 3); on constate que Ciranga et Luhihi restent toujours en tête, suivis de Mushweshwe et Mugeri, de Birava et Lwiro, enfin ceux d'Ihimbi et Kabushwa. Le fait que Ciranga et Luhihi soient en tête par rapport aux autres centres de Santé de la zone de santé de Katana serait dû à l'intensification des contacts de la population avec les foyers de la Schistosomiase (le marais, les étangs piscicoles et le Lac Kivu) et la migration de la population des zones à insécurité permanente à coté du Parc National de Kahuzi-Biega dans ces deux Centres de Santé [23]. Ici les marais sont beaucoup drainés et la population pratique beaucoup la pisciculture, ainsi que la pêche sur le Lac qui constitue sa source importante de revenue économique. Quant aux centres de Mugeri et Mushweshwe, les marais ne sont pas exploités et ce sont alors les activités de pêche sur le Lac qui y sont intensifiées. Aussi, dans ces deux Centres de Santé, les migrants sont rares à cause de la distance avec leur milieu d'origine car ils sont quelques fois contraints de rentrer pendant la journée pour exploiter leurs champs près du Parc National de Kahuzi-Biega.

Pour le centre de santé de Birava, le taux de prévalence y signalé est dû à l'activité exercée sur le Lac, alors qu'à Lwiro, ce sont les marais drainés, ainsi que les étangs piscicoles qui sont les causes probables de ce taux de prévalence y observé [17], [14]. Le taux de prévalence observé à Ihimbi se justifie par une faible exploitation de marais car la population fréquentant ce Centre de Santé est en grande partie au-dessus de la route où il y a absence de marais et cette population au-dessus de la route est la plus abondante. C'est elle qui fréquente le plus le Centre de Santé. Signalons aussi qu'il existe deux marais proches du Lac, qui sont des concessions privées, exploitées par un groupe restreint. La position géographique du Centre de Santé de Kabushwa, très éloigné du Lac, considéré comme foyer de la Schistosomiase [17], [14], serait la cause du faible taux de prévalence y observé, néanmoins, peu de gens y pratiquent des activités agricoles dans les marais moins drainés.

L'analyse statistique Chi^2 montre qu'il n'y a pas de différence statistique entre les taux de prévalence des Centres de Santé ($Chi^2 = 10,2$ $p = 0,35$). Dans les Centres de Santé de la Zone de Santé de Katana, le taux de prévalence varie légèrement comme déjà dit ci-haut et ne montre pas de signification statistique dans l'ensemble. Cette situation a été aussi observée dans la plaine d'Antananarivo (Madagascar) ou le taux de prévalence variait entre 0,27 à 9,50% et ne montrait pas de différence statistique [24]. Selon les recommandations de l'OMS, le taux de prévalence inférieur à 5% ne présente pas un danger sur le plan de santé publique [24], [25].

La répartition des cas positifs en fonction des tranches d'âge (Figure 4) montre que les adultes sont plus atteints de la schistosomiase que les enfants d'autres tranches d'âge, probablement parce que ce sont les adultes qui fréquentent le plus les foyers identifiés de Schistosome (Annexe 2). Ceci a été confirmé par d'autres auteurs qui pensent que la schistosomiase est un frein pour le développement car elle attaque les personnes qui peuvent produire dans la société [4], [26].

Pour la schistosomiase à *Schistosoma haematobium*, on observe qu'elle commence à apparaître dans la Zone de Santé de Katana. Cette parasitose n'existait pas auparavant dans la région [8], [17]. Les résultats de ce travail montrent que la parasitose commence à s'installer dans certains Centres de Santé (Tableau 1 ci-dessus).

Des cas positifs de la schistosomiase à *Schistosoma haematobium* ont été enregistrés dans certains Centres de Santé notamment les Centres de Santé de Birava, Ihimbi et Kabushwa. Dans les Centres de Santé, les analyses des urines sont rares

et seuls les malades présentant des signes cliniques étaient soumis aux examens. La présence des cas positifs dans ces Centres de Santé était beaucoup liée aux mouvements de la population dans la région dues a l'instabilité politique, aux migrations des refugiés [23] mais la persistance de cette maladie et l'apparition du mollusque hôte potentiel dans la région de Katana fait croire à une installation de la maladie [27]. Ces populations issues des régions endémiques dont le Rwanda et le Burundi [13] ; le Katanga et la Plaine de la Ruzizi [28], [29], [30], [8] pour la schistosomiase *à Schistosoma mansoni et Schistosoma haematobium* ont donc introduit le parasite dans une région où l'hôte intermédiaire était déjà présent et ont permis ainsi l'extension de la maladie [14], [19]. Selon [31] et [32], les mouvements de population, de plus en plus nombreux, favorisent la propagation de la schistosomiase. Cette schistosomiase à *Schistosoma haematobium* à commencé à apparaître vers les années 2007 dans la Zone de Santé de Katana et continue à se maintenir jusqu'en 2011. La conjoncture actuelle de la population, des modifications écologiques propices et de l'arrivée de migrants venant de zones endémiques dont la Plaine de la Ruzizi, la région de Katanga, de Burundi et du Rwanda [13], [28], [29], [30], [8], sont des facteurs très favorables au développement des schistosomiases dans la Zone de Santé de Katana. Selon le rapport de la Zone de Santé, ces migrants se trouvent dans la région et viennent se faire soigner dans les Centres de Santé (Rapport Zone de Santé, 2012).

Les facteurs de risque liés à la transmission de la schistosomiase dans la Zone de Santé de Katana ont été observés dans chaque Centre de Santé. En effet, l'hôte intermédiaire de la schistosomiase est un mollusque dulcicole vivant dans les eaux douces. Cette observation concernait l'utilisation des points d'eau par la population dans la Zone de Santé de Katana. Ainsi, les systèmes aquatiques utilisés par la population ont été notés à savoir les rivières et ruisseaux, les étangs, le lac ainsi que les marais. La figure 5 présente le pourcentage des réponses d'utilisation des écosystèmes par la population dans les Centres de Santé.

La présence de ces écosystèmes dans la Zone de Santé de Katana est un facteur favorisant l'infestation de la schistosomiase dans la Zone de Santé où l'hygiène est négligée. En effet, l'hôte intermédiaire de la schistosomiase est largement répandue dans le milieu [14]. Ceci est favorisé par leur condition de vie dans les écosystèmes aquatiques de la région (température, climat, végétation aquatique, permanence d'eau,…) [19], [18]. L'enquête parasitologique effectuée sur les Schistosomes à Yamoussoukrou en Côte d'Ivoire, avait démontré que la situation de l'endémie bilharzienne dans les quartiers traversés par des ruisseaux pouvait être à l'origine de foyers localisés [33]. Pour le cas des Centres de Santé éloignés du lac, leur infestation serait probablement due à la présence des nombreux étangs piscicoles, les marais et les sources d'eau non entretenues qui contribuent au développement du cycle parasitaire comme le prouve d'autres études [34], [35]. Le Lac Kivu est un milieu très favorable à l'installation des mollusques hôtes intermédiaires de la schistosomiase et c'est pourquoi la population environnante et utilisant l'eau du lac pour leur besoin primaire est exposée au risque d'infestation. Les travaux de mise en valeur des ressources hydriques s'accompagnent souvent d'un accroissement parfois notable de la prévalence de l'infection [36]. La création des lacs artificiels (étang, barrage Mushweshwe) et la mise en place ou l'agrandissement de systèmes d'irrigation (divers marais de la Zone de Santé de Katana) en régions d'endémie ou en zones adjacentes à des foyers de transmission favorisent puissamment l'extension de l'infection.

5 CONCLUSION

La schistosomiase à *Schistosoma mansoni* est en évolution croissante dans la Zone de Santé de Katana et la schistosomiase à *Schistosoma haematobium* est une infection présente dans cette Zone de Santé. Ce travail basé sur le dépouillement des rapports annuels de 8 Centres de Santé durant 11 ans montre que le taux d'infestation de la population examinée pendant cette période est de 0,95 % pour l'ensemble des Centres de Santé enquêtés pour la schistosomiase à *Schistosoma mansoni* et 0,35 % pour les cas de la schistosomiase à *Schistosoma haematobium*. Le taux de prévalence globale est faible dans la Zone de Santé de Katana comparativement au taux de prévalence dans la plaine de la Ruzizi. Dans la Zone de Santé de Katana, la gestion du milieu étant restée plus circonscrite, les schistosomoses intestinale et urinaire semblent s'être installées dans quelques foyers où les conditions épidémiologiques leurs sont favorables. Cependant, les migrations importantes des sujets infestés entraînent la poursuite de ce phénomène d'endémie. Enfin, si pour la schistosomose à *Schistosoma mansoni*, de nombreuses études permettent déjà de délimiter les zones de focalisation et les zones de généralisation de l'endémie, il n'en est pas de même pour la schistosomose urinaire, dont le principal hôte intermédiaire demeure encore inconnu dans la Zone de Santé de Katana.

Il apparaît indispensable de réaliser des études complémentaires parasitologiques et malacologiques dans des conditions épidémiologiques distinctes (zone à *Schistosoma mansoni*, zone à *Schistosoma haematobium*, région à transmission mixte) qui permettront de mettre en place un programme de lutte adapté contre les schistosomoses dans la Zone de Santé de Katana.

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REFERENCES

[1] OMS, ''Prevention and control of schistosomiasis and soil-transmitted helminthiasis''. Report of a WHO Expert Committee. WHO *Technical Report Series* No. 912. OMS, Genève, 2002.
[2] L.A. Tchuem Tchuenté, ''Lutte contre la schistosomose : défi et perspectives pour le XXIe siècle''. Bull Soc Pathol Exot, 99, 5, 372-376, 2006.
[3] OMS, ''Schistosomiase et géohelminthiases: prévention et lutte, Rapport d'un comité d'experts''. *Série de rapports techniques,* Genève; 912, 2004.
[4] P. Aubry, ''Schistosomoses ou bilharzioses : Actualités 2010''. Méd.Trop., 7p, 2010.
[5] A. A Ngenwi, J. M. Mafeni, K. A. Etchu, F. T. Oben, ''Characteristics of snail farmers and constraints to increased production in West and Central Africa''. African Journal of Environmental Science and Technology, 4, 5, 274-278, 2010.
[6] OMS, ''Schistosomiase (Bilharziose)''. Organisation Mondiale de la Santé, Genève, Janvier 2012. Aide-mémoire, no 115, 4p, 2012.
[7] B. Baluku, G. Josens, M. Loreau, ''Le régime alimentaire de *Biomphalaria pfeifferi* (Gastropoda, Planorbidae) au Zaïre Oriental''. Révue Zool., Afr., 101,272-282, 1987.
[8] B. Baluku, ''Répartition spatio-temporelle de la bilharziose à *Schistosoma mansoni* dans la plaine de la Ruzizi (Est du Zaïre)''. Révue des Sciences Naturelles V1, 1-10, 1990.
[9] B. Baluku, M. Bagalwa, B. Bisimwa, ''Enquête parasitologique sur la shistosomose à *Schistosoma mansoni* à Katana, République Démocratique du Congo''. Méd. Trop. 60 : 163 – 166, 2000.
[10] B. Baluku, M. Bagalwa, ''Problèmes posés par les bilharzioses en République Démocratique du Congo''. Cahiers du CERPRU, 14, 58 – 60, 2000.
[11] OMS, ''Atlas de la schistosomiase''. Presse Universitaire de Bordeaux éd. ; Genève, 171-182, 1987.
[12] B. Baluku, M. Loreau, ''Etude comparative de la dynamique des populations de *Biomphalaria pfeifferi* (Gasteropoda, Planorbidae) dans deux cours d'eau du Zaïre oriental''. Rev. Zool., Afr., 103, 311-325, 1989.
[13] J. Gillet, J. Wolfs, ''Les bilharzioses humaines au Congo belge et au Rwanda-Urundi'', Bull OMS, 10, 315-419,1954.
[14] M. Bagalwa, B. Baluku, ''Distribution des mollusques hôtes intermédiaires des schistosomoses humains à Katana, Sud – Kivu'', Est du Zaire. Méd Trop. 57, 369 – 372, 1997.
[15] G. Olivier, L. Brutus, M. Cot, ''La Schistosomiase intestinale à *Schistosoma mansoni* à Madagascar : Extension et focalisation de l'endémie''. Octeac, B.P 288 Yaoundé, Cameroun, 1998.
[16] J. Guevorts, Evaluation des impacts environnementaux de la fabrication de savon FOMULAC, République Démocratique du Congo''. Mémoire, UCL, Belgique, 146p, 2011.
[17] B. Baluku, ''Contribution à l'étude des hôtes intermédiaires des bilharzioses. Ecologie des mollusques *Biomphalaria pfeifferi* dans deux cours d'eau du Zaïre Oriental''. Thèse de Doctorat, ULB, 487p, 1987.
[18] S.D. Brown, ''Freshwater snails of Africa and their medical importance''. Taylor Francis, 609p, 1994.
[19] M. Bagalwa, B. Baluku, N. Mushayuma, ''Distribution des mollusques dans le Lac Kivu et leur importance médicale''. Numéro Special, CRSN- LWIRO, pp 14 – 21, 2009.
[20] J.C. Ernould, ''Importance du comportement humain dans la transmission des Schistosomoses. In «CHIPPAUX JP (Ed) - La lutte contre les Schistosomoses en Afrique de l'Ouest»''. IRD éd., Paris, Colloque; pp 31-41, 2000.
[21] A. Fain, ''Contribution à l'étude des faunes larvaires des trématodes au Congo-Belge et spécialement de la douve *Schistosoma mansoni*''. Mémoire Institut Royal colonial Belge, 22, 311p, 1952.
[22] S. Sow, S.J. de Vlas, K. Polman, B. Gryseels, ''Pratiques hygiéniques et risques de contamination des eaux de surface par les œufs de Schistosomes : le cas d'un village infecté dans le Nord du Sénégal''. Bull Soc Pathol Exot.; 96, 12-4, 2003.
[23] J.G.M. Majaliwa, S. Bashwira, M. Tenywa, F. Kansiime, ''An overview of pollution loading into Lake Kivu basin''. Third RUFORUM Biennial Meeting 24 - 28 September 2012, Entebbe, Uganda, 861 – 868, 2012.
[24] V.E. Ravaoalimalala, V.L. Ramaniraka., L.P. Rabarijaona, P. Ravoniarimbinina, R. Migliani, ''Situation épidémiologique actuelle des bilharzioses dans la plaine d'Antananarivo''. Arch Inst Pasteur de Madagascar; 68, 1, 2, 63-67, 2002.

[25] J.F. Roux, V.E. Ravaoalimalala, L. Rakoto, P. Bisier, B. Andriamahefazafy, D. Rabeson, Ph. Esterre, **''**Bases de réflexion et grandes lignes du Programme National de Lutte contre les Bilharzioses à Madagascar''. Arch Inst Pasteur Madagascar; 61 : 58-61, 1994

[26] OMS, ''Maladies tropicales: progrès de la recherche 1989-1990. Rapport PNUD/Banque mondiale'', Genève, 135p, 1991

[27] C. Batumike, B. Baluku, M. Bagalwa, K. Ndegeyi, ''Distribution spatio-temporaire des mollusques *Physa acuta* hôtes potentiels de la schistosomose à *Schistosoma haematobium* dans la région de Katana'', Annale de l'UEA (Sous presse), 2013.

[28] C. Ripert, P. Carteret et M.J. Gayte, ''Etude épidémiologique des bilharzioses intestinale et urinaire dans la région du Lac de retenue de la Lufira (KATANGA). 1. – Prévalence de l'infestation d'après l'étude de l'élimination des œufs dans les excréta''. Bulletin de la société de Pathologie exotique. Tome 62, n^{o} 3, 571-581, 1969.

[29] C. Ripert, et D.P. N'Gimbi, ''Etude épidémiologique des bilharzioses intestinale et urinaire dans la région du Lac de retenue de la Lufira (KATANGA). 2. - Prévalence de l'infestation d'après les résultats de l'intradermo-réaction et de la réaction de fixation du complément''. Bulletin de la société de Pathologie exotique. Tome 63, n^{o} 5, 562-579, 1970.

[30] C. Ripert, et C. Raccurt, ''Etude épidémiologique des bilharzioses intestinale et urinaire dans la région du Lac de retenue de la Lufira (KATANGA). 3. – Evaluation de la charge parasitaire d'après les résultats des numérations des œufs dans les excréments''. Bulletin de la société de Pathologie exotique. Tome 63, n^{o} 5, 580-590, 1970.

[31] A. Benyoussef, ''Health, migration and Urbanisation''. Bull. WHO, 49, 517-537, 1973.

[32] M.L. Barreto, ''Geographical and socio-economic factors relating to the distribution of *S. mansoni* in an urban area of North-East Brazil''. Bull. WHO, 69, 93-102, 1991.

[33] Y. Yapi, J.L. Rey, K.E. N'Goran, C. Bellec, P. Cunin, ''Enquête parasitologique sur les Schistosomoses à Yamoussoukro (Cote d'Ivoire)''. Médecine d'Afrique noire 35, 1.Tome xxxv N°1, 1988.

[34] J.L. Koeck, C. Modica, F. Tual, E. Czarnecki, R. Fabre, C. Erle, F. Monfort, ''Découverte d'un foyer de Bilharziose intestinale en République de Djibouti''. Med. Trop., 59, 1, 35 – 38, 1999.

[35] J.A. Patz, T.K. Graczyk, N. Geller, A.Y. Vittor, ''Effect of environmental change on emerging parasitic diseases''. Int. J. Parasitol. 30, 1395–1405, 2000.

[36] OMS, ''Epidémiologie de la schistosomiase et lutte antischistosomiases. Rapport d'un comité d'experts de l'OMS'', série des rapports techniques, Genève, 643, 72p, 1980.

ANNEXE 1

Tableau de nombre total d'examens, cas positifs et prévalence de la schistosomiase à *Schistosoma mansoni* pour chaque Centre de Santé

	Centres de Santé							
	MUGERI	IHIMBI	KABUSHWA	BIRAVA	CIRANGA	LUHIHI	MUSHWESHWE	LWIRO
2001								
Nombre de selles examinés	-	5031	2644	-	-	317	-	245
Nombre de selles positifs de *S. mansoni*	-	11	6	-	-	21	-	2
Prévalence	-	0,22	0,23	-	-	6,62	-	0,82
2002								
Nombre de selles examinés	-	4213	1133	4743	978	-	-	116
Nombre de selles positifs de *S. mansoni*	-	7	11	23	14	-	-	0
Prévalence	-	0,17	0,97	0,48	1,43	-	-	0
2003								
Nombre de selles examines	-	5673	1408	-	-	-	-	987
Nombre de selles positifs de *S. mansoni*	-	1	4	-	-	-	-	9
Prévalence	-	0,02	0,28	-	-	-	-	0,91
2004								
Nombre de selles examinés	-	6126	1132	3909	-	403	172	1727
Nombre de selles positifs de *S. mansoni*	-	14	2	19	-	33	1	2
Prévalence	-	0,23	0,18	0,49	-	8,19	0,58	0,12
2005								
Nombre de selles examinés	-	5921	1064	6605	1786	314	101	1129
Nombre de selles positifs de *S. mansoni*	-	12	2	35	48	27	6	2
Prévalence	-	0,20	0,19	0,53	2,69	8,60	5,94	0,18
2006								
Nombre de selles examinés	4671	5021	-	6351	2001	613	635	1513
Nombre de selles positifs de *S. mansoni*	45	18	-	16	37	11	30	9
Prévalence	0,96	0,36	-	0,25	1,85	1,80	4,72	0,59
2007								
Nombre de selles examinés	4772	3866	1893	3888	1323	469	760	686
Nombre de selles positifs de *S. mansoni*	34	3	4	21	88	39	15	3
Prévalence	0,71	0,08	0,21	0,54	6,65	8,32	1,97	0,44
2008								
Nombre de selles examinés	3790	4121	1308	4668	1866	500	-	872
Nombre de selles positifs de *S. mansoni*	27	14	1	64	66	48	-	2
Prévalence	0,71	0,34	0,08	1,37	3,54	9,6	-	0,23
2009								
Nombre de selles examinés	3865	3970	2785	1013	2703	1694	970	1473
Nombre de selles positifs de *S. mansoni*	59	7	2	12	115	61	0	5
Prévalence	1,53	0,18	0,072	1,18	4,25	3,6	0	0,34
2010								
Nombre de selles examinés	4908	4375	4596	6707	6308	3243	873	1272
Nombre de selles positifs de *S. mansoni*	68	3	2	54	117	50	6	4
Prévalence	1,39	0,07	0,04	0,81	1,85	1,54	0,69	0,31
2011								
Nombre de selles examinés	4500	4908	2460	3093	3686	5597	2090	1033
Nombre de selles positifs de *S. mansoni*	40	2	2	12	175	97	2	2
Prévalence	0,89	0,04	0,08	0,39	4,75	1,73	0,1	0,19

ANNEXE 2

Tableau séparateur des données de *Schistosoma mansoni* et *Schistosoma haematobium* par Centre de Santé et par tranches d'âge.

	Schistosoma mansoni				***Schistosoma haematobium***
	0 – 11 mois	12 – 59 mois	5 – 14 ans	>15 ans	>15 ans
Luhihi	0	41	110	236	0
Birava	0	25	95	136	12
Mushweshwe	0	8	14	38	0
Ciranga	0	108	305	247	0
Mugeri	0	3	73	197	0
Ihimbi	0	12	27	53	8
Kabushwa	0	0	13	23	5

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Les facteurs déterminants du Crowdsourcing

[The driving factors of Crowdsourcing]

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ABSTRACT: According to Lebraty, CS (Crowdsourcing) is a realistic alternative to conventional outsourcing. This research will attempt to clarify the concept of crowdsourcing with reference to factors that determine it.

KEYWORDS: Crowdsourcing, Competencies, Learning, Quality.

RESUME: Selon Lebraty, le CS (Crowdsourcing) constitue une alternative réaliste à une externalisation classique. Cette recherche tentera de clarifier le concept du crowdsourcing en se référant aux facteurs qui le déterminent.

MOTS-CLEFS: Crowdsourcing, Compétences, Apprentissage, Qualité.

1 INTRODUCTION

Par l'apparition du Web 2.0, l'Internet communautaire et ses grandes plates-formes (Facebook, MySpace, etc…) qui font l'objet de plusieurs études ([7]**,** [26], [30]), le monde de l'entreprise connait un bouleversement majeur. Un nouveau concept est né « le Crowdsourcing » qui n'est qu'une utilisation par le management des entreprises des possibilités du Web 2.0, afin de produire mieux et à moindre coût. En effet, comme le remarque **Howe (2006)** pourquoi délocaliser certaines activités dans des pays à la main d'œuvre peu coûteuse, alors que grâce à Internet les firmes ont à portée de clics de souris une population éclectique, souvent diplômée prête à s'investir dans des projets intellectuellement stimulants contre des rémunérations faibles, voire nulles.

Le phénomène est relativement ancien à l'échelle du Web : le projet Innocentive, plate-forme de Crowdsourcing, conçu initialement par la multinationale américaine de l'industrie pharmaceutique Eli Lilly, a été imaginé dès l'année 1998 [38]. Le vocable de Crowdsourcing n'est apparu que 8 ans plus tard dans un article du Wired **(Howe, 2006).** Si le phénomène a précédé son baptême, la notion de Crowdsourcing connaît un succès fulgurant dans la blogosphère et les communautés du Web 2.0 ; des dizaines de blogs traitent du sujet (comme par exemple celui de Jeff Howe : http://crowdsourcing.typepad.com). De même des journalistes spécialisés sur les questions d'Internet ont écrit des livres sur le sujet ([19], [34]). Ce succès tranche avec la relative absence de travaux académiques sur le sujet. Le sujet du Crowdsourcing est abordé mais souvent de façon indirecte par des travaux qui s'intéressent à l'Open Source ([12], [2]) ou encore simplement cité ou évoqué parmi les différentes formes que peut prendre le Web 2.0**.**

Les travaux de **Brabham (2008)** s'intéressent plus précisément au Crowdsourcing en proposant des études de cas riches, en particulier sur la plate-forme Istockphoto. Bien qu'ils ne traitent pas explicitement de la question du Crowdsourcing, les travaux de Gensollen s'en rapprochent puisqu'ils analysent les mécanismes de production de connaissance « par la foule » au sein de communautés d'expérience [15]**.** Différents auteurs ont affirmé la nécessité de clarifier la signification conceptuelle du crowdsourcing [32]**.** Selon **Lebraty,** au plan managérial, le CS constitue une alternative réaliste à une externalisation

classique et, à ce titre, de nombreuses entreprises sont susceptibles d'avoir recours à ce mode d'externalisation. Alors, qu'au plan théorique, il semble que les approches monopolisées traditionnellement pour expliquer les externalisations classiques n'expliquent pas complètement ce nouveau mode. Des recherches plus poussées devraient permettre de constituer un nouveau cadre théorique adapté et ainsi fournir des éléments plus fiables pour juger de la durabilité de ce phénomène.

C'est le point d'ancrage de notre problématique. Ainsi, la question centrale de notre recherche guidant ces travaux est:

Quels sont les facteurs déterminants du Crowdsourcing ?

Cette recherche tentera de clarifier les ambigüités qui entourent le concept du Crowdsourcing et préciser les facteurs déterminants de ce phénomène. Ainsi, nous présenterons brièvement une vue générale de la littérature sur le CS.

2 CONEXTE ET REVUE DE LA LITTERATURE

2.1 CROWDSOURCING

Le mot Crowdsourcing est construit à partir du mot anglais 'Crowd' qui signifie « la foule » et d'une contraction du mot « Outsourcing » que l'on peut traduire par 'externalisation'. Ainsi, 'Crowdsourcing' peut se traduire par 'Externalisation vers la foule', par commodité et parce qu'il est entré dans le langage courant nous utiliserons le terme de Crowdsourcing dans ce texte [38]. Il s'agit d'une notion récente, sa genèse est elle-même caractéristique du phénomène du Web 2.0 : c'est en effet lors d'une discussion sur un Forum Internet que le terme apparaît pour la première fois créé par un internaute anonyme. Mais c'est l'article, paru dans le célèbre journal en ligne Wired, écrit par Jeff Howe et Mark Robinson qui popularise ce nouveau vocable. Lors d'une étude de cas multi sources à partir des commentaires d'acteurs du CS effectuée par **J.F. Lebraty (2007),** trois sentiments paraissent partagés par l'ensemble des acteurs :

Le CS est un phénomène durable qui est susceptible de concerner un large spectre d'activités: le CS constitue une nouvelle modalité de management des activités par une organisation. Cette modalité va se développer aux côtés des approches traditionnelles (internalisation et externalisation classique).

Ce phénomène n'en est qu'à ses débuts et il est difficile de prévoir son évolution : les internautes estiment qu'une stabilisation va se produire, mais aucun n'ose le moindre pronostic et tous s'attendent à voir des nouvelles applications émerger.

Le CS s'inscrit dans la recherche de plus de flexibilité : la flexibilité concerne aussi bien les salariés qui risquent la fragmentation de leur activité en une multitude de micro-tâches les conduisant alors à recevoir plusieurs micro-revenus. Ainsi, un individu désirant travailler dans ce cadre devra disposer en permanence d'un large portefeuille de tâches de manière à parvenir à un salaire satisfaisant. La flexibilité concerne ensuite les organisations qui ont recours au CS. En effet, il apparaît plus facile pour elles de rompre un contrat ou de trouver de nouveaux fournisseurs que de se lier à un partenaire bien identifié. [32]

Les divergences d'opinions concernent les effets potentiels du CS. Ainsi, pour certains le CS apparaît comme un phénomène ayant des implications positives. Cependant, d'autres (majoritairement des internautes non identifiés) estiment qu'il s'agit d'un phénomène négatif qui tend à renforcer l'incertitude et la précarité. Ainsi, trois problèmes majeurs sont mis en avant : Le premier a trait au fait de ne plus disposer d'une activité pérenne. Le second problème concerne plus particulièrement le domaine des œuvres digitaux comme les photos et le dernier problème concerne le risque de perte de compétences pour les organisations et même pour la société dans son ensemble.

En synthèse des différents commentaires**, Lebraty (2007)** souligne la convergence concernant la nature du phénomène de CS, et une divergence d'interprétation quant à ses effets. Par ailleurs, ces interprétations apparaissent comparables à celles énoncées lors des grandes vagues d'externalisation des années 80 [14]**.**

Nous avons trouvés plusieurs définitions du crowdsourcing, citant ainsi celle de **Bonaccorsi et Rossi (2003)** qui considère que le CS émerge des usages du réseau Internet et semble requérir les mêmes facteurs de développement que le logiciel libre, à savoir, la motivation, la coordination et la diffusion. Il fait appel à une communauté d'individu qui va devoir résoudre des problèmes posés. ([28], [40], [13])**.** Le CS nécessite une certaine standardisation dans les procédures pour atteindre le plus grand nombre de personnes. Pour **Lebraty (2007)** le CS n'est qu'un nouveau mode d'externalisation :

« Le crowdsourcing signifie l'externalisation par une organisation, via un site web, d'une activité auprès d'un grand nombre d'individus dont l'identité est le plus souvent anonyme ».

Classiquement le mot « externalisation » signifie créer de la valeur à partir de l'extérieur de l'organisation. L'externalisation est devenue un mode de gouvernance majeur des activités d'une organisation [32]. C'est un accord qui stipule qu'une organisation fait effectuer une partie des activités dont elle assure le traitement par une autre organisation **Arnold (2000).**

« Une relation d'externalisation créera d'autant plus de valeur qu'elle repose sur les éléments suivants : les investissements dans les actifs spécifiques, le transfert et le partage des connaissances, la complémentarité des ressources et des compétences, une bonne gouvernance » [5]

En 2006, McConnon stipule que : « Le crowdsourcing innove en mettant des problèmes entre les mains d'une foule virtuelle, puis rémunère ceux qui ont les meilleurs idées »1

Pour l'instant, tout du moins, les individus qui proposent leurs services ont une activité salariée principale. Pour eux le crowdsourcing est une « micro-tâche » générant un « micro-revenu » et à laquelle ils accordent une petite partie de leur temps. Dans le cas du CS, l'externalisation est « ouverte » à la foule des « amateurs passionnés ». (Lebraty, 2007)

Le CS concerne par exemple les secteurs suivants :

-Des vidéos : la chaîne de télévision VH13 et son émission « Web Junk 20 » qui utilise des vidéos créées par des internautes et qui vient de racheter un portail (ifilm.com) afin de disposer de sa propre plateforme ;

-De la recherche & développement : Innocentive représente ce que **K. Lakhani**, chercheur à la Harvard Business School, appelle « Open source Science» ;

-Des tâches informatiques requérant de l'intelligence humaine.

2.2 TYPES DE CROWDSOURCING

La littérature sur le crowdsourcing distingue plusieurs pratiques de crowdsourcing. Cependant, il ya une variété de typologies de ces pratiques dans la littérature. Les typologies les plus utilisés de crowdsourcing sont : la typologie originale par **Howe (2008),** celle élaborées par **Kleeman, Voss et Reider (2008), Schenk et Guittard (2009) et Brabham (2010)** et la typologie du site « Crowdsourcing.org », une autorité sur le crowdsourcing fondée par des professionnels du domaine, est inclus (Crowdsourcing.org, 2011).

Les typologies ont pas mal de similitudes. Ces dérnières sont basées sur la nature de la pratique de l'initiative de crowdsourcing. Le crowdsourcing peut être utilisé à de nombreuses fins telles que le marketing, l'externalisation ou la résolution de problèmes, mais pas toutes les typologies incluent toutes ces fins. Ainsi, la différence entre les typologies réside dans l'absence de pratiques pour certaines typologies. Cependant, après plusieurs comparaisons des typologies et leurs pratiques, il peut être plus ou moins divisé en cinq pratiques les plus reconnues.

Le premier groupe des typologies est fondé sur les pratiques visant à obtenir des solutions aux problèmes posés. Le deuxième groupe vise à obtenir des idées créatives de la foule. Le troisième groupe vise à obtenir l'opinion de la foule, par exemple le vote par la foule (sondage d'opinion). Le quatrième groupe est basé sur l'externalisation de tâches vers la foule comme la traduction (tâches de sous-traitance). Enfin, il ya aussi une utilisation du crowdsourcing pour le but de lever des fonds de la foule (collecte de fonds).

Schenk et Guittard (2009) ont développé trois types de Crowdsourcing savoir:

- **Le crowdsourcing des tâches complexes** : est définit comme étant la capacité de la foule à trouver des solutions aux problèmes [38]**,** ceci est en ligne avec ce que **Howe (2008)** appelle l'accès à la «sagesse de la foule» et conformément à la typologie de **Kleeman et al. (2008) et Brabham (2010). Brabham (2010)** compare en outre cette pratique au fait de trouver une aiguille dans une botte de foin. Il peut y avoir plusieurs solutions au problème [38]**.** Ainsi, le crowdsourcing des tâches complexes est une pratique de crowdsourcing dans lequel l'organisation fait recours à la sagesse de la foule pour trouver des solutions à un problème défini.

[1] *A. McConnon, p.40, Business Week, 25 septembre 2006.*

- **Le crowdsourcing des tâches créatives : Schenk et Guittard (2009)** décrivent le crowdsourcing des tâches créatives comme une pratique dans laquelle la foule offre une certaine nouveauté et créativité. Ceci est en ligne avec les typologies **de Brabham (2010), Howe (2008)** et **Crowdsourcing.org (2011).** Le **Crowdsourcing.org (2011**) ajoute que la foule dispose de plein d'esprits créatifs permettant de développer la conception et augmente l'originalité. **Brabham (2010)** stipule que dans la foule il existe aussi des mauvaises réponses, or, les bonnes sont celles prises en charge par le marché. Ainsi, le crowdsourcing des tâches créatives est une pratique de crowdsourcing dans laquelle l'organisation fait recours à l'apport créatif de la foule sous la forme de contributions des nouvelles idées ou conception créative.

2.3. Les Facteurs déterminants du CS :

Lorsqu'une une entreprise décide de réaliser une opération d'externalisation, elle se fonde sur un certain nombre de facteurs déterminant son choix. L'émergence du crowdsourcing réside dans les perspectives suivantes ([4], [32]):

- **La réduction des coûts** : Il confie la tâche aux gens non professionnels mais aussi qualifiés, généralement il suffit de payer une petite rémunération, ou même sans payer, il réduit les coûts de main-d'œuvre.
- **L'efficacité** : Les tâches de crowdsourcing sont confiées aux participants du public à grande échelle avec l'aide de l'Internet, et a grandement réduit le temps, les participants sont des utilisateurs de produits ou de services qui connaissent exactement les besoins des consommateurs, avec leurs idées, les produits sont plus pratiques et le processus d'innovation est plus simple. La participation des clients renforce la relation entre les consommateurs et l'organisation.
- **La flexibilité et mondialisation:** les travaux du monde entier peuvent participer au processus de crowdsourcing sans les contraintes géographiques, avec l'application et le développement de l'Internet, et les organisations peuvent utiliser de nombreux personnels externes facilement.
- **L'implication de l'utilisateur :** L'aspect majeur du CrowdSourcing concerne l'implication, plus ou moins directe, du consommateur à la création du produit. En effet, grâce aux TIC2, et à l'internet en particulier, l'acheteur n'est plus en « fin de chaîne », en consommant de manière passive un produit, mais il participe à sa création, sa promotion ou sa diffusion, et par conséquent enlève le monopole de ces actions à l'entreprise. Au lieu de simplement recevoir, la communauté produit, publie et agis. La communauté peut inclure des consommateurs, des créateurs, des lecteurs, des écrivains, des auditeurs, des enregistreurs, des spectateurs, des producteurs…
- **La focalisation sur le cœur de métier** : Les plateformes sont généralement utilisées pour des prestations de service jugées non essentielles, non stratégiques, ou nécessitant une expertise particulière. Le Crowndsourcing permet donc de déléguer certaines tâches, permettant ainsi de se focaliser sur son cœur de métier ou sur d'autres priorités.
- **La motivation des participants :** Ce type de communauté se caractérise par le fait de porter un intérêt très important à un domaine, ou à un produit. Et généralement les membres de ce type de communauté ne cherchent pas à être rémunérer et leurs motivations se focalisent sur une volonté individuelle d'améliorer le centre d'intérêt qui les rassemble. Donc pour attirer leur attention, il convient de trouver un centre d'intérêt susceptible d'être le fondement de la constitution d'une communauté et la présentation de ce centre d'intérêt jouera un rôle décisif.
- **La qualité de service :** Le CS permet aux entreprises d'améliorer la qualité de leurs produits et services en se référant aux avis du public.
- **La création de la valeur :** Selon **Lebraty :** "le développement du CS peut s'expliquer par sa contribution à la création de valeur dans l'organisation ". Dans cette optique, on voit que via le CS, la firme incorpore la foule dans la chaine de la création de valeur surtout dans la phase de développent des idées. En prenant en compte des

[2] *TIC : Technologies de l'Information et de la Communication*

créativités et des idées de la foule, on crée déjà une valeur supplémentaire pour la firme. Surtout, la foule est elle même le public donc une idée qui provient de la foule ou de la communauté, est bien acceptée et la firme répond mieux aux besoins des clients. On peut dire que la firme crée la valeur en utilisant la compétence de la foule pour fabriquer les produits que veut la foule.

3 CONCLUSION

L'objectif de cette recherche était de fournir de nouveaux éclairages sur un nouveau sujet et identifier les variables pertinentes de processus de crowdsourcing. En se référant aux différentes études de ([4], [8], [28], [13], [32], [40]), le CS est défini comme étant l'externalisation « ouverte » à la foule des « amateurs passionnés ». Ce concept émergent permettant la résolution des problèmes en s'adressant aux compétences publiques via le web. Ce phénomène n'en est qu'à ses débuts et il est difficile de prévoir son évolution. Le CS est un nouveau mode d'externalisation. Il constitue une alternative réaliste à une externalisation classique. Aussi, il est considéré comme un type d'externalisation émergeant ayant moins de risques qu'une externalisation classique.

Il est clair de la définition de crowdsourcing, qu'il est semblable à l'externalisation, mais il y a aussi des différences. Dans ce qui suit, nous essayons de mettre en évidence les caractéristiques de crowdsourcing, en comparant les similitudes et les différences entre les deux.

Similitudes entre les deux: D'abord, briser la frontière de l'organisation : Les deux crowdsourcing et la sous-traitance permettent le complément des tâches percée par la frontière des organisations, et s'étend à l'entrepreneur ou du public en dehors des organisations. Deuxièmement, ils sont à la fois les produits de développement des technologies de communication, en particulier l'Internet. Les obstacles de l'espace et de temps seront brisés et les compétences partout dans le monde peuvent être acceptés et utilisés convenablement. La différence de prix est devenue l'une des forces motrices fondamentales pour les deux entreprises modèles.

Différence entre le crowdsourcing et la sous-traitance: Tout d'abord, leur philosophie et leur orientation sont différentes. L'externalisation reflète la relation de travail pur. L'externalisation est un contrat à la tâche des organisations ou des personnes professionnelles fixes, et il est le résultat inévitable de la spécialisation sociale. Toutefois, le crowdsourcing est de libérer les tâches à des personnes publiques incertaines, la plupart ne sont pas des professionnels. Il met l'accent sur le potentiel d'innovation apportée par la diversification et la différenciation.

Nous proposons de compléter cette recherche par un modèle conceptuel pour permettre une meilleure efficacité dans les projets de crowdsourcing. Une enquête plus approfondie sur les facteurs déterminants le concept du crowdsourcing est nécessaire, aussi, il nous semble important d'étudier le comportement des acteurs et la motivation des participants.

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RÉFÉRENCES

[1] Acar, O., & Van den Ende, J. (2011). Motivation, reward size and contribution in idea crowdsourcing, proceedings of the DIME-DRUID Academy Winter Conference 2011. Retrieved May 20, 2011, from: http://www2.druid.dk/conferences/

[2] Ågerfalk P.& B. Fitzgerald (2008). « Outsourcing to an unknown workforce: exploring open sourcing as a global sourcing », MIS Quarterly, 32(2): 385-409

[3] Albrecht, C. C., Dean, L. D., Hansen, J. V., (2005), Marketplace and technology standards for B2B e-commerce: progress, challenges, and the state of the art, Information & Management, Vol., 42, n. 6, pp. 865-875.

[4] Arnold, U., (2000), New dimensions of outsourcing: a combination of transaction cost economics and the core competencies concept, European Journal of Purchasing and Supply Management, n.6, pp. 23-29.

[5] Barthélemy J., (2006), Le mécanisme de création et d'appropriation de la valeur dans une relation interorganisationnelle : une analyse du cas Disney-Pixar, XVème Conférence Internationale de Management Stratégique, Annecy / Genève.

[6] Barthélemy J., (2007), Stratégies d'externalisation, Dunod 3ème édition, Paris.

[7] Bernard Y. (2004). « La netnographie: une nouvelle méthode d'enquête qualitative basée sur les communautés virtuelles de consommation », Décisions Marketing, 36 : 49-62.
[8] Bonaccorsi A. & C. Rossi (2003). « Why Open Source can succeed », Research Policy, 32(7): 1243-1258.
[9] Bootz J.P. & E. Schenk (2009). « Comment gérer les experts au sein et en dehors des communautés », in Les communautés en pratique : leviers de changements pour l'entrepreneur et le manager, J.P Bootz & F. Kern (eds), Lavoisier.
[10] Brabham D. (2008). « Crowdsourcing as a model for problem solving: An Introduction and Cases, Convergence », The International Journal of Research into New Media Technologies, 14(1): 75-90.
[11] Brabham, D.C. (2010). Crowdsourcing as a model for problem solving: leveraging the collective intelligence of online communities for public good (Doctoral dissertation) Retrieved April 20, 2011, from: http://gradworks.umi.com/34/18/3418941.html
[12] Dahlander L. & M. Magnusson (2008). « How do firms make use of open source communities? », Long Range Planning, 41 : 629-649.
[13] Dahlander, Linus, and Wallin, Martin W. (2006). "A man on the inside: Unlocking communities as complementary assets." Research Policy, 35, 1243-1259Grey, 1998;
[14] Galbraith, C. S., Kay, N. M., (1986), Towards a theory of multinational enterprise, Journal of Economic Behavior & Organization, Vol. 7, n. 1, pp. 319.
[15] Gensollen M. (2007). « Information goods and online communities », in Internet and digital economics, E. Brousseau & N. Curien (eds), Cambridge University Press.
[16] Grey, C. (1998), Enterprise and Culture, Routledge, London
[17] Guittard C., E. Schenk & P. Cohendet (2009). « TIC et communautés : le Forum comme espace de socialisation », in Les communautés en pratique : leviers de changements pour l'entrepreneur et le manager, J.P Bootz & F. Kern (eds), Lavoisier.
[18] Hamidizadeh. M. & Ashrafi. A. (2009), Preparation of Medicinal Science University of Iran in order to be a learning organization, Quarterly Journal of Research in Educational Systems, 8, 61-82
[19] Howe J. (2008). Crowdsourcing: How the power of the crowd is driving the future business. London: Random House Business Books.
[20] Howe, J. (2006). « The rise of crowdsourcing », Wired, 14(6).
[21] Howe, J. (2006a). The rise of crowdsourcing. Wired. Retrieved November 17, 2010 from http://www.wired.com/wired/archive/14.06/crowds.html
[22] Howe, J. (2006b). Crowdsourcing: a definition. Wired Blog Network: Crowdsourcing Retrieved November 20, 2010, from http://crowdsourcing.typepad. com/cs/2006/06/crowdsourcing_a.html
[23] Howe, J. (2006c). The crowds bites back. Crowdsourcing Blog. Retrieved December 19, 2010, from: http://www.crowdsourcing.com/cs/crowd_bites_back/
[24] Howe, J. (2008). Crowdsourcing. New York: Crown Publishing Group.
[25] Kleemann, F., Voss, G.G., & Rieder, K. (2008). Un(der)paid Innovators: The Commericial Utilization of Consumer Work through Crowdsourcing. Science, Technology and Innovation Studies, 4(1), 5-26.
[26] Kozinets R. V. (2002). « The life behind the screen : using netnography for marketing research in online communities », Journal of Consumer Research, 39: 64-72.
[27] Krishnamurthy S. (2005). « The Launching of Mozilla Firefox. A CaseStudy in Community-Led Marketing », MIT, http://opensource.mit.edu/papers/sandeep2.pdf.
[28] Krogh, V. G., Spaeth, S., Lakhani, K. R., (2003), Community, joining, and specialization in open source software innovation: a case study, Research Policy, Vol. 32, n. 7, pp. 1217- 1241.
[29] Lakhani K. & E. von Hippel (2003). « How Open Source software works: free user-to user assistance», Research Policy, 32(6): 923-943.
[30] Le Deuff O. (2007). « Le succès du web 2.0: histoire, techniques et controverse », http://archivesic.ccsd.cnrs.fr/sic_00133571.
[31] Le Moigne J.L. & E. Morin (1999). L'intelligence de la complexité, Edition l'Harmattan.
[32] Lebraty, J.F (2007), Vers un nouveau mode d'externalisation : le crowdsourcing, 12ème conférence de l'AIM, Lausanne : Switzerland (2007).
[33] Mau, B. with Leonard, J. and The Institute Without Boundaries (2004) Massive Change. New York: Phaidon.
[34] Pisani. F & Piotet. D. (2008), « Comment le web change le monde, l'alchimie des miltitudes », Editions Pearson et l'atelier BNP Paribas, 272 pages.
[35] Poetz, M.K, & Schreier, M. (2010) The value of crowdsourcing: can users really compete with professionals in generating new product ideas? Journal of Product Innovation Management. (Forthcoming)
[36] Probst, G. J. B. and B¨uchel, B. (1997). Organisationales Lernen : Wettbewerbsvorteil der Zukunft. Gabler, Wiesbaden

[37] Rus, I. and Lindvall, M., (2002) "Knowledge Management in Software Engineering," IEEE Software, vol. 19, no. 3, pp. 26-38.
[38] Schenk, E., & Guittard, C. (2009). Crowdsourcing: What can be Outsourced to the Crowd, and Why? (Working paper 00439256_v1).Retrieved November 12, 2010, from: http://ideas.repec.org/p/hal/wpaper/halshs-00439256_v1.html#download
[39] Schenk, E., and Guittard, C. (2011) Towards a characterization of crowdsourcing practices, Journal of Innovation Economics, 7(1), 93-107.
[40] Tiemann, M., (2006), An objective definition of open standards, Computer Standards & Interfaces, Vol. 28, n. 5, pp. 495507.
[41] von Hippel, E. (1994) ''Sticky Information'' and the Locus of Problem Solving: Implications for Innovation," Management Science, 40(4) 1994, pp 429-439.
[42] von Hippel, E. (2005). Democratizing innovation, London: MIT Press.
[43] von Hippel, E., & von Krogh, G. (2003). Open Source Software and the "Private-Collective" Innovation Model: Issues for Organization Science. Organization Science ,14(2), 209-223.

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Image Receptors: An update

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ABSTRACT: Image receptors has evolved in leaps and bounds from the time of discovery of x-radiations. This review article scans through the stages of development of image receptor from the conventional (films) to the digital (sensors) modes of image plates. An array of image receptors are available in the modern dentistry which leaves the dentist with a wide variety of options to confirm the clinical findings and thereby arrive at a clear diagnosis. It henceforthe helps in a better prognosis for the patient's ailment.

KEYWORDS: Image receptors, Conventional image receptors, Digital image receptors.

INTRODUCTION

An image is a reproduction, representation or imitation of the physical form of a person or thing. It is derived from Latin word for imitate. The inventor of photography was probably the Chinese about 3000 years ago. They possessed a light sensitive material that transferred the images of leaves onto the surface of pots and vases. Englishman William Henry Fox Talbot in 1841 developed negative and positive approach of image production.

Image is artificial imitation of external form of object and refers to picture and likeness of the object. Receptor refers to something that responds to the stimulus. Image receptors used in dentistry today are film, film-screen combinations, the electronic sensors used in digital imaging and computed tomography (CT). Some medical imaging systems, such as fluoroscopy systems, use X-rays as the energy source without film. Other systems such as CT, ultra sound (sound waves) and magnetic resonance imaging (MRI) (radio waves) system also do not use film to record the image. The 'films' seen in CT and MRI are actually print outs, referred to as hard copies, of the electronic image. Even with ever increasing use of digital imaging, film remains by far the most commonly used image receptor in dentistry today.[1]

Evolution of X ray films:

With the improvement of the power-supply, even the glass photographic plates previously used as the image receptors were replaced by the films. Until the First World War radiographic images were made on photographic plates. It is easy to imagine how easily these plates could break, especially in the mobile radiological units. The photographic cellulose film that had long been used for dental radiology replaced these plates.

First dental radiograph was made by Otto Walkhoff on the photo plate.

Photographic film and paper had been tried for recording of X-ray images as early as 1896.

- William J. Morton in 1896 used roll films manufactured by Eastman Kodak Company.
- Weston A. Price in 1900 designed celluloid base dental film.
- Kells in 1909 reported that he was cutting, wrapping and using roll type photographic film.

However, despite there cost, weight, bulk, fragility and patient discomfort in dental radiology, glass plates continued to be used.

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- In 1913 hand wrapped, moisture-proof dental packet containing two films was placed in the market.
- In 1919, first machine wrapped dental film packet called Regular film (Kodak) became available in the market. It has emulsion on one side and was relatively slow; a molar exposure required 8-9 secs. However, it produced sharp images.
- In 1924, emulsion was placed on both the sides of film, which doubled film speed (reduced exposure to 50%) and reduced tendency of film to when it dried. Marketed under name Radiatized film (Kodak).

In 1924, the American Eastman Kodak Company became the pioneer of radiographic filming.

- In 1940, Ultra speed (Improved Raditized) film became available, which again doubled the film speed.
- In 1955, speed of both these films was again improved by factor of 8.
- In early 1980s, Ekta speed films again reduced exposure by 50%, and are currently undergoing the slow but apparently inevitable acceptance by the profession.
- After this, a new dental x-ray film Dentus M4 was introduced by Agfa.
- In 1994, Kodak Ekta-speed plus films were manufactured by Eastman Kodak Co.
- In 1997, Agfa Dentus M2 Comfort film was placed in the market.
- In 2001, F-speed films were introduced.

Legacy of this evolution of ever faster film has been a concomitant lower patient exposure.

While changes in the film speed accompanied, film base was also undergoing improvements.

- Early 1920s, cellulose nitrate was used, which was highly inflammable and when burned emitted large quantities of poisonous gases.
- Although invented in 1906, a non-inflammable cellulose triacetate base was not marketed till 1924. As it has disadvantage as film base:
    - Expensive
    - Subject to mold, wrinkle
    - Tendency to break

Consequently, cellulose nitrate continued to be the most popular base material until 1929, when a fire in Cleveland Hospital claimed more than 100 lives. After that cellulose acetate was used.

- In early 1960s, film base of polyester was introduced and has been the material of choice. It is stronger than cellulose acetate, so the film can be made thinner and does not tend to warp like its predecessor.

The technology used for extra-oral imaging is as old as discovery of X-rays. Yet today, imaging dentists are still perfecting extra-oral radiography. They are finding new ways to improve its diagnostic qualities while, at the same time, reducing radiation exposure levels.

X-ray Film:

Photographic film and paper had been tried for recording of x-ray images as early as 1896. William J Morton used roll film manufactured by Eastman Kodak Company when he examined teeth in April of 1896 and about 1900 Weston A Price, a Cleveland dentist designed a celluloid base dental film, which was manufactured. Kells reported that he was cutting, wrapping and using roll-type photographic film in 1909. However, despite their cost, weight, bulk, fragility and patient discomfort in dental radiology, glass plates continued to be used. In 1913, a hand-wrapped, a moisture-proof dental packet containing two films was placed on the market. The first machine-wrapped dental x-ray film packet, called Regular film (Kodak), which became commercially available in 1919. It had emulsion on only one side and was relatively slow; a molar exposure required 8 or 9 seconds. However, it produced sharp images. 5 years later, the emulsion was placed on both sides of the film, which doubled the film speed (reduced exposure by 50 %) and reduced the tendency for the film to curl when it dried. This film was marketed under the name Radia-tized film (Kodak). In 1940, Ultra Speed (Improved Radia-tized) film became available, which again doubled the film speed over that of original Radia-tized film (Kodak). In 1940, Ultra-Speed (Improved Radia-tized) film became available, which again doubled the film speed over that of the original Radia-tized film. The speed of both these films was again improved by a factor of about 8 in 1955. However, with the increased film speeds, there was an accompanying increase in grainness of the image, which detracts from photographic quality. EKTASPEED film (Kodak), introduced in early 1980 s, has again reduced exposure by 50 %, and is currently undergoing the slow, but apparently inevitable acceptance by the profession.

While the changes in film speed were being accomplished the film base was also undergoing improvements. Until the early 1920s, cellulose nitrate was used, which was highly flammable and when burned emitted large quantities of poisonous gases. Although invented in 1906, a non-flammable cellulose triacetate base was not marketed until 1924. It had some disadvantages as a film base: it was more expensive, was subject to mould, wrinkled and had tendency to break. Consequently, cellulose nitrate continued to be the most popular base material until 1929, when a fire in Cleveland Hospital claimed more than a hundred lives. After that, cellulose acetate was used. In the early 1960s, a film base of polyester (Darcon) was introduced and has since been the material of choice. It is stronger than cellulose acetate, so the film can be made thinner and doesn't tend to warp like its predecessor.

Digital image receptor:

Digital image receptor is the device that intercepts the X ray beam after it has passed through patient's body, produces an image in digital form, that is, a matrix of pixels each with a numerical value. It replaces the cassette containing intensifying screens and films that is used in conventional film screen radiography.

Digital image receptor is in the form of a matrix of individual pixel elements, which work based on certain technologies like solid state technology and photostimulable phosphor (PSP) plate technology.[2] When a pixel area is exposed by x ray beam (after passing through patient's body), X ray photons are absorbed and energy produces an electrical signal. This signal is in the form of analogue data that is then converted into a digital number and stored as one pixel in an image. Three types of solid state sensors are in use- Charge Couple Device (CCD), Complementary Metal Oxide Semiconductor (CMOS) and Thin film transistor (TFT).[3]

PSP consists of a phosphor coated on top of a plate in which latent image is formed after X-ray exposure. Latent image is converted to a digital image by a scanning device through stimulation by laser light. It is also referred to as storage phosphor on the basis of the notion that image formation is temporarily stored within the phosphor. The term image plates is used to differentiate it from films and solid state detectors. The use of PSP plates in medical radiology is referred to as computed radiography.[2]

Dental Roentgenograms:

A dental roentgenogram is a photographic film presenting a shadowgraph of dental tissues.

When an x-ray beam reaches the patient .Its contains no useful medical information. After the beam passes through and interacts with the tissues in the part examined, it contains all the information that can be revealed by that particular radiographs examination. This is represented by variation in the number of x-ray photons in different areas of the emergent beam. The most important material used to decade the information carried day the attenuated x-ray beam is photographic film/x-ray film

X-ray photons making up the radiographic image cannot be seen by the human eye this information is converted into visible image either by a photographic emulsion can be exposed to the x-ray directly or the x-ray energy is converted into visible light a can be used to expose x-ray film.

Photographic film and paper had been tried for recording of x-ray images as early as 1896-William J Morton

1900 Watson designed a celluloid base dental film. However despite their cost eight bulk fragilities and patient discomfort gleam plate continued was in use.

Types:

1. Films -

- Intraoral films
- Extraoral films
- Duplicating films
- Self developing films

2. Films depending upon their mode of action -

- Direct action /Non-screen films
- Indirect action /Screen films

3. According to emulsion coating -

- Double coated films
    - Direct exposure films (Non-screen films)
    - Screen type films (Double screen films)
- Single coated films
    - - Screen type films (single screen)
    - Photofluorographic films
    - Cathode ray tube films
    - Duplication films substracton films
    - Laser imaging films

4. According type of emulsion used -

- Blue sensitive films
- Orthochromatic films
- Panchromatic films
- Infrared films

Intraoral X-ray films:

- Periapical films: objective is to show the apex of the teeth and surrounding structures and it should also show the entire crown of teeth.
- Bitewing films: objective is to show crowns of the teeth of both the arches and their interproximal bone crests on one film.
- Occlusal films: objective is to show large segments of maxillary and mandibular arches, part of maxilla and floor of mouth.

Size of the intraoral films:

Films Periapical Bitewing Size

Child films 1.0 2.0 22x35mm

Ant. Adult films 1.1 2.1 24x40mm

Post. Adult films 1.2 2.2 31x41mm

Occlusal films 3.4 57x76mm

Contents of the film packet:

The intra-oral film packets are available in quantities of 25,100 or 150 films per container made of plastic trays or cardboard boxes. Boxes are labeled with type of film, film speed, size, total no. of films enclosed and expiration date.

Dental x-ray film packets have four basic components:

1) **X-ray film:** it is a double emulsion film and requires less radiation exposure to produce an image.

2) **Paper film wrapper:** to protect the film from light, saliva, damage by fingers during processing.

3) **Lead foil sheet:** thin lead foil sheet is positioned behind the film to shield the film :-

- From back scattered radiations that result in film fog.
- Absorbs some of the radiations after x-ray beam exposes and passes through the film.
- Contributes to the rigidity of the packet

4) **Outer package wrapping:** it is a soft vinyl wrapper, which protects the film from exposure to light and saliva.

Outer package wrapping:

- **Tube side:** it is solid white and has a raised bump in one corner and when placed in the mouth white side of the film packet must face the teeth.
- **Label side:** it has a flap used to open the film packet and is color coded.

One film packet Two film packet

Kodak ultra speed	Green	Grey
Kodak ekta speed	Blue	Pink

The following information is printed on label side:-

- Dot that corresponds with raised identification dot on the film
- Statement "opposite side towards tube"
- Manufacturer's name
- Film speed
- No. of films enclosed

Self-developing films:

The x-ray film is presented in a special sachet containing developer and fixer. Following exposure, the developer tab is pulled, releasing developer solution which is milked down towards the film and massaged around it. After 15 sec. fixer tab is pulled and fixer solution is milked down and agitates the film. After fixing chemicals are discarded and film is processed using conventional processing procedures.

Advantage: It eliminates the need of dark room for processing and it is time saving.

Disadvantages: Poor image quality, expensive, image deteriorates with time, no lead foil inside the film packet, film is very flexible and easily bent and these films are difficult to use in film holders.

Speed of the films

Film speed refers to amount of radiation required to produce an image of standard density. It is the efficiency with which the film responds to x-ray exposure.

Speed = 1/roentgen

X-ray film which requires very little exposure to radiation to produce the radiograph is considered as very sensitive, very fast and having high speed.

Speed range (Reciprocal roentgen)

Films	ADA classification (1983)	ISO classification (1991)
A (slowest)	1.5-3.0	--
B	3.0-6.0	--
C	6.0-12.0	7.0-14.0
D	12.0-24.0	14.0-28.0
E	24.0-48.0	28.0-56.0
F (fastest)	48.0-96.0	56.0-112.0

- Kodak ultraspeed (D speed) films were introduced in 1955 and were most commonly used in U.S.

- In 1981, Kodak Co. introduced faster dental films of speed group E i.e. ektaspeed capable of reducing radiation exposure to half.

Ektaspeed films are double emulsion films coated on blue polyester base, have high sensitivity, low base fog, high sharpness, high gloss radiographs and invariant when used in different processing solutions.

Study was conducted by **Kaffe I**.et al in 1983, to compare ultraspeed with ektaspeed films with regard to speed, sharpness, resolution, and contrast of resultant image. He found that E-speed films were twice as fast as D-speed films. Exposure time was reduced to 50% with no loss of contrast and resolution.

- After this Agfa introduced a new dental x-ray film i.e. Dentus M4.

Benz et al in their study showed that Dentus M4 film is better than ektaspeed film and with a speed range of 48-96.

In another study conducted by **Swenson et al** in 1992, found that there was rapid build up of fog and low inherent contrast in Dentus M4 film as compared to ektaspeed film and has a limited diagnostic value.

- In 1994, Eastman Kodak co. introduced newest E-speed film called Ektaspeed plus films with flat tabular emulsion technology used in extra oral radiography.

The increased surface area that this tabular shape provided resulted more efficient way of producing density which is a key for good contrast radiographs.

Study conducted by **Conover Gary L. et al** in 1995 concluded that ektaspeed plus films are superior to E-speed and D-speed films and have similar contrast and image quality at reduced exposure.

- In 1997, Agfa introduced a new Dentus M2 comfort dental film in the market. This new film was described as E-speed film comparable to Kodak ektaspeed plus films with minimum background fog, fine grain size, and high sharpness and contrast.

- In 2001, F-speed films were introduced in the market by Kodak co.

Study was conducted by **John B. Ludlow et al** in 2001 to compare the film speed, contrast, and exposure latitude of ultraspeed. Ektaspeed plus and insight films. In his study he confirmed the characteristics of insight film as ISO F-speed intraoral film. He found that developer solution exhaustion caused performance of ultraspeed to decrease, performance of ektaspeed was steady and performance of insight film increased.

Resolution was same in all the three films.

Latitude – insight provided 93% of exposure latitude of ektaspeed plus.

Film quality – insight displayed better contrast (1.6), better tonality (1.8), better uniformity (1.9) and greater graininess (2.4).

Digital Image Receptors:

Digital imaging is very similar to film-based imaging in that it requires x-ray interaction with a receptor, latent image processing and subsequent viewing of the image. In digital imaging, the receptors are highly sensitive sensors that require considerably less radiation exposure than film. The data acquired by the receptor is analogue data in the form of a continuous gray scale and must be converted to digital data to be useful. The ADC or analogue-to-digital converter transforms analogue information into numerical information based on the binary number system. Computers operate on the binary number system in which two digits (0 and 1) are used to represent data or information. These two characters are called bits (binary digit) and they form words eight or more bits in length termed bytes. The total number of possible bytes for 8-bit language is 28 = 256. The voltage of the output signal is measured and assigned a number from 0 (black) to 255 (white) according to the intensity of the voltage. These numerical assignments translate into 256 shades of gray. Some digital systems sample the raw data at a resolution of more than 256 gray values such as 10 bit or 12 bit values but are reduced to 256 shades of gray [4]. Once the computer processes the data, the image appears on the monitor for interpretation, enhancement and storage.

Digital radiography receptors include “direct” and “indirect” receptors.

Direct receptors communicate with the computer through an electronic cable or, more recently, wirelessly.

Indirect receptors require a scanning step.

Direct Digital Image receptors:

The charge-coupled device (CCD), complementary metal oxide semiconductor (CMOS), and the complementary metal oxide semiconductor active pixel sensor (CMOS-APS) are all direct receptors. These receptors are rigid, solid-state detectors made of silicon that are arranged in an array of x-ray or light sensitive pixels.

All three of these sensors use similar technology with differences in power requirements, internal components, charge transfer and manufacturability.[5,6] Each pixel is approximately 40µ to 20µ15 in size and is configured into rows arranged in a matrix of 512 x 512 pixels. The pixel size varies depending on the digital receptor, and the size of the pixel has an influence on

the image resolution. For example, a 40µ-50µ pixel size results in an image resolution of approximately 10 to 11 lp/mm.16 Solid state sensors used for intraoral imaging are area arrays with two basic formats, direct and fibre optically coupled. Direct sensors capture the image directly like film while fibre optically coupled sensors utilize a scintillation screen coupled to a CCD. When x-rays strike the screen material light photons are produced, detected and stored by the CCD. Direct sensors communicate with the computer via an electrical cable, although wireless sensors recently have been introduced for direct digital intraoral imaging. Direct sensors are available in sizes comparable to 0, 1, and 2 films but are thicker and more rigid in their construction. The active image area is smaller than film so the area of coverage is somewhat diminished. Direct detectors can be reused for each successive projection and the acquired image can be viewed almost instantaneously after exposure.

Indirect Digital Image Receptors:

Photostimulable phosphor plates (PSP), also known as storage phosphor plates (SPP), use indirect receptors. PSP/SPP are flexible, wireless receptors that are similar in size and thickness to film.

Phosphor plates are available in the same sizes as intraoral film including 0, 1, 2, 3 and 4. An individual plate must be used for each projection in the survey, just like film. The phosphor plates consist of a polyester base that is coated with a crystalline halide emulsion of a europium activated barium fluorohalide compound.[7]

When x-rays interact with the phosphor, a latent image is formed and stored until the energy is released during a scanning process.

The plates must be carefully transferred and inserted into a scanning device in which a helium-neon laser beam is applied to release the energy in the form of light. The intensity of the emitted light is proportional to the amount of x-ray energy absorbed by the phosphor plate. The light is captured and intensified by a photomultiplier tube, which converts the light into an electronic signal. The analogue-to-digital converter digitizes the data and displays the image on the computer monitor. Before the plates can be reused, the remnant energy must be removed or erased by exposure to intense light. This can be accomplished by exposing the plates to view box light or by use of commercially produced devices that are less likely to scratch the plates.

There are a number of phosphor plate systems available for digital imaging. Like direct sensors, the primary advantage is exposure reduction. In addition, PSP receptors have wider dynamic range, a larger active area, are thin and wireless and can be used like film. However, the image resolution is lower than direct sensors and film,[8] a processing step is required like film and, thus, image display is delayed. The time delay varies from seconds to minutes depending on the system and the type and number of projections taken. The plates require careful infection control and gentle plate handling to avoid image artifacts. A study conducted by Bedard et al [9] investigated the durability of phosphor plates and the degradation of image quality due to emulsion scratches. They found that plate placement on the scanner drum had a significant impact on the number of scratches produced as did increased usage per plate.[9] Therefore, the plates need to be checked for wear on an on-going basis and may need to be replaced after 50 uses.[9]

Another study investigated the effects of different storage conditions and varying time intervals between exposure and scanning of the plates.[10] Martins et al found that with one PSP system certain storage conditions and time delay in processing the plates resulted in loss of image density, which could have an impact on image interpretation.[10] Therefore, the plates must be protected from storage conditions that might degrade the image and processed closer to the time of exposure to help prevent density alteration of the image.

Film-based images can be scanned to digitize radiographic information. Scanned radiographs are another form of indirect digital imaging. Since the scanning process produces a second version of the original image, some information is lost in translation. This technique requires an optical scanner that is capable of scanning at 600 dpi, able to process transparent images and has the appropriate software to produce the digital image.[11] This method allows digitization of film-based radiographic images so that they can be stored and incorporated into the digital patient record when the dental office makes the transition from conventional to digital radiography. The radiographic images are then available for comparison to newly acquired images and all information is organized and stored in one source for retrieval.

CONCLUSION

Digital radiography is the latest advancement in radiographic imaging in dentistry. Digital radiography systems utilize computer technology and radiation sensitive detectors that capture the image, convert it into numeric data and permit image display on a monitor. Digital images may be enhanced once acquired, conveniently stored, accessed, printed or transmitted. Digital radiography reduces patient radiation exposure and eliminates the need for the darkroom and chemical

processing. The quality of the images produced remains dependent on the technical skills of the clinician. Digital radiographic images are considered to be equivalent to film in their ability to diagnose caries, periodontal bone loss and periapical lesions.

REFERENCES

[1] Radiology for the Dental Professional. 9th Edition by Frommer, Stabulas-Savage.
[2] Oral Radiology- Principles and Interpretations. 2nd Edition by Stuart C White and Michael J Pharoh.
[3] Gerard C H Sanderink and Dale A Miles. Intraoral Detectors CCD, CMOS, TFT and other devices. Dental Clinics of North America 2000;44(2):249-55.
[4] Van der Stelt PF. Principles of digital imaging. Dent Clin North Am2000;44(2):237-48.
[5] Paurazas SB, Geist JR, Pink FE, et al. Comparison of diagnostic accuracy of digital imaging by using CCD and CMOS-APS sensors with E-speed film in the detection of periapical bony lesions. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2000; 89(3):356-62.
[6] Fossum ER. Active pixel sensors: Are CCDs dinosaurs? International Society for Optical Engineering (SPIE) 1993;1900:2-14.
[7] Hildebolt CF, Couture RA, Whiting BR. Dental photostimulable phosphor radiography. Dent Clin North Am. 2000;44(2):273-97.
[8] Huda W, Rill LN, Benn DK, Pettigrew JC. Comparison of a photostimulable phosphor system with film for dental radiology. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 1997;83(6):725-31.
[9] Bedard A, Davis TD, Angelopoulos C. Storage phosphor plates: how durable are they as a digital dental radiographic system? J Contemp Dent Pract. 2004;15;5(2):57-69.
[10] Martins MG, Haiter Neto F, Whaites EJ. Analysis of digital images acquired using different phosphor storage plates (PSPs) subjected to varying reading times and storage conditions. Dentomaxillofac Radiol. 2003;32(3):186-90.
[11] Parks ET, Williamson GF. Digital radiography: an overview. J Contemp Dent Pract. 2002;15;3(4):23-39.

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Les déterminants du succès des systèmes de gestion des connaissances dans les entreprises Tunisiennes

[The determinants of success of knowledge management systems in Tunisian companies]

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ABSTRACT: With the development of new information technologies and communication, organizations are implementing new management styles into account the knowledge of intangible capital. Therefore, organizations are struggling to survive and competitor. One of the strategies employed in these organizations is knowledge management (KM) with the support of Knowledge Management System (KMS). In fact, the effectiveness of KMS is intended to help companies achieve sustainable competitive advantage by using the existing knowledge base (Alavi, 2000). The benefits of KMS were observed, in many companies. However, it is not easy to successfully adopt KMS (Yogesh Malhotra, 2005).

KEYWORDS: Knowledge, knowledge management (KM), knowledge management systems (KMS).

RESUME: Avec l'évolution des nouvelles technologies de l'information et de la communication, les organisations mettent en place de nouveaux styles de management tenant compte des connaissances du capital immatériel. De ce fait, les organisations se battent pour survivre et se concurrent. Une des stratégies employée dans ces organisations est la gestion des connaissances (KM) avec le soutien du Système de Gestion des Connaissances (KMS). En fait, l'efficacité de KMS est prévue pour aider les entreprises à réaliser des avantages concurrentiels durables en utilisant la base de connaissances existantes (Alavi, 2000). Les avantages de KMS ont étés observés dans de nombreuses entreprises. Toutefois, il n'est pas facile de réussir à adopter KMS (Yogesh Malhotra, 2005).

MOTS-CLEFS: Connaissance, gestion des connaissances (GC), systèmes de gestion des connaissances (SGC).

1 INTRODUCTION

Aujourd'hui, et sous l'influence généralisée de l'externalisation, de la mondialisation des économies, des nouvelles technologies de l'information et de la communication, nous entrons progressivement dans une nouvelle ère où la richesse de toute organisation repose d'avantage sur ses capacités à valoriser son capital immatériel et à conserver ses compétences stratégiques. Ces évolutions s'accompagnent de nombreux bouleversements au sein des organisations qui, mettent en place de nouveaux styles de management tenant compte de plus en plus du capital immatériel, en général, et de la connaissance

en particulier : c'est le passage à ce que Peter Drucker (1993) a qualifié de l'ère de la connaissance. Ce regain d'intérêt pour les connaissances des organisations en tant qu'« actif spécifique » (Isabelle Bourdon et Nathalie Tessier, 2006) s'est traduit à partir des années 1995 par un nombre de plus en plus important de publications et de réflexions concernant les modes et les moyens de gestion des connaissances.

Ainsi, « la gestion des ressources internes en connaissances organisationnelles, appelée Gestion des connaissances est devenu un enjeu majeur pour les organisations » [33]. Alors, le Knowledge Management (KM) est un domaine souvent considéré comme récent, avec l'influence des travaux des japonais Takeuchi et Nonaka il s'est développé. Le succès du KM tient principalement à l'investissement de l'individu et son intérêt rationnel à participer à un processus collectif qui peut paraître parfois une forme de désappropriation de connaissances. Une telle démarche ne peut être mise en place que dans un climat de confiance mutuel.

De ce fait, les organisations se battent pour survivre et se concurrent. Une des stratégies employée dans ces organisations est la gestion des connaissances (KM) avec le soutien du Système de Gestion des Connaissances (KMS). Alors, les systèmes de gestion de connaissances permettent de faciliter la taches des responsables de l'organisation dans l'implantation de la technologie et leur permet de minimiser les risques d'échec des projets technologiques. Ils aident l'entreprise à prendre la décision, à partager et à transférer les connaissances. En fait, l'efficacité de KMS est prévue pour aider les entreprises à réaliser des avantages concurrentiels durables en utilisant la base de connaissances existantes (Alavi, 2000). Les avantages de KMS ont étés observés dans de nombreuses entreprises. Toutefois, il n'est pas facile de réussir à adopter KMS (Yogesh Malhotra, 2005).

Alors, notre **problématique** est sujet de controverse puisque un tour d'horizon sur la littérature récente en matière de management stratégique, nous permet de remarquer un manque de recherches et des études portant sur les systèmes de gestion des connaissances qui est, sans doute, l'un des principales sources d'avantage concurrentiel.

La littérature récente en matière de management stratégique est riche des travaux portant sur le concept de la gestion des connaissances, ces études ont contribués à éclaircir tout les points saillant de la KM. Cependant rares sont les recherche qui se sont focalisées sur l'exploration des déterminants de la réussite des systèmes de GC.

Malgré l'importance d'un tel sujet, le nombre des études consacrées à l'analyse des relations entre les concepts de gestion de connaissances et des systèmes de GC dans le contexte des pays émergents est très limité, en outre, la rareté des travaux sur ce thème dans le contexte Tunisien représente l'un des arguments justifiant la nécessité d'aborder ce sujet.

Ces deux constats ont fourni une bonne occasion pour répondre à la **question centrale** suivante : Quels sont les déterminants de la réussite des systèmes de gestion de connaissance dans les entreprises tunisiennes ? Pour ce faire, nous avons recours aux travaux de plusieurs auteurs tels que Nantapanuwat N. (2010) et al. et Al Busaidi K. et al. (2010).

2 REVUE DE LA LITTERATURE

CONNAISSANCE

La connaissance est un concept polysémique, il a fait l'objet de très nombreuses définitions. Nonaka, l'un des auteurs les plus cités dans le cadre de la gestion des connaissances, considère la connaissance comme « un processus humain dynamique de justification de croyances personnelles vers l'atteinte de la vérité » (Nonaka et Takeuchi, 1995). Dans la même optique, Davenport et Prusak considèrent que «Les connaissances sont un mélange fluide d'expériences vécues, de valeurs, d'informations contextuelles, dans la perspective d'un savoir-faire précis, qui forment un cadre permettant d'évaluer et d'intégrer de nouvelles expériences et de nouvelles informations » [29].

En effet, la littérature abondante sur le sujet montre qu'il est crucial, pour mieux cerner ce qu'est la connaissance, de la distinguer de la notion d'information (Nonaka et Takeuchi, 1995). L'information est un moyen ou un matériau permettant de découvrir et de construire la connaissance. Elle affecte la connaissance en lui ajoutant quelque chose ou en la structurant. Ainsi, « L'information est un flux de messages, tandis que la connaissance est créée et organisée par le flux même de l'information, ancré sur l'engagement et la conviction de son titulaire » [77]. La connaissance est de ce fait intimement liée au processus d'apprentissage, d'éducation, de recherche et d'utilisation des compétences (Morad Diani, 2002).

En définitive, une information est une donnée mise en contexte. Et une connaissance est une information comprise, c'est à dire assimilée et utilisée par un individu, qui permet d'aboutir à une action.

MANAGEMENT DES CONNAISSANCES

La gestion des connaissances s'entend comme un dispositif centré sur à ce que les spécialistes appellent « le capital intellectuel», source fondamentale de création de la valeur et du développement économique des entreprises. D'après Edvinsson L. et Malon M. S. (2007) c'est : « le processus à travers lequel les organisations génèrent de la valeur à partir de leurs actifs intellectuels, et des actifs fondés sur la connaissance. Le plus souvent, la génération de la valeur à partir de tel actif permet de les partager entre les employés, départements et même avec d'autres entreprises dans un effort de conseil de bonnes pratiques » [39]. Aussi, la Gestion des Connaissances peut être définie comme « la génération, la représentation, le stockage, le transfert, la transformation, l'application, l'enracinement et la protection de connaissances organisationnelles. Mémoire organisationnelle, partage d'informations et travail collaboratif sont aussi étroitement liés à la notion de Gestion des Connaissances » [93].

En résumé, ce concept protéiforme peut donc être vu de façon général comme l'art de valoriser la richesse immatérielle d'une organisation. C'est « l'exploitation de la richesse immatérielle d'une société pour atteindre des objectifs d'affaires » [99].

SYSTÈMES DE GESTION DES CONNAISSANCES

KMS est un concept très large et englobe toute une gamme de systèmes qui diffèrent à bien des égards (Alavi et al. 2001, Gallupe 2000). Ils diffèrent dans l'objet de la connaissance qu'ils contenir; les installations qu'ils fournissent; les technologies qu'ils utilisent, et la connaissance particulière processus qu'ils soutiennent.

De l'avis des auteurs, Zack (1999) et Maier (2002), est que le système est utilisé pour faciliter l'échange des connaissances: le système ne se fonde principalement sur des documents stockés dans certains type de référentiel, ou faut-il fournir des installations par lequel les parties respectives peuvent «Rencontrer» (même si virtuellement) et l'échange des connaissances dans un temps réel, ou semi temps réel.

En terme de technologie, KMS est le système qui capture les connaissances et permet le savoir d'etre appliquée à différents niveaux dans les organisations. Le KMS partage de nombreuses similitudes avec le système d'information (IS), et de nombreux outils et techniques de KMS sont liés à l'IS. (Gallupe, B. (2001). Par ailleurs, KMS peut se référer à une classe de IS utilisé pour gérer les connaissances organisationnelles et soutenir le processus d'organisation en termes de création de connaissances, de stockage/récupération, le transfert et l'application. Selon Turban, Leinder, McLean et Wetherbe (2006), KMS a besoin de trois types de technologies, à savoir :

- les technologies de communication qui permettent aux utilisateurs d'accéder aux connaissances nécessaires et de communiquer les uns avec les autres.

- Les technologies de collaboration qui font un travail de groupe possible.

- Les systèmes de gestion de base de données qui aide dans le stockage et la gestion des connaissances.

De plus, un KMS se réfère au système d'information (IS), qui est une IT-system élaboré pour soutenir le comportement de GC organisationnelles (Alavi et Leinder, 2001). En face de la volatilité des environnements d'entreprise, les organisations du monde entier sont consacrées à la mise en œuvre de SGC pour développer des connaissances en tant que source d'avantages concurrentiels (Alavi el Leinder, 2001 ; Zack, 1999)[1].

Par conséquent, la gestion efficace des connaissances de l'organisation est devenue un enjeu de plus en plus critique pour la mise en œuvre de technologie et de gestion. Comme tout système d'information, le succès du KMS dépend de son utilisation effective par les utilisateurs (Lul-Y et Lee T., 2010). Alors, un système de management des connaissances peut être définit comme étant une plateforme technologique dont la vocation est de soutenir l'ensemble du processus de management des connaissances (Gilles Ballmisse, 2006). De ce fait, le système de management des connaissances pourra donc se subdiviser en sous-systèmes ayant chacun une vocation (Alavi & Leidner, 2001).

Les caractéristiques du système de management des connaissances montrent qu'il ne s'agit pas ici de mettre en place de simples outils informatiques qui se limitent à la seule manipulation (stockage, traitement, diffusion…) des informations. En

[8] *Disponible sur : http://web.cba.neu.edu/~mzack/articles/kmarch/kmarch.htm*

effet, le système de management des connaissances renvoi à beaucoup plus que cela, du fait de la place prépondérante qu'occupe l'individu au sein de ce système, qui se préoccupe dès lors beaucoup moins de l'infrastructure comme c'est le cas pour les outils informatiques. Ainsi, ce système se présente donc, comme un ensemble qui s'aide des outils informatiques et dont la vocation est de permettre l'apprentissage en continu des individus (Ballmisse, 2005) ; en facilitant la mise en contexte de l'information, en diffusant de manière intelligente l'information, en facilitant les interactions sociales entre les individus, et en fournissant une interface utilisateur soignée.

3 CADRE CONCEPTUEL DE RECHERCHE

3.1 LES DETERMINANTS DE LA REUSSITE DES SYSTEMES DE GESTION DES CONNAISSANCES

3.1.1 LES DETERMINANTS TECHNIQUES

Les déterminants techniques sont des variables qui ont un impact significatif sur la réussite de systèmes de gestion des connaissances (Nattapol et al. 2010). En effet, plusieurs études citent la qualité de la connaissance, la qualité de système et la qualité de service comme les déterminants techniques les plus importants expliquant la réussite de systèmes de gestion des connaissances (Jennex et Olfman , 2003 ; Halawi et al,2008, Nattapol et al., 2010).

3.1.1.1 LA QUALITE DE LA CONNAISSANCE

Halawi A Leila., D.B.A. (2005) ont montré que la qualité de connaissances est essentielle dans l'utilisation du système de la gestion de la connaissance. Ils ont avancé que la bonne qualité de connaissance pourrait conduire à la satisfaction des utilisateurs d'un système de gestion des connaissances. La qualité de la connaissance est un important déterminant de la satisfaction. Larcker et Lessig (1980), Franz et Robey (1986) et Kraemer et al. (1993) ont tous soutenus qu'une augmentation de la qualité de l'information mènera à une augmentation de la satisfaction. Franz et Robey (1986) pensent qu'une qualité supérieure de la connaissance implique une plus grande satisfaction. (Peter B. Seddon Min-Yen Kiew, 1992).

Les caractéristiques souhaitables des résultat du système, c'est des rapports de gestion et de pages web, par exemple :la pertinence, l'intelligibilité, la précision, la concision, la complétude, l'intelligibilité, la monnaie, la rapidité et la convivialité. (Stacie P, DeLone and McLean, 2008). Aussi, La qualité de l'information est souvent une dimension clé des instruments de satisfaction des utilisateurs finaux (Ives et al. 1983 ; Baroudi et Orlikowski, 1988 ; Doll et al. 1994). En conséquence, la qualité de l'information n'est souvent pas distinguée comme un concept unique, mais est mesurée comme un élément de satisfaction des utilisateurs. Par conséquent, les mesures de cette dimension sont problématiques pour les études de succès IS. (Stacie P. Delone and McLean, 2008).

H1: Il existe une relation positive entre la qualité de la connaissance et la satisfaction de l'utilisation d'un système de la gestion des connaissances.

3.1.1.2 LA QUALITE DU SYSTEME

La qualité du système concerne la facilité de l'utilisation du système et sa fiabilité. Alors, la qualité du système élevée pourrait conduire à la satisfaction de l'utilisation du système de gestion des connaissances. (Peter B. Seddon et Min-Yen Kiew, 1992)

La qualité du système se réfère à la facilité, la rapidité, l'exhaustivité et l'efficacité du stockage. Comme pour les outils de stockage et de récupération peut effectivement améliorer la mémoire organisationnelle (Alavi et Leidner, 2001). La facilité de stockage encourage les gens à apporter connaissances (Goodman et Darr, 1998). De même, Al-Busaidi et al. (2007) ont constaté que la qualité du système en termes de facilité d'utilisation, la rapidité et l'intégration est essentielle pour le comportement de partage de connaissances. La qualité du système a été mesuré en termes de facilité d'utilisation, fonctionnalité la fiabilité, la qualité des données, portabilité, intégration et l'importance. (Brady, M.K. et al, 2002).

Les caractéristiques souhaitables d'un système d'information sont, par exemple, la facilité d'utilisation, la flexibilité et la fiabilité du système, et la facilité d'apprentissage. Aussi bien que la la sophistication, la flexibilité et les temps de réponse. (Stacie Petter, William DeLone and Ephraim McLean, 2008).

H2: Il existe une relation positive entre la qualité du système et la satisfaction de l'utilisation du système de gestion des connaissances.

3.1.1.3 LA QUALITE DU SERVICE

Pour Brady, M.K., Cronin, J.J., & Brand, R.R. (2002), la qualité du service est considérée comme étant un facteur important dans la satisfaction des utilisateurs du système de gestion des connaissances. Chung-Hung T., Hwang-Yeh C. M. (2007), ont montré également que ce système peut être influencé par la qualité du service.

La qualité de service est évaluée ici par cinq indicateurs: la fiabilité, la réactivité, l'assurance, l'empathie et la formation (Al busaidi Kamla et al, 2010). Les utilisateurs de tout système ont des critères semblables pour évaluer la qualité de service (Parasuraman et al, 1985). En outre, la formation est nécessaire pour améliorer la réussite d'un système d'information (Turban et al. 2001). La qualité du service se réfère à la qualité du soutien que reçoivent les utilisateurs du système de département IS et le support informatique de personnel, par exemple : La réactivité, la précision, la fiabilité, la compétence technique et l'empathie des membres du personnel. (Stacie Petter, William DeLone and Ephraim McLean, 2008)

H3: Il existe une relation positive entre la qualité du service et la satisfaction d'utilisation du système de gestion des connaissances.

3.1.2 LE DETERMINANT SOCIAL : LA CONFIANCE

La confiance est considérée comme un facteur important qui influence le succès du système de la gestion des connaissances. D'autres recherches ont indiqué que la confiance joue un rôle important dans l'utilisation du système de la gestion des connaissances et aussi il a été montré comme étant un facteur contribue à la satisfaction de ce système (Alavi M.; Leidner E. 2001)

S'inscrivant dans cette optique, Ganesan (1994), considère que la satisfaction par rapport aux résultats passées est un déterminant de la confiance. Mais, la relation confiance – satisfaction est loin de faire l'unanimité entre les auteurs. Si certains soutiennent que « la satisfaction est une source importante de la confiance »[2] (Selnes, 1998, p309), d'autres postulent que c'est la confiance qui est un déterminant de la satisfaction (Andaleeb, 1996 ; Geyskens et al. 1998 ; Anderson et Narus, 1990). (Ines chouk et Jean Perrien, 1999))

La confiance est un élément essentiel du partage des connaissances. La création de connaissances est souvent considérée comme plus précieuse que le travail avec les connaissances acquises. C'est ce qui explique la réticence des utilisateurs à mettre leurs connaissances et compétences disponibles à travers un référentiel de connaissances où le savoir est découplé du propriétaire des connaissances. Les connaissances propriétaires se préfèrent partager au sein d'un contrôlable, groupe de confiance dans les conditions négociés pour la situation spécifique et des partenaires.

Hovland et ses collègues ont montré qu'il ya deux dimensions de la crédibilité : habileté, qui est la mesure dans la quelle un communicateur est perçu comme une source d'affirmation valable, et la fiabilité, qui se réfère au degré de confiance dans l'intention du communicateur pour communiquer l'affirmation qu'il considère comme la plus valable (Dignum V., Eijk R., 2005)

H4: Il existe une relation positive entre la confiance et la satisfaction d'utilisation d'un système de la gestion des connaissances

3.2 LA SATISFACTION DE L'UTILISATION DU SYSTEME DE GESTION DES CONNAISSANCES

Il ya un besoin d'une meilleure approche pour mesurer la performance de gestion des connaissances. Cette dernière implique des changements internes dans les pratiques opérationnelles. Les utilisateurs des connaissances sont les arbitres ultimes des pratiques de gestion des connaissances. Ce n'est que lorsque les usagers sont satisfaits de la mise en œuvre des stratégies de gestion des connaissances, ils vont participer volontairement à la création et le partage des connaissances dans leurs organisations. Ainsi, la satisfaction des utilisateurs avec des stratégies de gestion de connaissances est reconnue comme l'indicateur efficace pour la mesure directe de la performance de gestion de connaissances (Terill et Flitman, 2002)

[2] *Cité par : Ines chouk et Jean Perrien, 1999*

De plus, le système de gestion des connaissances aide l'entreprise à prendre la décision, à partager et à transféré les connaissances (R. Maier, 2004). Aussi, Delone and Mclean (2003) ont constaté que l'utilisation du système est un facteur de succès du système de gestion des connaissances. Alors, Fraser, S.G., & Salter, G. (1995) ont remarqué que la satisfaction de l'utilisation du système de gestion des connaissances a une influence positive sur l'utilisation du système, en particulier en termes de son efficacité. En outre, la satisfaction de l'utilisation peut être considérée comme une mesure appropriée de la réussite du système, car elle conduit à l'acceptation du système (Wu, et Wang, 2006)

Le niveau de satisfaction des utilisateurs par des rapports, des sites Web et services de soutien (Stacie P., DeLone and McLean, 2008). La satisfaction des utilisateurs du système prise directement à partir de Delone et McLean (1992) et se réfère à l'utilisation réelle de KMS et à la satisfaction qui ont les utilisateurs à cette utilisation.

H5: Il existe une relation positive entre la satisfaction de l'utilisation du système de gestion des connaissances et son succès

La construction de notre modèle conceptuel est fondée sur les déterminants de la réussite du système de gestion des connaissances.

Donc à partir de ces variables explicatives, de ces variables à expliquer et des liens qui les unissent, notre modèle conceptuel à tester sera présenté comme suit :

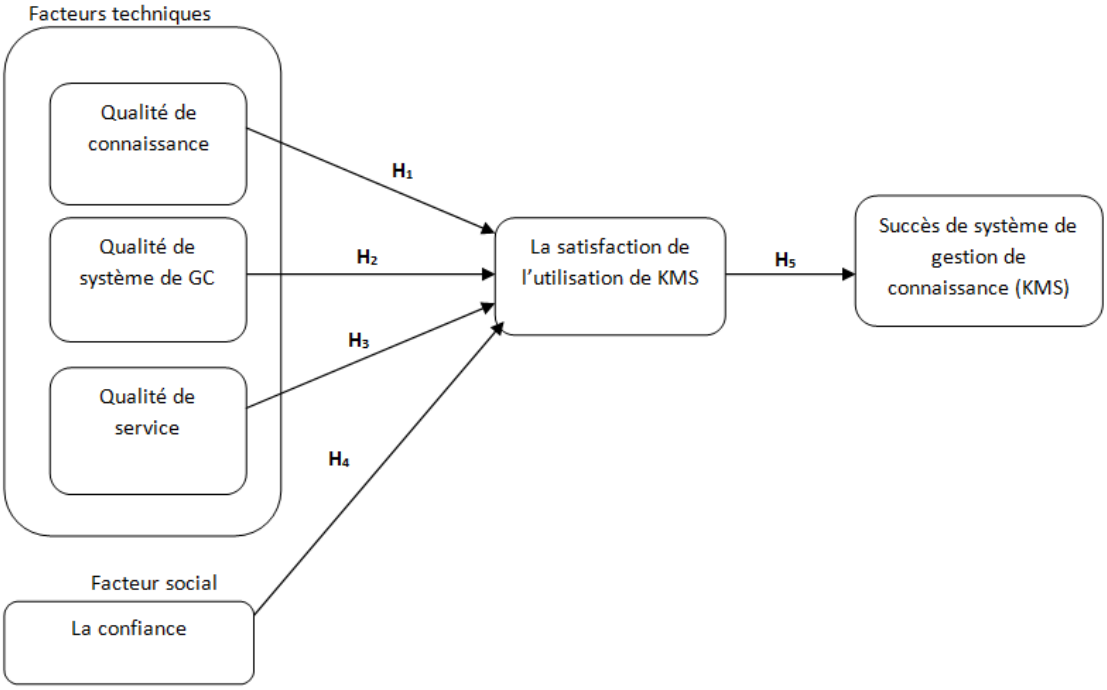


Fig. 1. Le modèle conceptuel de recherche

Comme l'affirme plusieurs études la satisfaction de l'utilisation des systèmes de gestion de connaissance a un effet positif sur son succès. Ce chapitre a présenté un modèle de recherche et ses différentes relations.

La présentation de la méthodologie d'analyse des données la plus appropriée pour tester notre modèle et les résultats obtenus font respectivement l'objet du troisième et du quatrième chapitre.

4 METHODOLOGIE DE RECHERCHE

4.1 LES VARIABLES ET LES MESURES

Une fois les variables de notre étude sont identifiées, nous pouvons passer à la genèse des items afin de les mesurer. La collecte des items des variables de notre modèle, est tributaire de la littérature antérieure principalement à l'étude de Nantapanuwat N. et al. (2010).

4.1.1 LE CHOIX DE L'ECHELLE

Nous avons choisi celle de l'échelle Likert pour la mesure des variables, elle est connue pour être la plus adéquate pour la mesure de variables (Evrard et als, 2003, p.282).

Dans notre cas, la position médiane à savoir, « sans avis » ou « neutre » est une réponse plausible de la part du répondant. Force est d'admettre qu'il n'est pas évident que le répondant comprenne ou utilise les informations mentionnées. Dans ce cas, l'obliger à choisir une attitude favorable ou défavorable pour chaque item alors qu'il n'a aucune idée de la réponse ne ferait que fausser nos résultats. Nous allons, donc, utiliser une échelle impaire à 5 points. Pour chaque variable, ci-après, nous apporterons plus amples précisions et renseignements.

4.1.2 LA GENESE DES ITEMS

Les variables de notre étude une fois identifiées, nous pouvons passer à la genèse des items afin de mesurer nos variables et c'est grâce aux échelles de mesure. La collecte des items des variables de notre modèle, est tributaire de la littérature système d'information. Concernant notre sujet, nous n'avons trouvé que peu d'articles qui font allusion la à la réussite de systèmes de gestion des connaissances.

4.2 LA COLLECTE DES DONNEES ET L'ECHANTILLONNAGE

Le mode de collecte de données le plus courant et le plus utilisé reste le questionnaire. En effet, cet outil nous permet d'avoir accès à des réponses précises de la part des personnes interrogées et correspondant au profil de la recherche. C'est la dernière phase avant la rédaction finale du questionnaire. Il s'agit d'une suite de propositions à travers lesquelles nous sollicitons l'avis, le jugement ou l'évaluation du sujet interrogé (Mucchielli, 1979).

Les résultats indiquent que la majorité des entreprises interviewées appartiennent au secteur industriel 54,2%. Alors que les 26 % et 12 ,5 % des organisations sont intéressés d'investir respectivement sur les secteurs du commerce et du service. Et seulement 7, 3 % des entreprises appartiennent au secteur financier.

Selon cette classification, nous remarquons que les entreprises qui sont de petite taille constituent 45,8% du nombre total des entreprises enquêtées, tandis que les entreprises de grande taille couvrent un pourcentage de 18,8%. Ainsi, les entreprises de moyenne taille couvrent un pourcentage de 12,5%, alors que celles de petite taille constituent 22,9% de l'échantillon.

5 ANALYSE DES DONNEES ET RESULTAT

Cette partie concerne la réalisation d'une analyse psychométrique des échelles de mesure des variables incluses dans notre modèle de recherche. En d'autres termes, nous étudierons les tests relatifs à la purification et la validation des échelles de mesure. La réalisation de ces tests se fait en deux étapes principales : la première est consacrée à l'analyse exploratoire (l'évaluation de l'unidimensionnalité des échelles de mesures et l'étude de sa fiabilité). La deuxième présente la démarche adoptée au test des hypothèses.

5.1 L'ANALYSE DE FIABILITE

La fiabilité (reliability) d'un test concerne sa capacité à mesurer un construit d'une manière cohérente. En pratique, la fiabilité est estimée par le coefficient alpha de Cronbach.

Le résultat est généralement présenté sous la forme d'un nombre entre 0 et 1. Un seuil de 0.7 est considéré comme minimum pour juger la fiabilité d'un construit. Un coefficient faible de l'alpha de Cronbach indique que l'échantillon des items ne représente pas réellement le phénomène étudié. En fait, quand la valeur d'Alpha est faible, certains items doivent être éliminés.

Tableau 1. Fiabilité des facteurs

Facteurs	Nombre d'éléments	Alpha de Cronbach
La qualité de la connaissance	4	,866
La qualité du système	9	,937
La qualité du service	3	,872
La confiance	4	,820
La satisfaction d'utilisation du système	4	,829
Le succès du système de la gestion des connaissances	5	,894

Les variables qui constituent le modèle conceptuel de notre recherche sont : les déterminants de la réussite du système de gestion des connaissances, la satisfaction d'utilisation du système de gestion des connaissances et l e succès du système de gestion des connaissances.

5.2 LE TEST DE L'UNIDIMENSIONNALITE D'ECHELLE DE MESURE DES VARIABLES

Tableau 2. Unidimensionnalité des facteurs

Indices / Facteurs	KMO	Khi-deux	ddl	Signification de Bertlett
Qualité des connaissances	0,829	173,998	6	0,000
Qualité du système	0,893	707,041	36	0,000
Qualité du service	0,736	143,096	3	0,000
La confiance	0,805	125,469	6	0,000
La SGC	0,705	171,793	6	0,000
Le succès du SGC	0,850	266,019	10	0,000

5.2.1 LE TEST DE L'UNIDIMENSIONNALITE D'ECHELLE DE MESURE DE LA VARIABLE « LA QUALITE DES CONNAISSANCES »

L'analyse factorielle montre que la matrice des données de l'échelle de mesure de la qualité de connaissance, est factorisable :

*KMO = 0,850 est supérieur à 0.5.

*test de Bartlett indique que toutes les variables sont parfaitement indépendantes les unes des autres (p= ,000 <0.05 ; Khi-deux = 201,548).

*les valeurs de MSA sont tous supérieurs à 0.5.

Nous remarquons d'après les résultats que la qualité de représentation de l'item 5 est inférieure à **0.5**. Donc, nous allons éliminer l'item qualicon5

Les nouveaux résultats de cette analyse dégagent une solution où le pourcentage de l'information récupérée du facteur est élevé à l'ordre de 71,446%. Les corrélations de ces items avec ce facteur varient de 0, 812 à 0,868. Ces corrélations servent à interpréter le rôle de chaque variable (item) dans la définition de chaque facteur. Plus le poids est élevé, plus la variable est représentative du facteur. Par conséquent, le choix de ces items est acceptable puisque ces corrélations sont élevées. Ces résultats sont apprécié d'avantage par la valeur d'alpha de Crombach 0,866 qui jugée bonne.

5.2.2 LE TEST DE L'UNIDIMENSIONNALITE D'ECHELLE DE MESURE DE LA VARIABLE « LA QUALITE DU SYSTEME »

L'examen de la matrice des corrélations entre les items de la variable «la qualité du système » montre que ces dernières sont positives et significatives et attestent par la suite l'unicité de l'échelle.

Une valeur de KMO étant de (0, 893) montrant une intégrité bonne entre les items et un test de Bartlett significatif (Khi-deux= 707,041; p=0,000) indiquent que les données peuvent être soumises à la méthode de l'analyse factorielle.

Ce résultat est apprécié davantage avec les indices de MSA (La qualité de représentation pour les tous items qui très satisfaisante > 0,7).

Les résultats de cette analyse dévoilent l'existence d'un seul facteur ayant une valeur propre supérieure à un, soient 6,024. Ce facteur saisisse 66,931 % de l'information initiale. Ces résultats sont confirmés aussi par une valeur d'alpha de Crombach de 0, 937 qui est jugée excellente.

D'après cette analyse, toutes les conditions sont vérifiées (les MSA sont supérieurs à 0.5, les contributions des items à la formation des facteurs sont supérieures à 0.6 et l'alpha de Cronbach est supérieur à 0.7).

5.2.3 LE TEST DE L'UNIDIMENSIONNALITE D'ECHELLE DE MESURE DE LA VARIABLE « LA QUALITE DU SERVICE »

L'analyse factorielle des items mesurant la qualité de service montre que le test KMO affiche une valeur de 0,787, le test de sphéricité de Bartlett est significatif (un Khi-deux = 220,163 et p=0.000), tous les MSAi sont supérieurs à 0.5 et le déterminant est différent de zéro (0,093)

Cette analyse permet de dégager un seul facteur ayant une valeur propre supérieur à un (soit 3,091). Ce facteur saisit 61,829 % de l'information initiale. Les poids des items (sont en fait la corrélation avec ce facteur sont forts.

Les résultats montrent également que l'item 1 et l'item5 sont à éliminer car ils présentent des qualités de représentation faibles à l'ordre de 0.441 et 0,361

Suite à l'élimination de ces items, l'analyse factorielle est reconduite afin d'extraire les composantes qui ont une valeur propre supérieure à 1 (2,395). Le résultat de cette analyse dégage une solution en un seul facteur. Le pourcentage de l'information récupérée de ce facteur est élevé environs 79,832 %. Les corrélations de ces items avec ce facteur varient de ,878 à ,908. Donc, le choix de ces items est acceptable puisque ces corrélations sont élevées. En plus, l'analyse de la fiabilité montre que cette échelle à un alpha de Cronbach est de 0,872. Nous sommes donc rassurés de la bonne fiabilité de cette échelle de mesure.

5.2.4 LE TEST DE L'UNIDIMENSIONNALITE D'ECHELLE DE MESURE DE LA VARIABLE « LA CONFIANCE »

Le déterminant de la matrice (0,005 différent de 0) et la valeur de KMO (0.805 >0,7) montrent une intégrité excellent entre les items. Aussi, test de Bartlett indique que toutes les variables sont parfaitement indépendantes les unes des autres (p= 0,000 < 0.05 ; Khi-deux = 125,469). Tous les MSAi sont supérieurs à 0.5.

Tous ces indicateurs indiquent que les données peuvent être soumises à la méthode de l'analyse factorielle.

L'ACP des items confirme l'existence d'un facteur unique qui explique 64,982 % de la variance totale des données originales. Les contributions factorielles (Loadings) sont positives et supérieures à 0,7. Elles confirment ainsi l'unidimensionnalité de ce construit. De plus, la qualité de représentation pour chaque item est aussi satisfaisante (>0,5). Ces résultats sont confirmés aussi par une valeur d'alpha de Crombach de 0,820 qui est jugée bonne.

5.2.5 LE TEST DE L'UNIDIMENSIONNALITE D'ECHELLE DE MESURE DE LA VARIABLE « LA SATISFACTION D'UTILISATION DU SYSTEME»

Tout d'abord, nous rappelons que l'échelle de mesure de la satisfaction d'utilisation du système est composée par 3 items. Les résultats de l'analyse factorielle sont satisfaisants. En effet, la matrice des données de cette échelle de mesure est factorisable puisque KMO =, 726. Ainsi, le test de Bartlett affiche un Khi-deux = 207,440 et p=0.000. De même le déterminant est différent de zéro (0,106).

L'examen de la qualité de représentation des items nous montre que la valeur de l'item 3 est inferieure de 0,5. Donc, nous allons l'éliminer.

Par la suite nous avons procédé à l'extraction des composantes. Nous nous retrouvons ainsi avec une solution satisfaisante d'un seul facteur ayant une valeur propre supérieur à un, soit 2,661 et qui restitue 66,520 % de l'information initiale. L'alpha de Cronbach de ce facteur et l'analyse factorielle relative à cette échelle est représentée dans le tableau ci-dessus.

5.2.6 LE TEST DE L'UNIDIMENSIONNALITE D'ECHELLE DE MESURE DE LA VARIABLE « LE SUCCES DU SYSTEME DE LA GESTION DES CONNAISSANCES»

L'analyse factorielle montre que la matrice des données de l'échelle de mesure du degré d'acceptation est factorisable :

*KMO = 0, 850 est supérieur à 0.5.

*test de Bartlett indique que toutes les variables sont parfaitement indépendantes les unes des autres (p= ,000 <0.05 ; Khi-deux = 266,019).

*les valeurs de MSA sont tous supérieurs à 0.5.

Le pourcentage de l'information récupérée par ce facteur est élevé à l'ordre de 70,423%. Les corrélations de ces items avec ce facteur varient de 0,819 à 0, 852. Ces corrélations servent à interpréter le rôle de chaque variable (item) dans la définition de chaque facteur. Plus le poids est élevé, plus la variable est représentative du facteur. Par conséquent, le choix de ces items est acceptable puisque ces corrélations sont élevées. Ces résultats sont apprécié d'avantage par la valeur d'alpha de Crombach 0, 894 qui jugée bonne.

6 L'ANALYSE ET L'INTERPRETATION DES RESULTATS DE LA REGRESSION LINEAIRE

6.1 LA RELATION ENTRE LA QUALITE DE LA CONNAISSANCE ET LA SATISFACTION DE L'UTILISATION D'UN SYSTEME DE LA GESTION DES CONNAISSANCES. (H1)

Les résultats de la régression linéaire relative à l'hypothèse H1 sont présentés dans le tableau ci-dessus :

Tableau 3. La qualité des connaissances

Variables à expliquer / Variables explicatives	Satisf
Qualicon	**-,157**
Coefficient de détermination	**,025**
Coefficient F de Fisher	**2,391**
Signification de F	**,125**
Durbin-Watson	**2,462**

*****p< 0,01 **p< 0,05 *p< 0,1**

Dans ce modèle, le pourcentage de la variance expliquée est faible de 2,5%. Aussi le coefficient de régression estimé n'est pas significatif et négatif (β=,-157, p=,125 > 0,05). Donc nous pouvons conclure que l'hypothèse (H1) stipulant que : « Il existe une relation positive entre la qualité de la connaissance et la satisfaction de l'utilisation d'un système de la gestion des connaissances» est donc rejetée.

6.2 LA RELATION POSITIVE ENTRE LA QUALITE DU SYSTEME ET LA SATISFACTION DE L'UTILISATION DU SYSTEME DE GESTION DES CONNAISSANCES (H2)

L'évaluation de la relation entre « la qualité du système » et la satisfaction de l'utilisation du système de gestion des connaissances est résumée dans le tableau suivant :

Tableau 4. La qualité du système

Variables à expliquer / Variables explicatives	satisf
qualisys	262
Coefficient de détermination	,074
Coefficient F de Fisher	8,514
Signification de F	,002
Durbin-Watson	1,563

*****p< 0,01 **p< 0,05 *p< 0,1**

Le coefficient de détermination R^2 = ,074 : nous pouvons dire que 7,4 % da la variabilité de la satisfaction de l'utilisation du système de gestion des connaissances est expliquée par la qualité du système.

Ainsi, il existe une relation positive entre la qualité du système et la satisfaction de l'utilisation du système de gestion des connaissances»: **béta= 262 ; t= 2,918 ; p= ,002.**

6.3 LA RELATION POSITIVE ENTRE LA QUALITE DU SERVICE ET LA SATISFACTION D'UTILISATION DU SYSTEME DE GESTION DES CONNAISSANCES (H3)

L'hypothèse (H3) prédit l'existence d'une relation entre la variable dépendante (la qualité du service) et la variable indépendante (la satisfaction d'utilisation du système de gestion des connaissances). Ceci est conformé par les résultats présentés dans le tableau17 ci-dessus, d'une régression entre ces variables puisque le pourcentage de la variance expliquée est de 25, 8%. Le coefficient de régression estimé est significatif et positif (β=, 382, p=,000 < 0,05). En d'autres termes, il existe une relation positive entre la qualité du service et la satisfaction d'utilisation du système de gestion des connaissances. L'hypothèse (H3) est donc acceptée.

Tableau 5. La qualité du service

Variables à expliquer / Variables explicatives	satisf
qualiserv	,382**
Coefficient de détermination	,258
Coefficient F de Fisher	37,220
Signification de F	,000
Durbin-Watson	2,255

***p< 0,01 **p< 0,05 *p< 0,1

6.4 LA RELATION POSITIVE ENTRE LA CONFIANCE ET LA SATISFACTION D'UTILISATION D'UN SYSTEME DE LA GESTION DES CONNAISSANCES (H4) :

Tableau 6. La confiance

Variables à expliquer / Variables explicatives	satisf
conf	,013
Coefficient de détermination	,000
Coefficient F de Fisher	,015
Signification de F	,002
Durbin-Watson	2,404

***p< 0,01 **p< 0,05 *p< 0,1

Le tableau 18, montre que «la confiance » a un Béta qui est:

confiance ; *béta=* ,013 *** ; p= 0,002 <0,005*

En d'autres termes, Il existe une relation positive entre la confiance et la satisfaction d'utilisation d'un système de la gestion des connaissances. L'hypothèse H4 est donc acceptée**.**

6.5 LA RELATION POSITIVE ENTRE LA SATISFACTION DE L'UTILISATION DU SYSTEME DE GESTION DES CONNAISSANCES ET SON SUCCES (H5)

Les résultats de la régression linéaire relative à l'hypothèse H5 sont présentés dans le tableau ci-dessus :

Tableau 7. La satisfaction de l'utilisation des KMS

Variables à expliquer / Variables explicatives	Succe
satisf	-,040
Coefficient de détermination	,002
Coefficient F de Fisher	2,391
Signification de F	,695
Durbin-Watson	2,022

***p< 0,01 **p< 0,05 *p< 0,1

Dans ce modèle, le pourcentage de la variance expliquée est faible de 2,5%. Aussi le coefficient de régression estimé n'est pas significatif et négatif (β=,-40, p=**,695** > 0,1). Donc nous pouvons conclure que l'hypothèse (H5) stipulant que : « Il existe une relation positive entre la satisfaction de l'utilisation d'un système de la gestion des connaissances et son succès» est donc infirmée.

7 LA DISCUSSION DES RESULTATS

L'objectif est d'analyser en profondeur les résultats de l'étude empirique pour identifier l'influence de la satisfaction de l'utilisation des systèmes de gestion de connaissance sur son succès. Nous essayons ainsi, de rapprocher les résultats obtenus dans notre étude avec ceux trouvés par d'autres travaux dans la littérature.

Après la purification des résultats, cinq dimensions « des systèmes de gestion de connaissance » ont été retenus : la qualité de la connaissance, la qualité du service, la qualité du système, la confiance et la satisfaction de l'utilisation des systèmes de gestion de connaissance.

7.1 LA QUALITE DE LA CONNAISSANCE

D'après les résultats obtenus, il n'existe pas une relation positive entre la qualité de connaissance et la satisfaction de l'utilisation d'un système de gestion de connaissances. Cette relation est infirmée par les travaux passés de Seddon P B., Kiew M Y. (1996), José L. Roldán and Antonio Leal (2003) et Nantapanuwat N. et al. (2010) qui ont montré le lien négatif entre ces deux variables. En termes de qualité du savoir, ce facteur influence la satisfaction des utilisateurs. Par conséquent, un gestionnaire de KM devrait accorder une attention sur les éléments qui contribuent à la qualité de connaissances telles que l'exhaustivité, la claireté, la disponibilité et l'adéquation des connaissances.

Alors les entreprises tunisiennes doivent utiliser plus efficacement les connaissances de leurs employés. Par exemple, augmenter «le partage des connaissances» parmi leurs employés, selon lequel, les employés possédant des connaissances dans un domaine particulier de le partager avec d'autres employés qui ne peuvent pas avoir cette connaissance, mais ils ont besoin pour leur travail.

7.2 LA QUALITE DU SYSTEME

L'examen d'une revue de la littérature, nous a montré que la qualité du système affecte positivement la satisfaction de l'utilisation du système de gestion de connaissances. En effet, cette hypothèse a été vérifiée dans le contexte tunisien. Ce résultat corrobore avec celui qui a été trouvé par Seddon P B., Kiew M Y. (1996), José L. Roldán and Antonio Leal (2003) et Nantapanuwat N. et al. (2010). Ces auteurs ont montré qu'il existe un lien significatif entre ces deux variables.

Un système de haute qualité répond aux exigences des utilisateurs. En termes de qualité du système, ce facteur a un effet positif sur la satisfaction des utilisateurs, ce qui influence à son tour l'utilisation de KMS. Par conséquent, la qualité du système n'est pas négligeable. KMS doit toujours être prêt et facile à utiliser. Si non, elle pourrait réduire la satisfaction des utilisateurs et ainsi décourager l'utilisation de KMS.

7.3 LA QUALITE DU SERVICE

Suite à une revue de la littérature (An Investigation of the Determinants of Knowledge Management Systems Success in Banking Industry), nous avons supposé que la qualité de service influence positivement la satisfaction de l'utilisation de KMS. En effet, cette hypothèse a été vérifiée dans le contexte tunisien.

Ce résultat corrobore avec celui qui a été trouvé par Nantapanuwat N. et al. Cependant, la qualité du service a d'effet positif sur la satisfaction des utilisateurs. Il se pourrait bien que les attentes sur le KMS sont élevées, et donc la satisfaction des utilisateurs est élevée (Benard R., & Satir A. (1993). Par conséquent, un service doit avoir une bonne connaissance et compréhension du système ainsi que les problèmes communs et potentiels. C'est pour permettre à un service de haute qualité d'être facilement utilisable à tous les utilisateurs.

7.4 LA CONFIANCE

L'examen d'une revue de la littérature, nous a montré que la confiance affecte positivement la satisfaction des utilisateurs. En effet, cette hypothèse a été vérifiée dans le contexte tunisien. Ce résultat est conforme à celui qui a été trouvé par Maryam A. et Leidner E. (2001) et Nantapanuwat N. (2010). Ces auteurs ont montré qu'il existe un lien significatif entre ces deux variables. Ceci est également soutenu par Tanya et al. (2003) considérant la satisfaction des utilisateurs, la confiance est le facteur le plus important qui affecte la satisfaction des utilisateurs.

En termes de confiance, ce facteur a un effet élevé sur la satisfaction des utilisateurs dans le contexte tunisien. Cela indique son importance sur le succès KMS. Une confiance sur les connaissances contenues dans le KMS et la confiance sur le système en soi, pourrait donner satisfaction et conduire à l'utilisation du système. Cependant, puisque la confiance est basée sur la perception individuelle vers une certaine chose, un knowledge manager aura besoin de mettre des efforts supplémentaires sur la création ou influencer cette perception.

7.5 LE SUCCES DE L'UTILISATION DE SGC

D'après nos résultats obtenus, la satisfaction de l'utilisation des systèmes de gestion de connaissances n'affecte pas son succès, en effet ces résultats sont infirmés par ceux des travaux de Seddon P B., Kiew M Y. (1996) ; Tanya McGill et al. (2003) ; Nantapanuwat N., et al. (2010).

En effet, l'analyse des résultats a montré que l'effet de la satisfaction de l'utilisation des systèmes de gestion de connaissance sur son succès n'est pas significatif.

Le test d'hypothèse révèle que la satisfaction de l'utilisation des SGC a une relation négative avec le succès de KMS. En effet, si les employés sont satisfaits de l'efficacité et l'efficience du système, ils seront prêts à utiliser le système. Cela implique que, la satisfaction des utilisateurs est un facteur fondamental sur lequel un gestionnaire de KM devrait prêter attention. La satisfaction pouvait être améliorée en se concentrant sur les besoins des usagers et rendre le service KMS mieux les accueillir.

Alors, les entreprises tunisiennes doivent développer leurs pratiques opérationnelles internes car les utilisateurs des connaissances sont les arbitres ultimes des pratiques de gestion des connaissances. Ce n'est que lorsque les usagers de GC sont satisfaits de mise en œuvre des systèmes de gestion des connaissances, ils vont participer volontairement à la création et le partage des connaissances dans leurs organisations. Ainsi la satisfaction des utilisateurs de SGC est reconnue comme l'indicateur efficace pour la mesure directe des performances de gestion des connaissances.

Aussi, la résistance au changement par les membres des entreprises tunisiennes explique le non succès des SGC. Afin de réduire les résistances aux changements, les organisations doivent se concentrer sur certains membres veulent plutôt que ce que les organisations sont la prestation. Lorsque sont satisfait des initiatives de gestion des connaissances, Les membres de l'organisation participent volontairement au processus de connaissance diversifié. Les organisations doivent prêter plus d'attention aux membres de l'organisation touchée, la compréhension de la volonté de changement et de transformation culturelle de leurs comportements et les enrôler dans les processus de planification des changements.

En effet, après avoir placé l'étude dans son contexte en précisant clairement les différentes hypothèses à tester ainsi que la démarche utilisée lors de l'enquête, il a été question de procéder à des manipulations statistiques à l'aide du logiciel de statistiques SPSS18, afin d'obtenir des résultats statistiques qui, une fois interprétés, ont permis de confirmer ou d'infirmer les hypothèses émises. L'interprétation de ces résultats a dès lors relevé qu'il existe une relation négative entre la satisfaction de l'utilisation des systèmes de gestion de connaissance et son succès.

8 CONCLUSION

Dans un contexte de dématérialisation de plus en plus accrue de la valeur de l'entreprise, la présente étude s'est interrogée sur les déterminants de l'efficacité des systèmes de gestion de connaissance. La carence des recherches à ce sujet, principalement dans les pays en voie de développement, a fortement motivé cette étude. Cette dernière a tout

d'abord procédé a un tour d'horizon de la revue de littérature, dans le but de mieux cerner les tenants et aboutissants des deux concepts fondamentaux de cette recherche, à savoir : la gestion des connaissances et les systèmes de gestion de connaissance.

Ce tour d'horizon, a permis de dégager non seulement les grands axes de la gestion des connaissances ainsi que les pratiques y afférentes, mais également les liens pouvant exister entre ces pratiques de gestion des connaissances et les systèmes de gestion de connaissances. Par la suite, en se basant sur cette revue de littérature, cette étude a émis cinq hypothèses à tester en vue de répondre à la problématique de départ. Cette étude a supposé qu'il existe une relation négative entre la satisfaction des systèmes de gestion de connaissance et son succès. Le test de ces différentes hypothèses a donc été effectué sur un échantillon aléatoire de 96 entreprises Tunisiennes.

L'interprétation des résultats statistiques a permis de conclure dans un premier temps qu'il n'existe pas une relation entre la qualité de la connaissance et la satisfaction de l'utilisation des systèmes de gestion de connaissance, ce qui souligne que la première hypothèse de cette étude a été infirmée. En second lieu, la variable qualité du système a un effet positif sur la satisfaction de l'utilisation des SGC, ce qui implique que cette variable est confirmée. La troisième hypothèse affirme qu'il existe une relation positive entre la qualité du service et la satisfaction de l'utilisation des SGC, donc cette hypothèse est acceptée. Ensuite, la variable confiance a un effet positif sur la satisfaction de l'utilisation des KMS. Alors cette hypothèse est confirmée. Enfin, l'interprétation des résultats statistiques a démontré que, la satisfaction de l'utilisation des KMS à un effet sur son succès, mais, cet effet est négatif tel que le prévoyait la cinquième hypothèse de cette étude, d'où le rejet de celle-ci.

Par ces analyses et les principales conclusions qui en découlent, cette étude est susceptible d'apporter une réelle contribution à l'ensemble de la communauté scientifique à deux niveaux. D'une part sur un plan théorique, cette étude vient enrichir la littérature encore embryonnaire sur le sujet des pratiques de gestion des connaissances dans les pays en voie de développement. D'autre part, sur un plan pratique cette étude pourrait amener les managers d'entreprises évoluant dans les pays en voie de développement à prendre conscience de l'enjeu de systèmes de gestion de connaissance en tant qu'atout concurrentiel majeur, et dès lors, inciter ces managers à consacrer davantage de temps et de ressources aux pratiques de gestion des connaissances susceptibles d'améliorer les systèmes de gestion de connaissance de leurs entreprises et de motiver les usagers pour ne pas résister aux changement et prêter plus d'attention aux membres de l'organisation touchés, la compréhension de la volonté de changement et de transformation culturelle de leurs comportements et les enrôler dans les processus de planification des changements.

Cependant, il convient de souligner que la présente étude comporte un certain nombre de **limites** non négligeables. Dans un premier temps, cette étude a été menée auprès d'un échantillon relativement faible. Cette faiblesse de l'échantillon principalement due aux contraintes de temps et à la difficulté d'approcher les entreprises ciblées, a pour conséquence de limiter fortement la possibilité de généraliser les résultats obtenus par cette recherche. Par ailleurs, à partir de l'enquête, l'une des mesures importantes de la qualité du savoir est le degré de pertinence des connaissances, qui varie dans des contextes différents, en fonction des caractéristiques organisationnelles et opérationnelles.

En conséquence, les résultats pourraient ne pas être applicables dans d'autres industries qui fonctionnent différemment. Dans un deuxième temps, le fait que cette étude repose en grande partie sur la perception des différents répondants, la recouvre d'un voile de subjectivité qui, empêche davantage la possibilité de généralisation des résultats issus de la recherche.

Pour finir, le champ de la recherche scientifique étant en perpétuelle évolution, la présente étude pourrait dans une certaine mesure suggérer certaines **voies futures de recherche**. En effet, en considérant les limites de cette étude, il serait intéressant pour les recherches à venir dans le contexte Tunisien, de répliquer ce travail mais à une plus grande échelle, qui permettrait non seulement de confirmer ou d'infirmer les résultats déjà obtenus dans le cadre de cette étude, mais aussi et surtout de les généraliser à l'ensemble de la population.

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REFERENCES

[1] Al Busaidi K. et al. (2010). «Sharing Knowledge to A Knowledge Management System: Examining the motivators and the benefits in an Omani organization», p4et5.

[2] Alavi M. (2000) «Organizational Knowledge Management, Framing the Domains of IT Management Research: Glimpsing the Future through the Past», Pinneflex Educational Resources, Cincinnati, OH, 2000. http://www.amazon.com/Framing-Domains-Management-Projecting-Future-Through/dp/1893673065

[3] Alavi, M., & Leidner, D. (1999). «Knowledge management Systems: Issue, challenges and benefits». Communication of AIS, 1(7). Alavi, M., & Leidner, D. E., (2001). «Review: Knowledge Management and Knowledge Management Systems: Conceptual Foundations and Research Issues». MIS Quarterly, 25(1), p. 107-136.

[4] Ali O., Aurélie D. (2003). « Etat de l'art des approches de définition du Système de Gestion des Connaissances (SGC) ».

[5] Argote L. et Ingram P. (2000), «Knowledge Transfer: A Basis for Competitive Advantage in Firms, Organizational Behavior and Human Decision Processes», 82, 1, 150-169.

[6] Aviv I., Levy M., Hadar I. (2008), «Socio-Engineering Knowledge Audit Methodology (SEKAM) for Analyzing End-User Requirements», Actes de la conférence AMCIS, Toronto.

[7] Balmisse G. (2005), «Guide des outils du knowledge management, Panorama, choix et mise en œuvre», Paris, Editions Vuibert, Coll. « Entreprendre Informatique ».

[8] Balmisse G. (2006). « Outils du KM Panorama, choix et mise en œuvre Seconde édition actualisée ».

[9] Bals C. et al. (2007). «Assessing User Acceptance of a Knowledge Management System in a Global Bank: Process Analysis and Concept Development», International Conference on System Sciences.

[10] Barthélémy L. ; Dudézert A. (2003). MYSMAC: « Une méthode d'analyse et de suivi des systèmes de gestion des connaissances ».

[11] Bayad M. et al. (2006). «Gestion des connaissances et capital social: une histoire d'influence», colloque : En route vers Lisbonne

[12] Berthon B. (2001), «Le transfert intra-organisationnel de connaissance: survol de la littérature». 10ème conférence de l'AIMS, Université de Laval, Québec

[13] Boisot M. **(**2005) **«**Knowledge Assets», Oxford, 1998. Cite par MAILHOT C., ÉTHIER S. Le dilemme technologie – individus dans l'implantation de la gestion des connaissances: le cas de Cossette Communication. Cahier de recherché n°5-22, Montreal, HEC, Disponible sur : http://www2.hec.ca/recherche/publications/cahiers/2005/05-22.pdf. Consulté le 17/12/2006.

[14] Brady, M.K. et al. (2002). «Performance-only measurement of service quality: a replication and extension». Journal of Business Research, 55(1), 17-31.

[15] Boughzala I., Dudezert A., (2008), « Vers le KM 2.0 : quel management imaginer pour faire face aux défis futurs », Vuibert.

[16] Bourdon I. et Tessier N. (2006). «Gestion des connaissances : De nouvelles compétences attendues», XVIIe Congrès de l'AGRH – Le travail au cœur de la GRH IAE de Lille et Reims Management School.

[17] Bollen K.A (1989), «Structural equations with latent variables "(Wiley, New York)

[18] Boutelitane S., (2005), «Management des connaissances et processus d'innovation», Cahier de recherche, Faculté des sciences économique et de gestion, HEC Genève.

[19] Boutin G. (2000) « Le béhaviorisme et le constructivisme ou la guerre des paradigmes » n° 119, 2000, p. 37-40.

[20] Boomsma A. (1982). «The robustness of LISREL against small sample sizes in factor analyses models». In K.G. Joreskog & H Wold (Eds), systems under indirect observation: Causality, structure, prediction (Part I, pp. 149-173). Amsterdam: North-Holland.

[21] Caumont. D. (1998). « Les études de marché », Dunod, Paris.

[22] Cécile GAUMAND, Alain CHAPDANIEL, Aurélie DUDEZERT.(2010); «Systèmes de Gestion des Connaissances pour la chaîne logistique intra organisationnelle, Cas de la société Bonfigioli ; Knowledge Management Systems in intra-organizational Supply Chains: an Action-Research in Bonfigioli», version 1 - 16; "Systèmes d'Information et Management 15, 2 99-124"

[23] Chauvet V., (2002)**. «** Les facteurs de l'émergence du Knowledge Management: Changements environnementaux, technologiques et organisationnels », W.P. n° 626.

[24] Choi B., Lee H. (2002). «Knowledge management strategy and its link to knowledge creation process".

[25] Christos N. P. (2009). Edith Penrose's «The Theory of the Growth of the Firm Fifty Years Later», MPRA: Munich Personal RePEc Archive

[26] Chung-Hung T., Hwang-Yeh C. M. (2007). «Assessing Knowledge Management System Success: An Empirical Study in Taiwan's High-Tech Industry». Journal of American Academy of Business, Cambridge, 10(2), 257-262.

[27] Couk I. et Perrien J. (1999) «Les déterminants de la confiance en marketing : Panorama, questions en suspens et pistes de recherche».
[28] Cox E.P. (1980) «The optimal number of response alternative for a scale: a review», Journal of Marketing Research, Vol. 17, pp. 407-422.
[29] Davenport, T. & Prusak, L.**,** (1998), «Working Knowledge: How organizations manage what they know», Harvard Business School Press. http://books.google.com/books?hl=fr&lr=&id=QIyIWVhdYoYC&oi=fnd&pg=PR5&dq=davenport+et+prusak,+working+knowledge&ots=Z2YKfjV2OR&sig=qSnkwN5aAlKmCplzA6Af8i3Mp58
[30] Davenport T. H. et al. (1998) «Successful Knowledge Management Projects», Sloan Management Review», vol.39, N°2, pp. 43-57.
[31] De Lagarde, J. (1995), « Initiation à l'analyse des données », Paris, Dunod.
[32] Dudezert A. et Lancini A. (2006), «Performance et Gestion des Connaissances: Contribution à la construction d'un cadre d'analyse», Actes des Journée des IAE, Congrès du cinquantenaire, Montpellier, France.
[33] Drucker P., (1993), «Au-delà du Capitalisme, La métamorphose de cette fin de siècle, Paris, Dunod. Edition originale "Post-capitalism Society", Butterworth-Heinemann Ltd. , Oxford, Great Britain. http://books.google.com/books/about/Au_del%C3%A0_du_capitalisme.html?id=BRh-GwAACAAJ
[34] Dudezert A. (2003). «La valeur des connaissances en entreprise : recherche sur la conception de méthodes opératoires d'évaluation des connaissances en organisation», Thèse de Doctorat, Ecole Centrale Paris.
[35] Durand C. **(**2005). « L'analyse factorielle et l'analyse de fidélité », 13 juillet 2005.
[36] Diani, M. (2002). «Connaissance et performance économique : Une nouvelle vision de la firme dans une économie basée sur la connaissance», Communication au Colloque Interdisciplinaire « Connaissance(s) et Incertitude », Aix-en-Provence.
[37] Dignum V.; Eijk R. (2005). «Towards a Model to Understand the Influence of Trust in Knowledge Sharing Decisions».
[38] Earl M. (2001). «Knowledge management strategies : toward a taxonomy», Journal of Management Information Systems, Volume 18, n°1, p. 215-233.
[39] Edvinson L. Malon M.S. (2007). « Actifs immatériels et création de valeur ». L'observateur OCDE, 2007. Disponible sur : http://www.oecd.org/dataoecd/30/34/38313204.pdf. Consulté le 17/12/2006. Intellectual Capital, Editions Harper Collins, New York. Cité par: GORIA
[40] Ermine J.L. (2004). **«**Valoriser les connaissances critiques d'une entreprise», collection IC2, Hermes Science publications, pp 107-125.
[41] Etienne Wenger. (2006). «Communities of practice a brief introduction».
[42] Evrard. et al, 2003, Market , «Etudes et Recherches en Marketing, Fondement , Méthodes »,Dunod
[43] Fraser, S.G., & Salter, G. (1995). «A motivational view of information systems success: A reinterpretation of Delone & McLean's model». Proceedings of the 6th Australasian Conference on Information Systems, 1, 119-140.
[44] Frédiric Leroy (1998). «L'apprentissage organisationnel: une revue critique de la littérature».
[45] Galliers R.D. et Newells S. (2001), « Back to the future: from knowledge management to data management », in proceedings of ECIS 2001, pp. 609-615.
[46] Gallupe, B. (2001) «Knowledge Management Systems: Surveying the Landscape», International Journal of Management Reviews, 3(1), pp. 61-77.
[47] Goury M.L. et Spalanzani A. (2010). «Le rôle de l'outil de gestion des connaissances pour les communautés de pratique : le cas d'une chambre de commerce et d'industrie», cahier de recherche n°2009-11 E5 ; version 1 – 26.
[48] Grant, R.M. (1996), **«** Toward a knowledge-based theory of the firm», Strategic Management Journal 17(special issue): 109-122.
[49] Grant R. M. (2001), «Knowledge and Organization, in Managing Industrial Knowledge: creation, transfer and utilization», ed. I. Nonaka and D.J. Teece (Eds.), London, Sage Publications, p. 145-169
[50] Grundstein M., (2002), «Le Management des Connaissances dans l'Entreprise Problématique, Axe de progrès», Orientations research report MG Conseil
[51] Grundstein M., (2003), «De la capitalisation des connaissances au management des connaissances dans l'entreprise : les fondamentaux du knowledge management, INT – Entreprises».
[52] Grundstein M., (2003), «Le Management des Connaissances dans l'Entreprise, Problématique : Axe de progrès, Orientations», MG Conseil.
[53] Halawi A Leila*.,* D.B.A. (2005). «Knowledge Management Systems' Success in knowledge-based organizations: An empirical validation utilizing the Delone and McLean IS Success Model». Nova Southeastern University.
[54] Hansen. M. T, Nohria. N. et Tierney.T. (1999), «What's your strategy for managing knowledge», artwork by Theo Runald
[55] Hamel G., Prahalad C.K., (1995): «Competing for the future», Harvard Business School Press, 1994.

[56] Idem Stéphane. (2006) « L'expression du problème dans la recherche d'informations : application à un contexte d'intermédiation territoriale ». Thèse de doctorat, université de Nancy 2, P.50.
[57] Ioana R., Mikael L. (2002). «Knowledge Management in Software Engineering», focus guest editors' introduction, Fraunhofer Center for Experimental Software Engineering, Maryland
[58] Jöreskog, K. G. (1981). «Analysis of Covariance Structures», Scandinavian Journal of Statistics, 8, pp. 65-91.
[59] José L. Roldán and Antonio Leal, (2003), «A Validation Test of an Adaptation of the DeLone and McLean's Model in the Spanish EIS Field», Chapter IV, Idea Group Publishing.
[60] Knowledge Based View**,** Encyclopedic Dictionary of Strategic Management.
[61] Lu I.Y.; Lee T. (2010). «Examining the Effects of Information Quality on Behavioral Intention of Knowledge Management System»**,** Journal of Quality Vol. 17, No. 4.
[62] Mabeu Y. *;* Christelle M. (2010). «Knowledge Management et performance organisationnelle : cas des entreprises Tunisiennes», mémoire de fin d'étude.
[63] Maier R. (2002), « State-of-practice of knowledge management systems: results of an empirical study, knowledge management and information technology », Upgrade, vol.3, n°1
[64] Maier R. (2004). «Knowledge Management Systems: Information and Communication Technologies for Knowledge Management»
http://books.google.com/books?hl=fr&lr=&id=r5pAHIN1ChwC&oi=fnd&pg=PR5&dq=R.+Maier.+(2004).+Knowledge+Management+Systems:+Information+and+Communication+Technologies+for+Knowledge+Management&ots=yAa6-uBQo7&sig=i6fB_-O-ZKIZlR4BturT2s9NBHc
[65] Malhotra Y., (2005). «Integrating knowledge management technologies in organizational business processes: getting real time enterprises to deliver real business performance», Journal of Knowledge Management, VOL. 9 NO. 1
[66] Marie-L.G ; Alain S. (2010). «Le rôle d'un outil de gestion des connaissances pour les communautés de pratique : le cas d'une chambre de commerce et d'industrie», version1
[67] McGill T. et al. (2003). «User-developed applications and information systems success: A test of DeLone and Mclean». Information Resources Management Journal, 16(1), 24.
[68] Michael Polanyi. (1966). «The tacit Dimension». Routledge & Kegan Paul Ltd, London
[69] Michael K. Bradya, J. Joseph Croninb, Richard R. Brand. (2002). **«**Performance-only measurement of service quality: a replication and extension», Journal of Business Research,vol(55), 17– 31.
[70] Mohamed B. Serge, Francis S. **(**2003). «Le management des connaissances : état des lieux et perspectives», XIIème Conférence de l'Association Internationale de Management Stratégique.
[71] Mucchielli R. (1979). «Le questionnaire dans l'enquête psycho-sociale: connaissance du problème», collection : Formation Permanente en Sciences Humaines, (partie connaissance du problème), 10 édition.
http://books.google.tn/books?id=uAmgdwThsUC&printsec=frontcover&hl=fr&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false
[72] Murray E. J., Lorne O. (2005). **«**Assessing Knowledge Management Success»**,** International Journal of Knowledge Management, 1(2), 33-49**.**
[73] Nantapanuwat N. et al. (2010). «An Investigation of the Determinants of Knowledge Management Systems Success in Banking Industry», World Academy of Science, Engineering and Technology, 71
[74] Nelson R.R, Winter S.G. (1982): «An Evolutionary Theory of Economic Change». Harvard University Press, Cambridge, MA,
http://books.google.com/books?id=6Kx7s_HXxrkC&printsec=frontcover&dq=Nelson+et+Winter+(1982):+An+Evolutionary+Theory+of+Economic+Change&hl=fr&ei=6m7KTonaMMymsAaP-tSHBw&sa=X&oi=book_result&ct=result&
[75] Newell A., Simon H A., (1972), «Human Problem Solving», Prentice Hall.
[76] Nonaka I. (1991), «The Knowledge Creating Company», Harvard Business Review, Volume 69, n° 6, p. 96-104.
[77] Nonaka I. (1994) «A Dynamic Theory of Organizational Knowledge Creation organization science», Vol. 5, No. 1
[78] Nonaka I. & Takeuchi H. (1995), «The Knowledge Creating Company», New York, The Oxford University Press.
[79] Nonaka, I et Takeuchi, H. (1997). «La connaissance créatrice : la dynamique de l'entreprise apprenante».
[80] Nunally J. (1967) «Psychometric Methods», New York: McGraw-Hill Book Co.
[81] OCDE **(**2004), «Importance de la gestion des connaissances dans le secteur des entreprises», Organisation de Coopération et de Développement Économiques.
[82] Penrose E., (1995), «The theory of the growth of the firm», Oxford University Press
http://www.amazon.com/Theory-Growth-Firm-Edith-Penrose/dp/0198289774
[83] Perrin A. (2004). «La valorisation des pratiques de management des connaissances, outils de mesure et mesure des outils»**.**
[84] Perrin A. et al., (2006), «Valuing Knowledge Management in Organizations, from theory to practice: the case of Lafarge Group».

[85] Perrien, J. et al. (1983), « Recherche en marketing : méthodes et décisions », Chicoutimi : Gaëtan Morin.
[86] Polanyi, M. **(**1966). «The tacit dimension». New York: Anchor Day Books.
[87] Prax J. Y., (2001), «Compte-rendu « les enjeux des TIC: le knowledge management », Conférences du 3ème millénaire.
[88] Quintas P. (1997). «Managing Knowledge in a New Century»**,** The Open University Business School.
[89] Reinbold J. (1977). « Le behaviorisme et les psychologues sociaux » vol. 4, n° 2, 1977, p. 335-340.
[90] Riley T. B. (2003). «La gestion des connaissances et la technologie». Rapport de sondage complémentaire international. Rapport numéro 2
[91] Ruggles R. (1998), «The state of the notion: knowledge management in practice», California Management Review, 40, (3), 80-89.
[92] Rusli A. et al. (2008) «The Development of Bioinformatics Knowledge Management System with Collaborative Environment», IJCSNS International Journal of Computer Science and Network Security, VOL.8 No.2, 309
[93] Schultze U., Leidner D. (2002), «Studying Knowledge Management in Information Systems Research: Dis-courses and Theoretical Assumptions», MISQ, vol.26, n°3, p 213-242
[94] Seddon P. B., Kiew M.Y. (1992). «A partial test and developpement of Delone and Mclean's of IS success», vol 4, No.1
[95] Skyrme D. (1994), « The knowledge asset », Management insight, David Skyrme Associates, N°11, URL: http://www.hiway.co.uk/skyrme/insights/11ka sset.htm, 1994.
[96] Stacie P., William D. and Ephraim M. (2008). «Measuring information systems success: models, dimensions, measures, and interrelationships», European Journal of Information Systems 17, 236–263, Operational Research Society Ltd. , P238 et 239
[97] Stenmark D. (2002), « Information vs. knowledge: the role of intranets in knowledge management », Knowledge Management Group, Gothenburg, Suede.
[98] Stéphane Goria. (2006). « Knowledge Management et intelligence économique : Deux notions aux passés proches et aux futurs complémentaires. »
[99] Sveiby, K., E., (2000), «Knowledge Management : La nouvelle richesse des entreprises», Maxima.
[100] Teece, D. J. (1998). «Capturing value from knowledge assets: The new economy, markets for know-how, and intangible assets». California Management Rev. 40(3) 55–79.
[101] Terill et Flitman (2002), «Facteurs influant sur la satisfaction des utilisateurs avec Intégrative systèmes de gestion de connaissances : un préliminaire»
[102] Triki A, 2007, «Méthodologies de la Recherche en Gestion : Théories et Applications en Marketing», Tunis Edition, 1er édition.
[103] Tixier B. (2001), « La problématique de la gestion des connaissances», Rapport de recherche, institut de recherche en informatique, Université de Nantes.
[104] Youssef. H ; Boughzala. I. (2005). « L'impact de la pluralité des objectifs sur la capitalisation des connaissances au sein des organisations »
[105] William H. D.; Ephraim R. M. (2003). «The DeLone and McLean Model of Information Systems Success: A Ten-Year Update», journal of information systems, vol 19, N° 4,pp 9-30
[106] Wu J.H., Wang Y.M. (2006) «Measurement KMS success: A respecification of the DeLone and McLean's model. Information & Management», 43, 728-739.
[107] Zack, M. H., 1999, «Managing codified knowledge», Sloan Management Review, 40(4), 45-58. http://web.cba.neu.edu/~mzack/articles/kmarch/kmarch.htm

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Development and Optimization of a Compliant Clamp for Grasping Robotics

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ABSTRACT: The study aims to investigate the development and the optimization of a compliant clamp in accuracy high required robotic mechanisms. In this research, a compliant clamp is developed based on flexure hinges to offer the flexibility of movement. Firstly, Solidwork software is used to create a compliant clamp model. Next, a finite element analysis (FEA) is performed using ANSYS software to explore the deformation behavior and stress distribution. The stress and the displacement of the mechanism are two important objective functions considering simultaneously to find the best optimal dimension of flexure hinges. Finally, to improve the strength and increase movement capacity (i.e. how to minimize the stress and maximize the displacement of this mechanism simultaneously), the fuzzy logic reasoning combined with Taguchi method that is proposed in this paper for multiple quality optimization problem. The results reveal that the proposed clamp has the mechanical advantages and the optimal dimension of proposed flexure hinge is the length of 15 mm, the width of 6 mm, and the thickness of 1mm. Therefore, the strength of suggested compliant clamp was improved. It is expected to used in robotic industry and other fields.

KEYWORDS: Compliant clamp, FEA, Fuzzy logic reasoning, Taguchi method, Multi-objective optimization.

BACKGROUND

Flexure based mechanisms, compliant mechanisms, are mechanisms that reply on elastic deform of components to transfer force, moment, translation, rotation, etc. They have been commonly used in high precision actuators, manipulators, robotics, and chemical environment to other industrial areas because they are a monolithic mechanism, lowest cost for manufacturing. From these view of points, a novel compliant clamp is proposed in this paper with regard to multiple quality characteristics optimization problem via using the Taguchi method based fuzzy logic reasoning.

1 INTRODUCTION

A clamp is considered as a device/an end-of-arm tooling or robotic hand for grasping, holding, and picking up the various size objects. Fig. 1a shows the traditional clamp consisting of a lot of sub-components, which connected at kinematic joints, but it must require the lubricant due to the friction, maintenance, and high cost. To overcome the limitation of the conventional clamp, a novel clamp was developed based on the flexure joints as in Fig. 1b, it is only monolithic mechanism and offers a lot of advantages such as no joint, high accuracy, no friction, no clearance, backlash, no lubricant, and no maintenance. However, the flexure joints have some defects as the limited fatigue life and the stress concentration. Thus, as the design and manufacture the compliant clamp, it should take into account to minimize the stress and maximize the displacement of whole mechanism. A numerous previous researchers designed and controlled tradition clamp for grasping. Yocshikawa [1] controlled a robotic hand for grasping and manipulator. Kroemer et al. [2] studied on active learning and active control for grasping. Faraz et al. [3] designed a grasper for surgeon for increasing grasping force. To optimize simultaneously the stress and the displacement, there are a lot of approaches as genetic algorithm, neural network, and fuzzy logic combined genetic algorithm/Taguchi method. Of these, the fuzzy logic combined Taguchi method (FLTM) has been also easier common tool. Hsiang et al. [4] used the fuzzy logic combined Taguchi method to optimize extrusion of magnesium alloy bicycle carriers. Another study by Hsiang et al. [5] found the optimal process parameters based on FLTM for the hot

extrusion of AZ31 and AZ61 magnesium-alloy bicycle carriers. Luo et al. [6] optimized the multi-objective topology of CM-continuum structures using a density interpolation scheme, the rational approximation of material properties method and a globally convergent version of the method of moving asymptotes. Huang et al. [7] designed and fabricated a micro-gripper with an optimal topology compliant mechanism. Frecker et al. [8] presented a topology of CMs with multiple outputs.

In this paper, a novel clamp mechanism are proposed via using flexure hinges and optimized by using fuzzy logic-Taguchi method.

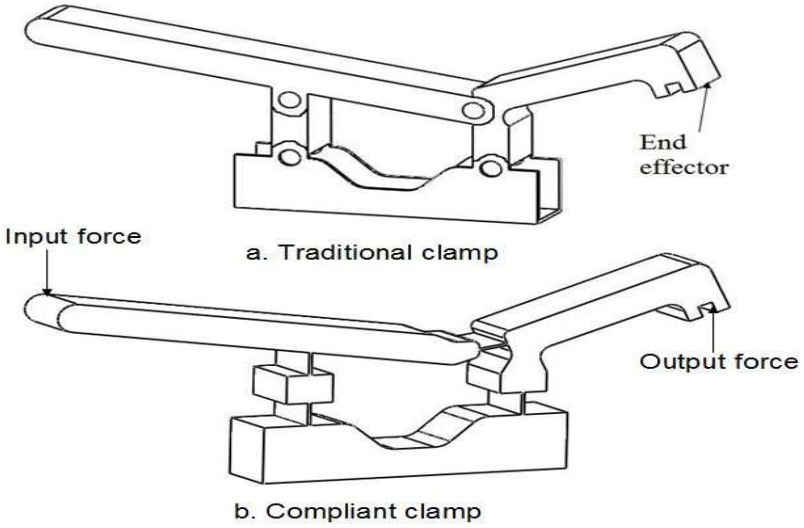


Fig. 1. Model of traditional and complaint clamp

2 SIGNIFICANT AND CONTRIBUTION OF PROPOSED APPROACH

A clamping robotic hand were developed and based on flexible hinges for the purposes of grasping, holding, and pick up various sized objects. The advantages of compliant clamp for robotic mechanism include monolithic, high accurate, no joint, no friction, no clearance on backlash, no lubricant, and no maintenance. It is expected to use in robotic mechanisms and high precision mechanisms. Also, the proposed methodology for optimization is used to optimize multiple quality characteristics in many engineering areas; in particular, this method is utilized in this paper.

3 FINITE ELEMENT ANALYSIS (FEA)

The finite element analysis carried out on ANSYS software to investigate the deformation behavior and stress distribution of the proposed clamp, made of polyethylene, such as the stress distribution and the displacement. A meshing method used hex dominant and a meshing type was quadrant; an applied constant force is 2 N. The stress distribution described in as Fig. 2, and the total deformation showed in as Fig. 3. From that, it reveals that the stress concentration and the displacement of flexure hinges are the most significant two aspects result in the flexibility of movement for clamping.

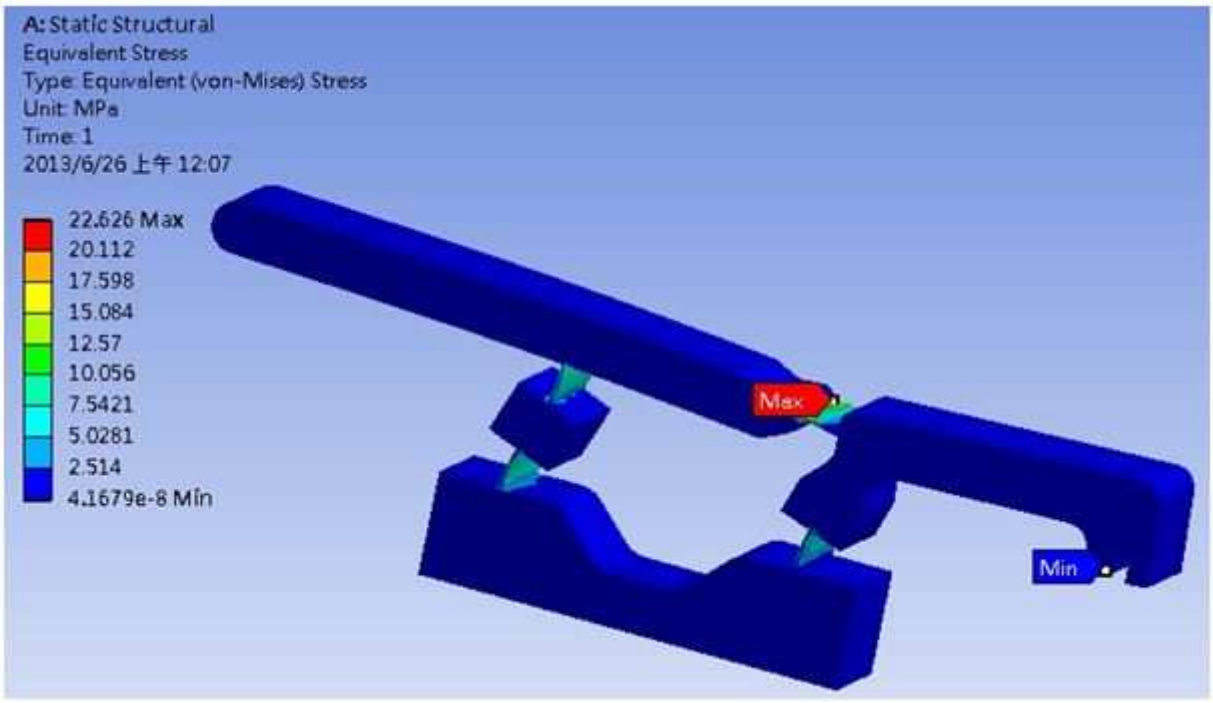


Fig. 2. Stress distribution of clamp compliant

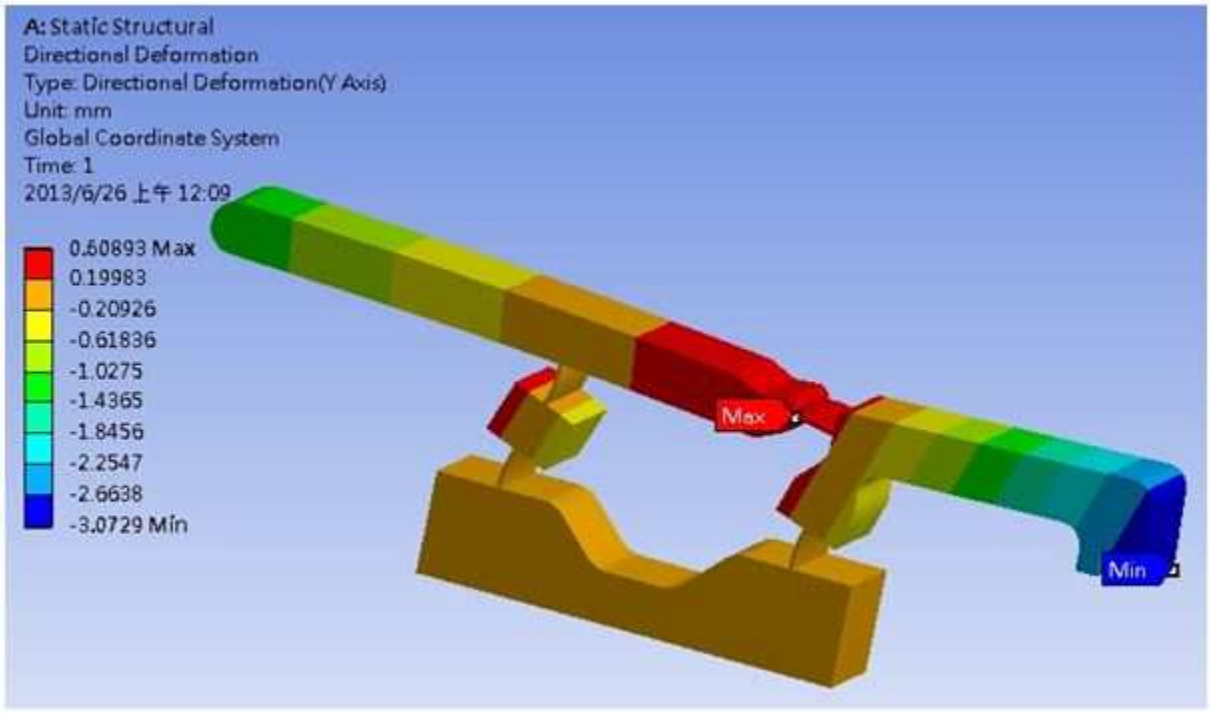


Fig. 3. Total deformation of compliant clamp

4 OPTIMIZATION OF COMPLIANT CLAMP

Because flexure based mechanisms are moved in elastic area, as a result the proposed compliant clamp must also deformed in the limit of material; if this movement is over the limit of material, in plastic area, the mechanism will be failure. Therefore, the resulting stress of the mechanism must be lower than the yield strength of material. Besides, the

displacement is also the other aspect that should be considered in any compliant mechanisms because it is often limited in movement.

To obtain the desired motion of the proposed compliant clamp, the optimal design must determine the optimal size of flexural hinges. The first objective function is the maximizing the displacement of a proposed the mechanism. The second one is the minimizing the stress at the flexure hinges. These two objective functions are always in conflict with each other. To handle this conflicting issue of multi-criteria optimization, a fuzzy logic control based on the Taguchi method is discussed in this section.

4.1 FORMULATION OF THE MULTI-OBJECTIVE OPTIMIZATION PROBLEM

The aim of the design of a rectangular flexure hinges is to provide an alternative to a conventional rotary bearing with the same rotational motion function. However, a proposed flexure has drawbacks, such as limited displacement, and the high stress occurring at the flexural pivot. To solve existing issues and to determine the optimal design, the displacement must be maximized, and the stress must simultaneously be minimized. The optimal design problem for the suggested compliant clamp is formulated as follows:

Minimize the stress f_1 (l, w, h)

Maximize the displacement f_2 (l, w, h)

S.T. $f_1 \leq \sigma_y$ (1)

where l is the length, w is the width, and h is the thickness of flexure hinges, f_1 is considered as a function of stress that depends on l, w, h. f_2 is a function of displacement that depends on l, w, h. σ_y is yield strength of proposed material (25 MPa)

4.2 OPTIMAL PROCEDURE

In order to find optimal process parameter values based on a single quality characteristic, the Taguchi method is one of the most significant tools because it is an efficient experimental method, and only requires a small number of experiments to measure the quality and analysis of the optimal process. However, optimal results obtained using different quality characteristics always contradict each other. As a result, in an attempt to improve this contradictory problem, fuzzy logic combined with the Taguchi method (FLTM) was utilized in this paper to find the combination of process parameters that optimize the multi-response performance index (MRPI).

4.3 TAGUCHI METHOD

Taguchi method applications are concerned with the optimization of a single performance characteristic. The Taguchi method uses a special design of orthogonal arrays to study an entire parameter space with only a small number of experiments. The experimental results are then transformed into a signal-to-noise (S/N) ratio. The S/N ratio can be used to measure performance characteristics deviating from the desired values. Usually, there are three categories of the performance characteristics in the analysis of the S/N ratio: the lower-the-better, the higher-the-better and the nominal-the-better. In this study, an L_9 orthogonal array experiment was used because there are three parameters and three levels. To obtain optimal motion performance, the displacement of the proposed mechanism and the minimum stress at the flexible pivots are desired. Therefore, the higher-the-better displacement and the lower-the-better stress should be selected. After determining the orthogonal array experiment and the number of parameter levels, this research performs the calculation for the S/N of the displacement and the stress of the flexible hinges, as the following equations briefly describe:

The higher-the-better displacement is:

$$S/N_L = -10\log\left(\frac{1}{n}\sum_{i=1}^{n}\frac{1}{y_i^2}\right) \quad (2)$$

The lower-the-better stress is:

$$S/N_S = -10\log\left(\frac{1}{n}\sum_{i=1}^{n} y_i^2\right) \tag{3}$$

where y is the observed data.

To consider the two different performance characteristics in the Taguchi method, the S/N ratios corresponding to the displacement and stress at the fixed end of the flexure hinges are two inputs processed by the fuzzy logic control in order to find the optimal parameter values.

4.4 FUZZY LOGIC BASED ON TAGUCHI METHOD

Using fuzzy logic control, the optimization of multiple performance characteristics can be transformed into the optimization of a single performance index. Thus, the proposed method is the integration of fuzzy logic control with the Taguchi method; they are used to simultaneously achieve the optimization of multiple performance characteristics.

A fuzzy logic unit comprises a fuzzifier, membership functions, a fuzzy rule base, an inference engine and a defuzzifier. First, the fuzzifier uses member functions to fuzzify the signal-to-noise ratios. Next, the inference engine performs fuzzy reasoning on fuzzy rules to generate a fuzzy value. Finally, the defuzzifier converts the fuzzy value into a multi-response performance index. The structure of the two-input-one-output fuzzy logic is shown in Fig. 4. In the following, the concept of fuzzy reasoning is briefly described, based on the two-input-one-output fuzzy logic unit. The fuzzy rule base consists of a group of if-then control rules, with two inputs, x_1 and x_2, and one output, y.

In this paper, fuzzy logic reasoning combined with the Taguchi method is used to optimize multiple performance characteristics for the compliant clamp. An orthogonal array, the S/N ratio and MRPI are used to study the performance characteristics of this mechanism. Matlab 7.1 software is used to solve the roots of nonlinear equations and support for fuzzy logic reasoning. Regardless of the category of the performance characteristic, a larger S/N ratio corresponds to a better performance characteristic. As a result, the optimal level of the process parameters is the level with the highest S/N ratio. The loss function corresponding to each performance characteristic is fuzzified; then an MRPI is achieved through fuzzy reasoning using fuzzy rules.

The flow chart structure of the fuzzy logic controller coupled with the Taguchi method used in the study is shown in Fig. 5. Based on this figure, the optimization problem in this study is easily solved. It shows the procedure of the combined optimal method. At the beginning of the procedure, the given design variables as the thickness h, the width w, and the length l of a flexure hinge are assigned for an optimal process. Then, the allowed range of these parameters will be divided into three levels. Application of Taguchi method, this study selected an orthogonal array L_9 for arranging the experimental matrix. Next, continued work is the formulation of two objective functions; and calculating the S/N for these functions. Two S/Ns are inputs of fuzzy logic system. Based on fuzzy logic reasoning, MRPI or output of fuzzy logic system determined. After that, the mean of MRPI of each level is calculated.

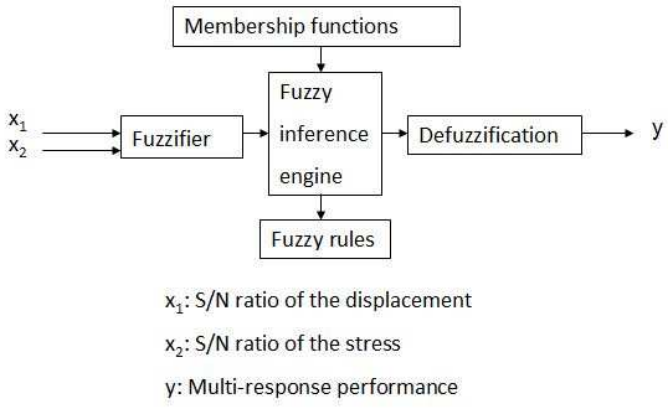


Fig. 4. Structure of the two-input-one-output fuzzy logic control

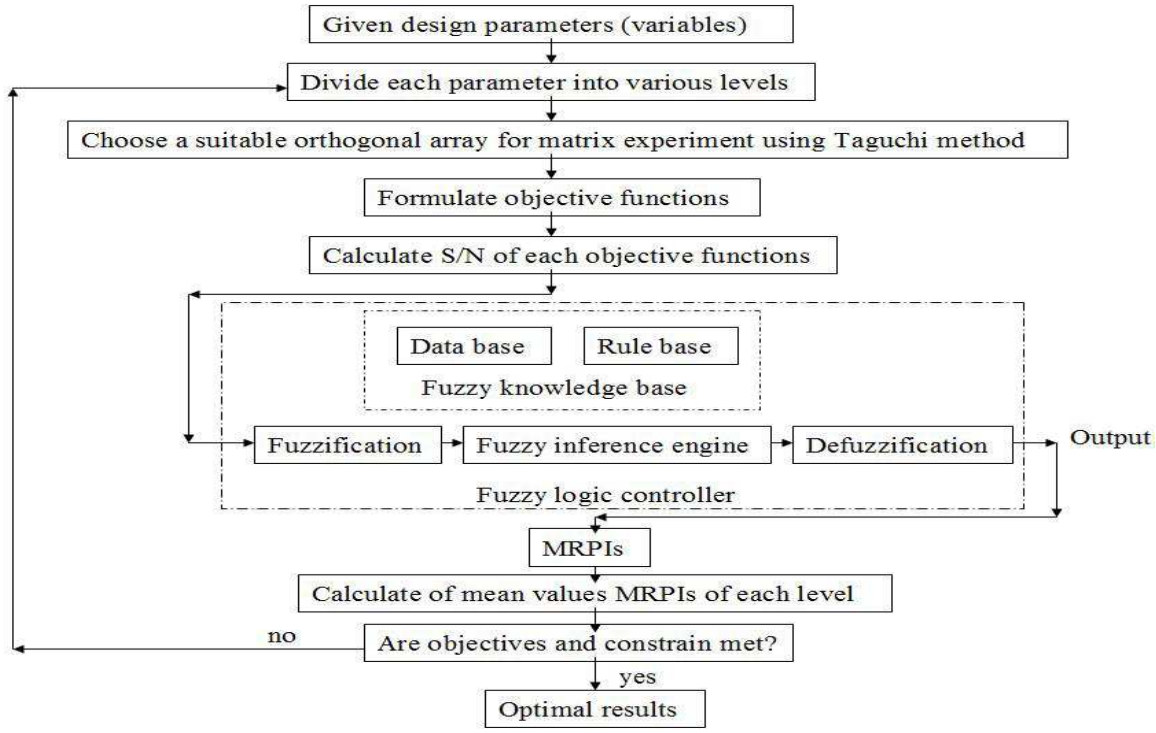


Fig. 5. Flow chart of an FLTM optimization procedure

5 RESULTS AND DISCUSSION

According to the flow chart in Fig. 5, an optimization process for the proposed mechanism is performed using FLTM. This research formulated nine fuzzy rules that are directly based on the fact that the larger the S/N ratio is, the better the performance characteristic in the fuzzy logic controller will be, as presented in Table 1.

The value of each of the process parameters was divided into three levels, as shown in Table 2. Based on the Taguchi method, the L_9 orthogonal array with nine experiments and detailed values of each level is given in Table 3. The higher-the-better displacement of a proposed hinge and the lower-the-better stress should be selected in this study. The results of the S/N ratio of the displacement, the S/N ratio for the stress, and the MRPI are calculated in Table 4. Next, the mean of the MRPI of the input parameters at each of their levels is calculated in Table 5, and shown in Fig. 6. Based on Fig. 6, optimal dimensions are the length level 2 of 15 mm, the width at level 2 of 6 mm, and the thickness at level 3 of 1 mm. The optimal stress is much less than the yield strength value of 25 MPa, which was satisfied constrain in Eq. (1).

Table 1. Fuzzy rules

MRPI		**S/N ratio of stress, $f_1(l,w,h)$**		
		Small	Medium	Large
S/N ratio of displacement $f_2(l,w,h)$	Small	Very small	Small	Medium
	Medium	Small	Medium	Large
	Large	Medium	Large	Very large

Table 2. The values of process parameters and their levels

Symbol	**Parameter**	**Range**	**Unit**	**Level 1**	**Level 2**	**Level 3**
M	**Length, *l***	10-20	mm	10	15	20
N	**Width, *w***	4-8	mm	4	6	8
P	**Thickness, *h***	0.4-1	mm	0.4	0.7	1

Table 3. Nine trials with detailed values

Motion parameters			
Experiment No.	**M, Length (*mm*)**	**N, Width (*mm*)**	**P, Thickness (*mm*)**
1	10	4	0.4
2	10	6	0.7
3	10	8	1
4	15	4	0.7
5	15	6	1
6	15	8	0.4
7	20	4	1
8	20	6	0.4
9	20	8	0.7

Table 4. Results for S/N ratio and the MRPI

Experiment No.	**Displacement along the y-axis, $f_1(l,w,h)$ (*mm*)**	**S/N ratio (dB) of $f_1(l,w,h)$**	**Stress, $f_2(l,w,h)$ (*MPa*)**	**S/N ratio (dB) of $f_2(l,w,h)$**	**Output of fuzzy logic controller**
1	0.60893	-4.3087	22.626	-27.0922	0.394
2	0.3376	-9.4320	10.429	-20.3649	0.439
3	0.26745	-11.4551	7.5235	-17.5284	0.5
4	0.0918	-20.7431	4.3546	-12.7790	0.447
5	0.0857	-21.3404	3.0205	-9.6016	0.532
6	1.472	3.3582	21.221	-26.5353	0.5
7	0.0296	-30.5742	1.721	-4.7156	0.5
8	0.739	-2.6271	17.264	-24.7428	0.438
9	0.30696	-10.2584	5.6238	-15.0006	0.5

Table 5. MRPI for input parameters

Symbol	**Input parameters**	**MRPI**			
		Level 1	**Level 2**	**Level 3**	**Max-Min**
M	**Length**	0.4	0.493	0.479	0.093
N	**Width**	0.447	0.470	0.5	0.053
P	**Thickness**	0.465	0.462	0.511	0.046
Total of MRPI = 0.469					

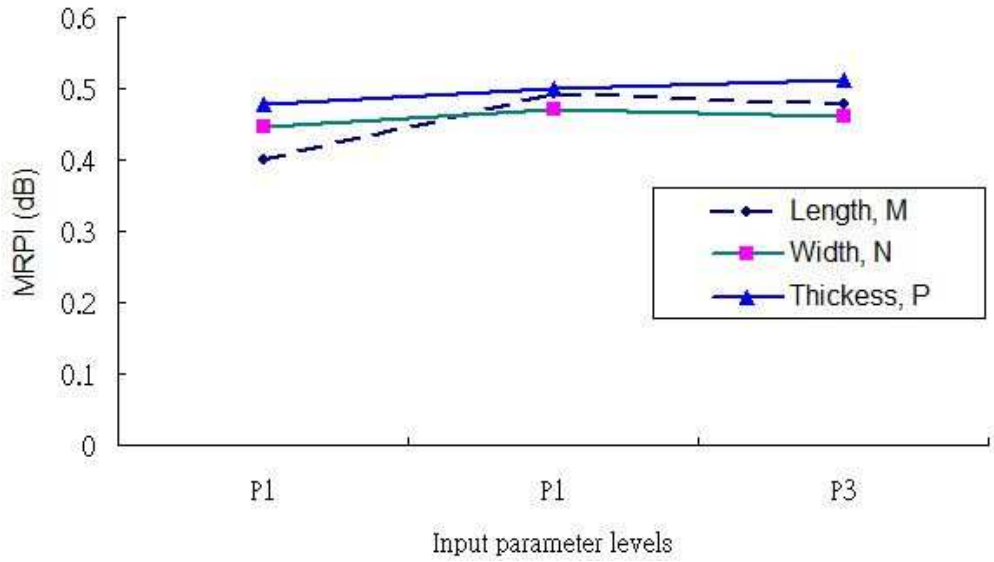


Fig. 6. Schematic diagram of the optimal parameters

6 CONCLUSION

This research presents the development and optimization of a novel flexible clamp mechanism. In this paper, a novel flexible clamp was designed via the use of the concept of compliant mechanism. And then multiple objective optimization problem of the mechanism was performed by using fuzzy logic reasoning combined with the Taguchi method. A FEA conducted on ANSYS software to explore the deformation state and stress distribution. It showed that the compliant clamp has the mechanical advantages better than the traditional clamp. As a result, the strength and mechanical advantage of proposed clamp was improved through the optimization of displacement and stress. Future work will conclude investigation into the thermal effects on the flexibility capacity of compliant clamp.

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REFERENCES

[1] T. Yoshikawa, “Control for grasping and manipulation,” Annual Reviews in Control, vol. 34, pp. 199–208, 2010.
[2] O.B. Kroemer, R. Detry , J. Piater , J. Peters, “Combining active learning and reactive control for robot grasping,” Robotics and Autonomous Systems, vol. 58, pp. 1105–1116, 2010.
[3] A. Faraz, S. Payandeh, A. Salvarinov, “Design of a force control grasper through stiness modulation for endosurgery: theoryand experiments,” Mechatronics, vol. 10, pp. 627–648, 2000.
[4] S.H. Hsiang, Y.W. Lin, J.W. Lai, “Application of fuzzy-based Taguchi method to the optimization of extrusion of magnesium alloy bicycle carriers,” J Intell Manuf, vol. 23, pp. 629–638, 2012.
[5] S.H. Hsiang, Y.W. Lin, and J.W. Lai, “Application of fuzzy-based Taguchi method to the optimization of extrusion of magnesium alloy bicycle carriers,” J Intell Manuf, vol. 23, pp. 629–638, 2012.
[6] Z. Luo, L. Chen, J. Yang, Y. Zhang, and K.A. Malek, “Compliant mechanism design using multi-objective topology optimization scheme of continuum structures,” Struct Multidisc Optim, vol. 30, pp. 142–154, 2005.
[7] S.C. Huang, C.C. Chiu, and W.L. Chen, “Design and fabrication of a microgripper with a topology optimal compliant mechanism,” Int. J. Computational Materials Science and Surface Engineering, vol. 2, Nos. ¾, pp. 282–301, 2009.
[8] M. Frecker, N. Kikuchi, and S. Kota, “Topology optimization of compliant mechanisms with multiple outputs,” Structural Optimization, vol. 17, pp. 269-278, 1999.

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L'Excellence dans la Revitalisation Urbaine. Une Mise en Valeur Architectonique des Marchés de plein air à Busan

[The Excellence in Urban Revitalization. An Architectonic Enhancement of Outdoor Street Markets in Busan]

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ABSTRACT: Busan is one of the most densely populated urban areas in South Korea. The tremendous pressure this megacity exacts on architecture in terms of urban revitalization promotes innovation. The purpose of this article is to explore the urban renewal in one particular aspect: the outdoor market in Busan. The development of South Korea, supported by a robust policy and reinforced by Chaebols, has resulted in a legacy of unattractive concrete. When the time has come to review, the Korean government has implemented a new and more influential policy with the aim of improving the economic vitality and preserving the Korean culture. Policymakers have not failed this time to follow the train of modernity and opted for sustainable architecture. Busan is a great city and it represents a laboratory ideally suited to this new policy. The strict criteria of sustainable design are fully respected in order to preserve the cultural heritage of Busan community. Two international examples, Mexico and Rouen, served as an inspiration for projects of Busan where outdoor markets represent nuclei of economic productivity and catalysts of social life. Market Jagalchi was in dire need of new ideas and a revitalization project was undertaken that we will study in detail.

KEYWORDS: Urban Revitalization, Outdoor Market, Local Economy, Sustainable Architecture, Dynamic City.

RESUME: Busan est l'une des villes urbaines les plus densément peuplées en Corée du Sud. La pression démesurée que cette mégapole exige sur l'architecture en termes de revitalisation urbaine favorise l'innovation. Le but de cet article est d'explorer le renouvellement urbain dans un aspect particulier : le marché de plein air à Busan. Le développement de la Corée porté par une politique forte et soutenu par les *Chaebols* a eu pour conséquences pour l'heure un héritage en béton disgracieux. Quand l'heure de la révision a sonné, les pouvoirs publics ont mis en place une nouvelle politique en Corée plus agressive visant le dynamisme économique et préservant la culture coréenne. Les décideurs n'ont pas manqué cette fois-ci de bondir dans le train de l'actualité et d'opter pour une architecture durable. Busan est une ville fantastique et représente un laboratoire parfaitement adapté à cette nouvelle politique. Les critères de conception durable stricte y sont parfaitement respectés afin de préserver l'héritage culturel de la communauté de Busan. Deux exemples internationaux, au Mexique et à Rouen, ont servi d'inspiration pour les projets de Busan où les marchés de plein air représentent des noyaux de productivité économique et des catalyseurs de la vie sociale. Le marché de Jagalchi avait grand besoin d'idées nouvelles et un projet de revitalisation a été entrepris que nous étudierons en détails.

MOTS-CLEFS: Revitalisation Urbaine, Marché de Plein Air, Economie Locale, Architecture Durable, Ville Dynamique.

Corresponding Author: Djamil Benghida

1 INTRODUCTION

L'architecte compose avec les éléments de l'environnement pour créer, façonner et construire des espaces de vie, tout en exploitant différemment les éléments de la nature. Ces créations architecturales peuvent être distinguées selon deux modes: les constructions temporaires; dont l'utilisation est limitée dans le temps, et les constructions permanentes, qui varient suivant la conception des infrastructures (le choix de l'espace, des matériaux, l'impact climatique, etc.). Dans le cas des projets de marchés, il est important de créer une structure robuste, facile à entretenir et avec un minimum de coûts.

L'architecte est l'artiste de l'organisation, c'est donc dans sa nature que l'architecte éprouvera le plus souvent le besoin de restructurer l'espace des marchés de plein air symbole du désordre urbain. Ce type de marchés revêt une importance capitale quant au tissu architectural et identitaire des villes d'autant plus que ces marchés de plein air jouent un rôle important dans la vie économique et sociale de la communauté. À ces objectifs professionnels s'ajoutent souvent des contraintes législatives et administratives destinées à réglementer l'exploitation des espaces publics.

La plupart des recherches réalisées sur les marchés de plein air ont été développées au travers du prisme de l'étude urbanistique, économique voire même touristique. Le versant architectural semble être systématiquement délaissé. Au-delà de l'aspect fonctionnel et urbanistique du marché, l'aspect formel constitue une architecture invisible qui n'est pas pris en considération par les études urbanistiques contemporaines pour lesquels la forme de ce type de marché est sans intérêt.

L'objectif principal de cet article est d'analyser le cas du renouvellement urbain dans la ville de Busan en citant des exemples concrets de marchés de plein air. Selon nous, l'intervention sur la revitalisation urbaine des marchés de la ville de Busan va non seulement créer une atmosphère qui encourage l'activité piétonnière mais va aussi rendre le quartier plus prospère et plus dynamique et va renforcer la communauté dans son ensemble.

Il faut, de prime abord, apporter certaines clarifications à notre terminologie trop souvent contaminée par des glissements sémantiques, car pouvant induire en erreur toute personne qui s'intéresse aux marchés de plein air. Le marché de plein air est la déviation d'une rue ou d'une allée de sa fonction classique vers une activité économique et commerciale durant une période donnée qui peut être un jour par semaine par exemple. Il s'agit d'une variante du Souk qui est le marché de plein air connu dans les pays arabes et qui se distingue de notre cas d'étude par le fait qu'il soit localisé dans une place publique souvent dédiée à cet effet. Ce lien à la rue qui caractérise les marchés de plein air est plus évident dans l'appellation anglaise « *Open-Air Street Market* ».

2 LE DÉVELOPPEMENT FULGURANT DE LA CORÉE

Grâce à une politique déterminée de réorientation stratégique avec une nette percée des exportations, la Corée s'est imposée dans de nombreux secteurs comme l'agriculture, la pêche et l'industrie textile. Une croissance auto-entretenue, dès les années 70 a conduit au développement du pays. Cette économie se classe, de nos jours, parmi les trente premières au monde. La croissance économique de la Corée a permis, outre une industrialisation rapide, une urbanisation importante du pays, en raison de la stratégie de «pôles de croissances» que le gouvernement Coréen a adopté dès les années 60 [1]. D'imposantes constructions en béton armé s'élevaient à travers le pays sans aucun égard au style architectural ou du patrimoine architectonique, mais focalisées uniquement sur l'aspect fonctionnel du cadre bâti [2].

En 1950, le nombre total de la population coréenne était de 18.8 million, avec une croissance démographique importante. Ce chiffre avoisine les 50 millions en 2013 [3]. Cette croissance a eu pour corollaire, de nombreux problèmes urbains, notamment la pénurie de logements accessibles aux travailleurs à faible revenu et dont l'importance s'est amplifiée suite à l'exode rurale. Le président Kim Young Sam en 1993 a appelé chaque Coréen à saisir la dernière chance de moderniser le pays. Des firmes coréennes performantes, connues sous le nom de *Chaebols* (correspondant à des clans financiers contrôlés par les familles fondatrices), se sont aussitôt identifiées comme de véritables fers de lance de cette quête de la modernité et ont été les véritables artisans du miracle coréen [4]. En 2007, la Corée se classait au treizième rang mondial des pays selon leur produit intérieur brut (PIB).

Ce progrès devrait, selon nous, se poursuivre avec l'ouverture des marchés coréens à divers collaborateurs étrangers qui y voient une opportunité unique puisque la Corée est considérée comme la « porte d'entrée vers les pays de l'Asie de l'est » [5].

3 POLITIQUE D'URBANISATION EN CORÉE

Jusqu'aux années 70, un tiers de la population Coréenne a vécu dans des bidonvilles, mais la situation a changé au rythme de l'industrialisation du pays. La croissance économique est une « révolution tranquille» ; une appellation utilisée la première fois pour décrire la période de changements socio-politiques vécus au Québec dans les années 60.

À l'image de certaines capitales européennes gangrénées par le béton, les villes ont connu une croissance exponentielle et une expansion tentaculaire qui rapidement a étouffé les coréens jaloux de leur identité et de leur culture qui tend à disparaître sous le poids du béton.

L'objectif prioritaire, et louable admettons le, du gouvernement coréen durant cette période était de construire des logements le plus rapidement possible, toutefois pour des raisons de coûts, les projets entrepris ont sciemment négligé les espaces verts, les espaces publics et l'aspect esthétique de l'architecture. La réhabilitation urbaine et durable durant cette période consistait en l'élimination des constructions illicites ou insalubres par de nouvelles constructions qui respectent les normes internationales de l'habitat.

Depuis les années 90, un nouveau concept de développement durable a vu le jour axé autour du respect de l'environnement. En 2010, le Ministre des terres, des transports et des affaires maritimes (Division logement de réaménagement), a validé un projet de loi (n. 02-2110-8270) concernant la promotion de la rénovation urbaine [6]. Selon l'article 1 de cette loi, le but est de promouvoir un développement urbain équilibré et de contribuer à l'amélioration de la qualité de vie de la population et la mise en œuvre de projets pour l'amélioration de l'environnement résidentiel, l'expansion des infrastructures, et la récupération des fonctions urbaines dans les zones urbaines défavorisées. Par ailleurs, l'article 2, paragraphe 2, section c, définit les marchés traditionnels comme « *objectif de promotion de la régénération à prendre en considération dans la régénération de la promotion du district* ».

4 LE CAS DE LA VILLE DE BUSAN

Busan est la seconde ville coréenne en termes d'activité commerciale. Située au Sud-Est du pays, sa création remonte à quatre siècles avant notre ère. Ville portuaire par excellence, le port de Busan est au dixième rang mondial en termes de trafic portuaire. La ville de Busan est également célèbre par ses attractions touristiques, ses sites historiques, ses sites culturelles et bien-sûr par son poisson frais. Avec une population de plus de 3.6 million, les marchés de plein air y sont nombreux. Les sites de Jagalchi et de Gukje, au cœur de Busan, sont des lieux de convivialité et contribuent au dynamisme économique des quartiers avoisinants.

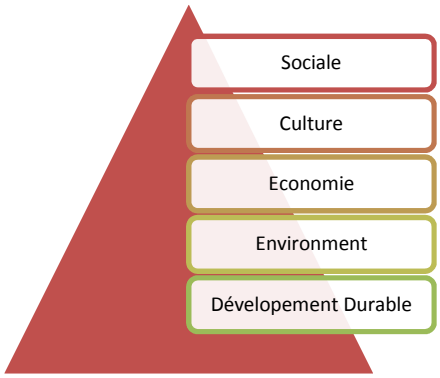
Les cinq principaux marchés de plein air busanais sont répertoriés dans le tableau 1:

Tableau 1 : Principaux marchés de plein air de la ville Busan. (Source : Auteur)

Nom	Lieu	Creation	Ouverture	Horaire	Parking	Type
Jagalchi	Nampo dong	1922	Tous les jours	08 :00 / 22 :00	Oui	Fruits de mer
Kukje	Sinchang dong	1945	Sauf le troisième dimanche du mois	09:30 / 19:30	Non	Divers
Bupyeong	Bupeyong dong	1910	Tous les jours	18 :00 / 24 :00	Non	Divers
Bosu	Bosu dong	1950	Sauf le troisième dimanche du mois	11:00 / 20:00	Non	Vieux livres
Gijang	Gijangeup	1944	Tous les jours	24/24	Non	Fruits de mer

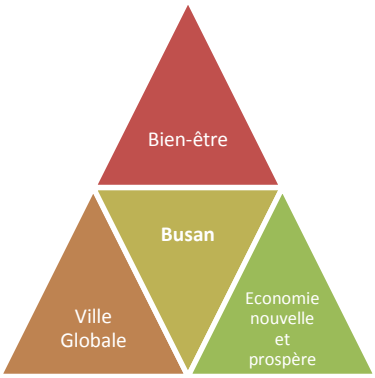
Busan, la ville qui ne cesse de s'accroître, est un hub économique crucial en Asie du Nord-Est. Le Dr Hur Nam-sik, est maire de la ville de Busan depuis 2004, travaillant sans relâche pour rentrer Busan dans le top 10 des villes mondiales. Ses objectifs ambitieux peuvent être schématisés selon trois grands axes principaux (diagramme 1): l'économie, l'environnement et la culture. Cette dernière étant intimement liée à l'héritage social et historique du peuple coréen.

Diag. 1. Les axes principaux du Maire de Busan. *(Source : Auteur)*



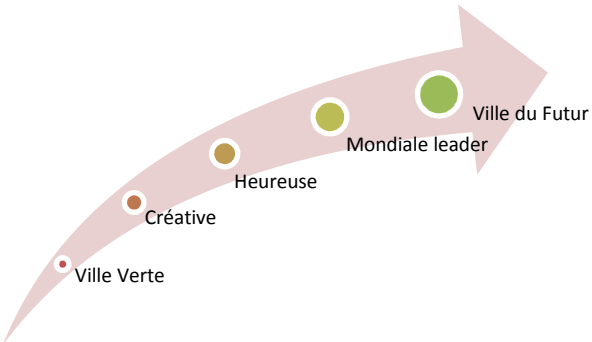
Des initiatives stratégiques intéressantes sont en train d'être élaborées au sein même de la ville de Busan. Ces initiatives respectent trois principes fondateurs que sont le bien-être des citoyens de la ville de Busan, le respect de la dimension de ville globale que mérite amplement Busan et enfin l'apport de nouvelles filières économiques garantissant la prospérité (diagramme 2.).

Diag. 2. Principes fondateurs des initiatives à Busan. *(Source : Auteur)*



Des exigences modernes dans l'élaboration de projets colossaux sont en réalité assez simples puisqu'ils incluent la dimension humaine de la ville avec ses besoins écologiques et la vision tournée vers le monde de cette ville florissante (diagramme 3).

Diag. 3. Les dimensions de la ville du futur. *(Source : Auteur)*



5 LE TOURNANT DE L'ARCHITECTURE DURABLE

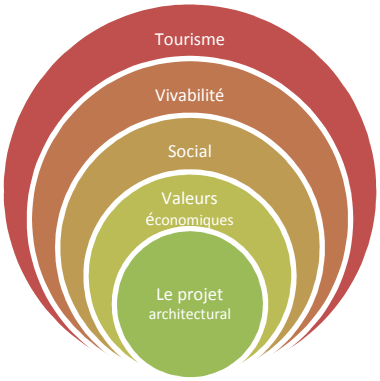
Le concept d'une ville du futur comporte des objectifs sociaux, environnementaux, politiques et culturels, ainsi que physiques et économiques. Il s'agit d'un organisme dynamique aussi complexe que la société elle-même et assez sensible pour réagir rapidement aux changements de Busan, la ville du futur, une ville aux multiples facettes (tableau 2)

Tableau 2 : Conception de Busan comme ville écologiste futuriste. (Source : Auteur)

Busan	est une ville où la justice, la nourriture, le logement, l'éducation, la santé et l'espérance sont équitablement répartis et où tout le monde (population) participe au développement;
Esthétique	l'art, l'architecture et le paysage stimulant l'imagination et l'esprit;
Créativité	l'ouverture d'esprit et d'expérimentation mobilise pleinement le potentiel de ses ressources humaines et permet une réponse rapide au changement;
Ville écologique	minimise son impact écologique. Où le paysage et la forme bâtie sont équilibrés et où les bâtiments et les infrastructures sont économes en ressources naturelles;
Mobilité	l'information est échangée en face-à-face et par voie électronique.
Compact et polycentrique	qui protège la campagne, se concentre et intègre les communautés dans les quartiers et maximise proximité;
Diversité	où un large éventail d'activités qui se chevauchent crée l'animation, de l'inspiration et favorise la vie publique.

La conception de projets architecturaux a changé substantiellement depuis les dernières décennies. L'architecte conçoit des projets de villes du futur en portant la casquette de designer, paysagiste, urbaniste, ergonome, etc. Le projet qu'il conçoit doit prendre en considération de nombreux facteurs sociaux, touristiques, économiques et de vivabilité (diagramme 4).

Diag. 4. Les facteurs liés au projet architectural. *(Source : Auteur)*



Les critères de conception peuvent schématiquement être listés comme suit :

- ✓ La conception aspire à réinventer la rue et correspond à la créativité.
- ✓ La conception est modulaire, dans le sens où une unité peut se multiplier, pour offrir la flexibilité à l'échelle en fonction de l'espace: la fluidité et la plasticité de l'espace sont les principales caractéristiques.
- ✓ La conception prend égard des matériaux qui seront utilisés et leur impact sur l'environnement: le critère de qualité est donc essentiel.

Les avantages économiques et les retombées financières de telles initiatives sont essentiels. Une stratégie réussie peut créer de nouveaux emplois et stimuler la croissance économique tout en répondant aux besoins du secteur public tel que le tourisme. Le développement du marketing des marchés de plein air présente un effet direct sur le commerce de détail. L'industrie de détail a commencé à reconnaître la culture comme un outil d'attraction d'une éventuelle clientèle.

Développer une économie de marché de plein-air peut avoir des retombées économiques sur toute la région à long terme ce qui entrainera des revenus réguliers pour toute la ville, cet impact financier peut être maximisé localement et régionalement par le biais des fournisseurs et sous-traitants locaux comme les restaurants, les hôtels et les transports.

La culture et le développement social vont de pair et peuvent bénéficier de l'injection de la vie dans ces espaces micro-urbains régénérés et donner aux gens une meilleure image de leur quartier mais aussi donner/ou récupérer une identité architecturale à une ville comme Busan.

La régénération des espaces urbains (marché de plein air) joue un rôle clé dans la cohésion de la communauté et le tissage des liens forts au sein de plusieurs quartier, c'est une conception inclusive qui a pour but tous les groupes sociaux de la ville, en outre, des activités créatives peuvent engager et inclure les personnes avec un handicap ou âgées.

S'agissant des avantages environnementaux ou physiques, cette régénération urbaine relie le vernaculaire avec le contemporain dans un nouveau cadre de l'aménagement urbain, et fournit une base intéressante pour la participation des citoyens, et ainsi favorise le marché de plein air comme une destination de patrimoine culturel et industriel, et initie la formation des compétences et de nouveaux emplois dans le patrimoine et le secteur touristique.

La ville de Busan peut utiliser avec succès ce patrimoine et le développer comme une marque unique et ainsi générer des emplois supplémentaires. Les marchés de plein air sont une occasion unique de combiner la richesse du patrimoine avec la culture et l'engagement communautaire. En investissant dans la création d'espaces attractifs, la ville de Busan va attirer et retenir les entreprises.

La transformation physique a peut-être besoin d'être accompagnée par un changement symbolique. Beaucoup de zones défavorisées et délabrés à Busan souffrent d'une image désuète et d'une mauvaise réputation, et sont associés à un déclin économique et ses conséquences sociales.

D'une manière générale, la stigmatisation peut endommager les perspectives d'emploi des résidents locaux, saper la confiance locale et l'estime de soi, décourager l'investissement privé dans le logement et le développement économique, et décourager les visiteurs et les autres groupes ayant un pouvoir d'achat qui pourraient aider à la relance économique. La raison pour laquelle les efforts pour améliorer l'image locale, améliorer l'environnement naturel, modifier les perceptions extérieures et redéfinir l'espace d'une manière plus positive, peut être un élément essentiel d'une vaste stratégie de régénération.

La stratégie communautaire durable est identifiée comme étant l'amélioration de l'image aux touristes, est une question clé à Busan. Les améliorations des attractions du patrimoine et de l'environnement peuvent faire la ville de Busan un centre régional pour l'économie du tourisme. Un objectif clé de la stratégie est: «Stimuler la culture et les loisirs: activités culturelles, promotion de la créativité et à accroître les possibilités pour les gens de découvrir des activités récréatifs de haute qualité. » (diagramme 5).

Diag. 5. Les dimensions de l împact économique de l´architecture durable. *(Source : Auteur)*



6 EXEMPLES DE DÉVELOPPEMENT URBAIN

Le renouvellement urbain désigne non seulement le recyclage urbain dans leur dimension architecturale, mais aussi parfois un phénomène plus limité de revitalisation de quartiers existants sans avoir recours pour autant à la démolition.

Le défi qui se présente aux architectes dans ce genre d'exercice est de réussir à intégrer leurs idées de régénération urbaine tout en préservant l'âme et le caractère typique de la zone du projet, et en déclenchant une cascade de conséquences positives au niveau économique, social, culturel, écologique et physique.

Nous aborderons dans cet exposé le cas de deux exemples réussis sur deux sites différents, l'un en France, et l'autre au Mexique, et qui se sont révélés comme opportunités pour reconquérir l'espace et le transformer en un territoire plus stratégique qui a donné lieu à deux modèles urbains fort intéressants.

Le premier modèle se trouve en France, il s'agit de l'église Jeanne d'Arc et la place du vieux-marché dans la ville de Rouen (figure 1 et figure 2).

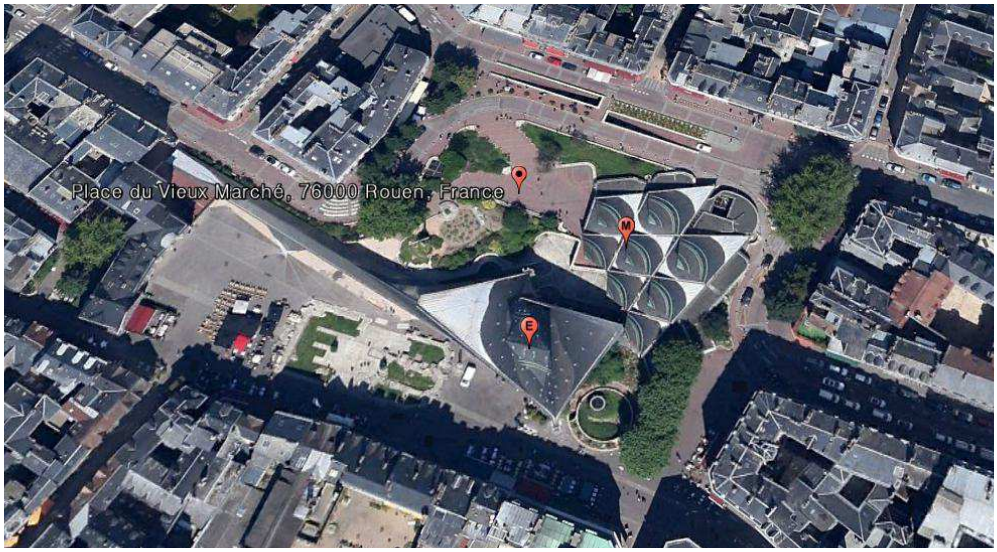


Fig. 1. Vue aérienne de l´église Jeanne d´Arc (E) et du vieux marché adjacent (M). *(Source: Google earth)*



Fig. 2. Photo de l´église Jeanne d´Arc et du vieux marché adjacent. *(Source: Flickr)*

L'architecte Louis Arretche a conçu la nouvelle église de Jeanne d'Arc en 1979 sur l'ancien site d'une église qui se trouvait au centre-ville de Rouen, en Haute-Normandie. L'architecte a vu son œuvre reconnue puisqu'il a été désigné lauréat du concours grâce à l'hybridité de sa conception ingénieuse; l'architecte a donné une forme architectonique particulière à la toiture non seulement en lui donnant une forme qui évoque le casque de l'armure de Jeanne d'Arc, mais aussi en créant une extension de cette même toiture pour intégrer la place du vieux-marché (marché de plein air) qui se présente sous la forme d'une extension de l'église. L'architecte a pu valoriser ainsi deux entités, l'église et le marché de plein air, en toute convivialité créant une cohésion urbaine au bénéfice des vendeurs, des habitants et des touristes. Un espace urbain a vu le jour invitant à la fois à l'échange, à la socialisation, au repos, à la promenade, etc.

La revitalisation de cette zone de commerce et de ce lieu de culte limitrophe a répondu avant tout à un enjeu essentiel du développement durable quant à sa performance au niveau de l'économie, de l'environnement et du le fonctionnement de la ville en général.

Le second projet au Mexique a été construit plus récemment, en 2011 : le renouvellement du Malecón de Puerto Vallarta. Le projet a été désigné lauréat dans le concours de rénovation urbaine dans le centre-ville, parmi les seize projets proposés. Ce projet a valu le titre du Meilleur projet de design urbain à « la XII Biennale d'architecture mexicaine 2012 » qui s'est tenue dans la ville de Durango.

Situé dans le centre historique de Puerto Vallarta, sur le bord du quai de 870 mètres en longueur qui débute de la Plaza Pescadores et qui s'étend tout le long du chemin de la Plaza de Armas, le Malecón est, aujourd'hui, une icône emblématique de la ville offrant une vue magnifique sur la baie et attirant les touristes vers une grande variété de restaurants, de bars, de galeries d'art, de bijouteries, de boutiques. Plus de dix-sept sculptures et autres attraits qui en font un lieu de prédilection pour les visiteurs et les habitants ceinturent ce lieu exceptionnel (figure 3).



Fig. 3. Le renouvellement du Malecón de Puerto Vallarta. *(Source : Agraz Arquitectos)*

Ce qui rend ce projet intéressant pour notre cadre d'étude, c'est l'utilisation d'infrastructures métallique et textile, nommée « structure tendue » ou « structure à câble ». Il s'agit d'une structure légère qui a la forme d'un voile aéré offrant un confort optimal, présentant l'avantage notable de la facilité et de la rapidité de construction, et utilisant des matériaux de construction inaltérables.

Ces deux exemples réussis en France et au Mexique, et ces deux structures de protection, furent les ancêtres d'un nouveau concept plus audacieux proposant des toitures en toile imaginées par la société *XpecteDesign*, font basculer les concepts de design durable dans une nouvelle ère de la régénération urbaine contemporaine à Busan et contribuer ainsi à la prospérité de cette ville tant sur le plan économique que sur le plan social et la qualité de vie. Busan grâce à cette voie empruntée, cramponnée à son passé, définitivement tournée vers son avenir, renforce sa compétitivité face à un monde en profonde mutation.

7 LE MARCHÉ DE PLEIN AIR

Le marché de plein air n'est pas bien connu puisqu'il est souvent confondu avec le souk ou le bazar. Il nous paraît donc pertinent de passer en revue un certain nombre de caractéristiques des différents lieux de commerce apparentés au marché de plein air afin de les différencier comme résumé dans le tableau 3.

Tableau 3 : les caractéristiques des marchés de plein air. *(Source : Auteur)*

Type	Definition	Structure	Lieu
Marché de plein air/Ouvert	Lieu public de vente et d'achats de biens et de marchandises à l'air libre.	Temporaire	Rue Place
Marché couvert	Marché local destiné à la vente des produits locaux.	Permanente	Bâti
Bazar	Marché de détail dans les villes perses.	Permanente	Bâti
Souk	Marché dans les villes arabes.	Permanente	Place
Marché aux puces	Marché de détail exclusivement d'articles de récupération (objets usagées).	Temporaire	Rue
Marché forain	Marché de détail mobile, qui n'est pas du lieu.	Temporaire	Rue Place
Passage/Gallerie	Éspace commercial urbain entre deux immeubles couvert et piétonnier.	Permanente (verre et acier)	Rue Place

Pour se positionner comme étant un pôle attractif, le marché de plein air, en plus de la spécificité du produit vendu, doit être visible. En effet, sans aucune structure architectonique il n'a jamais eu l'opportunité d'être mis en valeur et d'être défini comme un élément architectural dans le tissu urbain. A l'intérieur même du marché on y trouve des aires de circulation des piétons qui attirent le public et encouragent celui ci à s'y adonner à plusieurs activités dynamiques[7].Le marché de plein air peut être composé de bancs d'expositions des marchands et souvent de parasols aux couleurs et aux formes aléatoires. Le marché est un lieu public de vente et d'achat de biens, de marchandises, de fruits, légumes frais, ou de poisons ; il peut être couvert ou non-couvert et peut se situer dans une place publique ou sur une voie entre deux immeubles.

L'inscription des marchés sur la liste du patrimoine mondial de l'Unesco a apporté à la ville de Carcassonne une rentabilité touristique quadruple, par la majoration de la fréquentation touristique. Cette augmentation de fréquentation touristique est tributaire du label Unesco, mais aussi et surtout à la visibilité des sites.

Plus qu'un simple endroit pour acheter des fruits frais, des légumes et du poisson, les marchés de plein air peuvent être des moteurs hautement efficaces pour le développement économique et de la régénération urbaine.

Le marché de plein air a joué un rôle très important dans les villes européennes, non seulement économiquement, mais aussi en termes de développement social, environnement, planification, tourisme et développement communautaire. C'est cette "image globale", en termes d'externalités positives que les marchés ont lié les villes entre elles, et ont favorisé le développement durable de la ville du futur.

Selon une étude anthropologique et économique faite aux États Unis en 1995, concernant le marché de plein air Maxwell à Chicago [8], le marché pointe un certain nombre d'avantages tels que la création d'emploi familiaux, et des avantages pour les consommateurs (produits frais et abordables), sur le plan social, le marché de plein air participerait à l'absorption de la délinquance par les possibilités de travail qu'il offre. Ainsi, il n'y a que des bénéfices touristiques supplémentaires notamment pour les sites historiques.assure ainsi le maintien des traditions historique.

L'inscription à la liste de l'Unesco n'est toutefois pas obligatoire pour rendre un site touristique. Ce qui rend un site touristique attrayant, c'est sa visibilité : les marchés de plein air à Busan, sont déjà visibles par tout le monde avec plus d'une centaine de marchés à travers toute la ville mais qui ne sont visibles qu'à travers des photos de produits vendus; généralement du poisson dans le cas de Jagalchi, mais sont invisibles du point de vue strictement architectural.

8 EXEMPLE CONCRET: LE PROJET DU MARCHÉ DE JAGALCHI

Célèbre marché de fruits de mer, qui a été crée en 1945, le marché de *Jagalchi* est situé dans le quartier de Nampo-dong à Jung-gu, *Jagalchi Fish Market* à Busan est le plus grand marché aux poissons de Corée du Sud.

Ce marché est situé à proximité du port Nampo (figure 3), ce qui facilite la livraison du poisson aux vendeurs. Les femmes âgées sont majoritaires parmi le personnel y travaillant, les hommes se trouvent traditionnellement au large pour la pêche. Véritable attraction touristique avec, cerise sur le gâteau, une disponibilité de plusieurs restaurants.



Fig. 3. Marché de Jagalchi. *(Source : Google earth)*

L'institut de développement de la ville de Busan (*Busan Development Institute : BDI*) a engagé une démarche originale : un concours international d'idées pour l'amélioration de la vivabilité de la ville dans les domaines suivants (tableau 4):

Tableau 4. La vivabilite de la ville de Busan. *(Source : Busan Development Institute)*

Champ	Description
Économie et industrie	Promouvoir le développement de l'activité économique et de l'industrie innovatrice.
Tourisme et culture	Développement des ressources, des infrastructures touristiques et culturelles.
Espace urbain	Développement urbain et des projets d'aménagements de zones industrielles défavorisées.
Bien-être social	Initiatives politiques et infrastructures.
Autres	Législations et réglementations.

9 DESCRIPTIF DU PROJET VAINQUEUR

La genèse de l'idée centrale de la conception du marché de Jagalchi est née du besoin de la ville de concepts innovants axés autour de l'architecture durable d'une part, et de l'observation de projets innovants passés à travers le monde qui ont offert une singularité et une ingéniosité particulière.

Le prix d'excellence fut décerné à l'agence de Design et D'Architecture Italienne *XpecteDesign* pour leur proposition créative qui répond parfaitement aux exigences des autorités locales concernant les trois questions urgentes dans les cinq prochaines années (figure 3).

Le projet en question permet de créer une symbiose entre le passé, le présent et le futur, avec une certaine ingéniosité, non seulement par la redéfinition des marchés de plein air traditionnels dans la ville, mais aussi par la revitalisation de l'identité architecturale locale avec les nouvelles technologies de construction dans une perspective durable et low-cost.

L'idée était de créer un espace extérieur avec une structure temporaire, mobile est légère dont le résultat se traduira par un paysage spatial, géométriquement homogène qui permet le bon fonctionnement des activités quotidiennes des commerçants tout en liant ceux-ci avec les usagers et les touristes.

Nous tâcherons de décortiquer brièvement les différentes composantes de ce projet.

Le point de départ a été certainement la compréhension du mode de vie des citoyens de Busan chez qui le marché de plein air constitue une composante de la société. Ces espaces fortement achalandés constituent un véritable kaléidoscope de couleurs, de sons et de senteurs et où les citoyens de Busan excellent dans l'art de la négociation. Il n'est pas surprenant de voir ce type de marché, quasi patrimoine culturel coréen, parsemés dans les quatre coins de la ville.

La seconde particularité de ce projet, malgré qu'il puisse être généralisé à n'importe quel marché de plein air, c'est qu'il a été pensé pour le marché de *Jagalchi* spécifiquement. Le but ayant été de rendre l'endroit homogène, fonctionnel et lui attribuer un caractère distinctif afin de mieux représenter les ambitions urbaines de la ville de Busan. L'aspect esthétique du site devait représenter l'âme du vieux Busan afin d'en amplifier la valeur.

En ce qui a trait aux modalités de la réalisation, la seule contrainte que le designer s'est imposé est de respecter le site et de ne pas le dénaturer, tant au moment de la conception même que au moment de la mise en place du marché et de sa fermeture. Il n'est pas rare de voir à travers le monde des sites de marché de plein air où la circulation est impossible, et qui laissent place à une scène de désolation le soir venu avec des déchets amassés en petits monticules dans le coin de la rue. La ville de Busan ne pouvait supporter un tel traitement. L'idée était donc de mettre en place des structures amovibles susceptibles d'être installées et enlevées en moins de trois heures.

Ces structures en toile résistante et en métal, dont la forme est généreusement inspirée du modèle floral Corolle, répondent parfaitement à ces exigences. Les modèles en toile existent de façon abondante à Busan, le but de ce projet est donc de les rendre homogènes en leur offrant un design de qualité mais qui doivent être accessibles aux petits commerçants et préfabriqués et qui seront assemblés et désassemblés selon le besoin.

Les avantages de ces concepts peuvent être énumérés comme suit:

- ✓ Amélioration de l'aspect esthétique de la place de ce marché.
- ✓ Offrir une protection contre les éléments de la nature pour ce marché spécialisé dans la vente de poisson, marchandise particulièrement périssable.
- ✓ Respect du site où aucune transformation n'est nécessaire par des structures faciles à monter et à démonter.
- ✓ Conception d'unités « Florales » pouvant être placées dans n'importe quel endroit.
- ✓ Faible coût du design qui serait estimé entre $20.000 et $35.000 USD.
- ✓ Redynamisation de l'économie du quartier.

10 CONCLUSION

L'intervention sur la revitalisation urbaine des marchés de la ville de Busan s'inscrit dans une politique urbaine sociale et une politique de développement urbain qui touche différents domaines économiques, culturels, sociologiques, environnementales, techniques, architecturales, etc.

Les architectes ou les urbanistes font souvent face à une décision mue par des valeurs culturelles, des valeurs politiques, des valeurs économiques et enfin des valeurs esthétiques dans le but de donner forme à l'environnement physique. Afin de répondre au mieux aux nécessités d'un lieu, ce processus a besoin avant tout de la combinaison de l'expertise et du savoir-faire de plusieurs professionnels du milieu urbain; architectes et urbanistes pour la plupart, mais aussi constructeurs, graphistes, sociologues, artistes, paysagistes, etc. Dans le cas des marchés de plein air de Busan, visiblement, l'urbaniste s'est concentré sur la fonction urbaine des lieux en termes de vie sociale et d'activités économiques, rendant ainsi nécessaire l'expertise de l'architecte qui peut enrichir davantage les dimensions physiques et esthétiques. Comme le dit si bien Léonard De Vinci : «Les détails font la perfection, la perfection n'est pas un détail». L'architecte se voit, de nouveau, investi de sa noble mission d'offrir une cure de jouvence aux villes du monde. Busan, à l'image de la Corée grandissante et flamboyante de mille feux, a souffert des errances en termes de politique d'urbanisation.

Le Plan d'action de la ville de Busan que ces professionnels du milieu urbain ont besoin de relever mène, à notre avis, à trois grands défis étroitement liés les uns aux autres. Le premier défi est de définir le potentiel du marché de plein air pour contribuer à améliorer la compétitivité économique et l'emploi afin d'améliorer le capital humain et social, et de valoriser l'environnement urbain et les infrastructures. Le deuxième défi est la nécessité d'encourager une panoplie d'actions au sein du marché de plein air, comme une zone urbaine bien déterminée, afin d'accélérer un processus décisionnel innovateur

entre les urbanistes et les architectes. Le troisième défi est de rendre les marchés de plein air plus durables sans pour autant imposer des coûts élevés pour leur développement urbain.

Les standards ayant changé, la Corée prend le train de la modernité en adoptant en politique de renouvellement urbain axé autour de l'architecture durable à coûts minimes.

La société *XpecteDesign* a réussi, s'inspirant des expériences mondiales à créer un concept qui trouvera facilement sa place dans tous les marchés de plein air à travers le monde. Ma connaissance de ce peuple travailleur me laisse présager pour l'avenir architectural de ce pays, des lendemains florissants, loin de la démesure des projets pharaoniques, une culture coréenne pour une architecture durable, fonctionnelle est abordable prendra racine dans la ville de Busan.

L'amélioration des marchés de plein air à Busan est un enjeu capital, les ajustements architecturaux, associés à un esprit visionnaire qui anime cette ville et qui la fera bondir de plein pied dans une véritable renaissance urbaine. Le bon goût architectural croise l'esprit cartésien fonctionnaliste asiatique dans cette ville.

REFERENCES

[1] Lee (Jong Youl), "The Practice of Urban Renewal in Seoul, Korea: Mode, Governance, and Sustainability". 2nd International Critical Geography Conference. Kyungil University, Taegu, 2000. En ligne à: http://econgeog.misc.hit-u.ac.jp/icgg/intl_mtgs/JYLee.PDF (05/12/2013)

[2] Johnstone (Michael), "Is Seoul An Ugly City? Urban Planning in Korea's Capital", in The Asian Persuasion, publié le 9 Avril 2013. En ligne à: theasianpersuasion.org/articles-about-korea/expat-life-in-korea/is-seoul-an-ugly-city-urban-planning-in-koreas-capital (21/05/2013)

[3] Rüdiger (Frank), Hoare (James E.), Köllner (Patrick) and Pares (Susan), Korea 2013: Politics, Economy, and Society (Korea yearbook), vol. 7, Koninklijke Brill NV, Leiden, Netherlands, 2013.

[4] Mahon (James-E.),"Stratégies d'industrialisation : une comparaison entre l'Amérique latine et l'Asie du Sud-Est", Problèmes économiques, n° 2299, 1992.

[5] Cornu (Gérard), Le Cam (Gérard), Maurey (Hervé), Nicoux (Renée), "La Corée du Sud : richesse d'un pays développé, dynamisme d'un pays émergent". Rapport d'information n°388 (2011-2012). Rapport d'information. Sénat. France. 2012.

[6] Ministry of Government Legislation, Korean Laws, 2010. En ligne à: www.moleg.go.kr/english/korLawEng?pstSeq=52776&rctPstCnt=3&searchCondition=AllButCsfCd&searchKeyword=urban (21/05/2013)

[7] Nam (Yu Jung), Revitalizing and Reinvinting of the Diminishing Public Sphere: The Namdaemun Market District in Seoul, Korea, MA thesis, Massachussetts Insttitute of Technology : USA, 2013

[8] Morales (Alfonso), Balkin (Steven), Persky (Joseph), "The Value of Benefits of a Public Street Market: The Case of Maxwell Street", Sage, Economic Development Quaterly, vol. 6, n. 4, 1995.

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Cyanobacteria "the blue green algae" and its novel applications: A brief review

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ABSTRACT: Cyanobacteria are among the earliest of inhabitants of Planet Earth and are highly diverse members of the current global biodiversity and are making significant contributions to the Carbon and Nitrogen bio-geochemical cycles, particularly in the deep oceans. Cyanobacteria in recent year have gained importance because of their potential use in various areas of research. This diverse group has application in various fields like biotechnology, pharmacology, agriculture etc. Due to presence of wide spectrum of bioactive compounds cyanobacteria has possesses antiviral, antibacterial, antifungal and anticancer activities. Several strains of cyanobacteria are also rich in food supplements. Further nitrogen fixing capacity of cyanobacteria has attracted agriculturists and researchers and they used blue green algae as a component of biofertilizers to improve both the fertility of soil as well as growth of plants. Recent studies have also shown that cyanobacteria have capability to degrade environmental pollutants and are also being used as a promising source of alternative energy. In spite of all these investigation and research more efforts should be made in search of more strains of cyanobacteria and genetically modifying known strains to ensure maximum production of the desired products.

KEYWORDS: blue green algae, secondary metabolites, alternative fuel, xenobiotics, nitrogen fixation.

1 INTRODUCTION

Cyanobacteria a group of gram negative photoautotrophic bacteria are the one of the most primitive component of our mother earth and it was the cyanobacteria in the Archaean and Proterozoic Eras (2.7 billion years ago) that were responsible for creating our oxygenic atmosphere through their photosynthetic activities. Cyanobacteria were the first organisms to utilize two photosystems (photosystems I and II) and split H_2O instead of H_2S as other bacteria do. Cyanobacteria capture sunlight using chlorophyll a and various accessory pigments especially c-phycocyanin and perform photosynthesis as algae and plants. Although cyanobacteria perform oxygenic photosynthesis just like eukaryotic green algae and higher plants, they do not store food in the form of starch. Their principal storage product is cyanophycean starch and glycogen together with specialized intracellular storage compounds like lipids, protein containing cyanophycean granules and polyphosphate bodies [1]. Cyanobacteria are ubiquitous in nature and found commonly in lakes, ponds, springs, wetlands, streams, and rivers, and they play a major role in the nitrogen, carbon, and oxygen dynamics of many aquatic environments. Cyanobacteria not only have wide range of habitat but also have a range of organization that range from unicellular, to filamentous, to colonial. Cyanobacteria not only persist as free living but also form symbiotic associations like *Rickelia intracellularis* lives as endosymbionts in large diatoms. Cyanobacteria are also endosymbiotic in fungi (lichens), bryophytes (*Anthoceros)*, pteridophytes (*Azolla*), cycads (coralloid roots), angiosperms (*Gunnera*) and certain marine sponges and corals. It is also believed that the chloroplasts in plants and algae derived from an endosymbiosis in which a cyanobacterium was engulfed and retained within a colorless eukaryotic cell. Cyanobacteria are prokaryotic and lack internal organelles, a discrete nucleus and the histone proteins associated with eukaryotic chromosomes unlike eukaryotes and like all eubacteria, their cell walls contain peptidoglycan, not cellulose (like many algae and all plants). All cyanobacteria possesses chlorophyll a and also other pigments like the blue phycobiliproteins, phycocyanin and allophycocyanin, which gives cyanobacterial cells their characteristic blue-green color because of which they are dubbed as "blue green bacteria". Other taxa also contain the

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phycobiliprotein phycoerythrin, making the cells red, or sometimes black. Phycobiliproteins are found in specialized structure called phycobilisomes and these efficiently guides or monitors captured solar energy to the reaction centers of photosynthesis i.e. photosystem II [2]. Cyanobacteria also form symbiotic association with leguminous plant and play vital role in the growth and health of the plant. Cyanobacteria are among one of few organisms that convert atmospheric nitrogen into an organic form, such as **nitrate** or ammonia and thus they serve as inexpensive natural biofertiliser for the plants. Cyanobacteria are not only known for their role in ecology and evolution but also have a wide range of application in pharmacological and biotechnological applications. Cyanobacteria today are not only explored in agriculture as biofertiliser but also in pharmacology, in cancer treatment, bioremediation, as biofuel and also as a food supplements. In other words, we can say that cyanobacteria have ignited a revolution in wide area of health and agriculture.

2 CYANOBACTERIA AS A NATURAL BIOPHARMACEUTICALS

Now a days there are many modern approaches for drug discovery even though drug development have not gained much pace due to lack of proper lead in biomolecules, which is crucial to designing newer drug [3].Hence there is a need to switch to newer natural bioresources that could act as the reservoir for such molecules and this lead to the researchers for screening of cyanobacteria for discovering new drugs .Cyanobacteria are Gram-negative eubacteria and are known for their morphological diversity leading to the development of natural biopharmaceuticals due to presence of structurally diverse groups of compound [4], [5]. Cyanobacterial secondary metabolites have been isolated from a number of cyanobacterial genera from different geographical locations and represent a vast diversity of structures which is a result of the cyanobacterial capacity to integrate both Non-Ribosomal Peptide Synthethases with Polyketide Synthases. Cyanobacteria have a wide range of enzymes responsible for methylations, oxidations, tailoring and other alterations [6], resulting in chemically diverse natural products such as linear peptides [**7**], cyclic peptides [**8**], linear lipopeptides [**9**], depsipeptides [**10**], cyclic depsipeptides [**11**], fatty acid amides [**12**], swinholides [**13**], glicomacrolides [**14**] or macrolactones [**15**].

During the last two decades, cyanobacterial secondary metabolites have attracted the attention of researchers mainly due to two reasons; (i) acute toxicity of toxins produced by several bloom forming cyanobacteria in freshwater system and their harmful effect on animals and human health, and (ii) potential therapeutic use of several secondary metabolites [16], [17], [18]. The cyanobacterial secondary metabolites include several biological activities like antibacterial, antifungal, antialgal, antiprotozoan, and antiviral activities.

2.1 ANTIBACTERIAL ACTIVITY

Bacterial resistance towards antibiotics has been the main factor responsible for the increase of morbidity, mortality and health care costs of bacterial infections. The defense mechanism against antibiotics is widely present in bacteria (eg : *Pseudomonas, Klebsiella, Enterobacter, Acinetobacter, Salmonella, Staphylococcus, Enterococcus* and *Streptococcus*) and became a worldwide concern. So there is rising interest of researchers for natural products for the discovery of new antimicrobial and antioxidant agents in the last three decades. Secondary metabolites with antibacterial activity are widely produced by cyanobacteria [19]. These compounds are effective against both Gram-positive and Gram-negative bacteria. It has also been found by the researchers that both toxic and nontoxic strains of cyanobacteria are potent producers of antibacterial compounds that are distinct from cyanotoxins [20]. Literature survey revealed that Malyngolid from *Lyngbya majuscule* [17], Norharmane (*N. insulare*) [21], Kawaguchipeptin B (*Microcystis aeruginosa*), cyclic undecapeptides, lyngbyazothrins A, B, C , and D from the cultured *Lyngbya* sp.have antibacterial activity against number of bacteria (eg *Micrococcus flavus, Bacillus subtilis*, *Escherichia coli*, *Pseudomonas aeruginosa*, and *Serratia marcescens, Mycobacterium smegmatis* and *Streptococcus pyogenes* [22]. Some author also reported the production of antimicrobial agents from *Nostoc communes, Cytonema hofmanni, Hapalosiphon fontinalis, Anabaena spp., Nostoc spongiaeforme, Microcystis aeruginosa, Synechocystis* and *Synechococcus, Phormidium sp.,* and *Fischerella sp* and extracts of *Spirulina platensis* obtained by different solvents exhibited different degrees of antimicrobial activity on both Gram-positive and Gram-negative organisms [23]. Many investigators also found that the acetone extract of Cyanobacteria have antimicrobial activity *Nostoc commune* on *E.coli, Bacillus subtilis* and *Pseudomonas aeruginos*a [24], [25]. Many more antibacterial compounds are also isolated from various other Cynobacterial strains such as Noscomin [26]. from Nostoc commune, Carbamidocyclophanes are paracyclophanes isolated from Nostoc sp. CAVN 10 [27]. Nine ambiguines from Fischerella sp. are isolated , which showed antimicrobial activity [28]. Two new norbietane compounds, showing antibacterial activity against various Gram positive and Gram negative bacteria, were isolated from Micrococcus lacustris [29].

2.2 ANTIFUNGAL ACTIVITY

Fungi, as a major disease causing agent, were realized after 1980, especially among the immunocompromised and other serious diseases [30]. There are limitations with regards to antifungal drugs because of their price and side effects [31]. So, the researchers are exploring biodiversity for search of new lead compounds with minimum or no toxity. In this regard cyanobacteria came out to be a novel organism. Antifungal compounds include fisherellin A, hapalindole, carazostatin, phytoalexin, tolytoxin, scytophycin, toyocamycin, tjipanazole, nostocyclamide and nostodione produced by cyanobacteria belonging to Stigonematales, Nostocales and Oscillatoriale [32], cyclic depsipeptide Lyngbyabellin B was also isolated from *L. majuscula* which show toxicity against brine shrimp and fungus *Candida albicans* [33]. Studies done by Vijayakumar Madhumathi et. al. also reavaled antifungal activitiy of various strains of cyanobacteria. It was found that acetone extract of *Phormidium corium,* methanol extract of *Lyngbya martensiana* and diethyl ether extract of *Microcystis aeruginosa* have antifungal activity. In addition, *Oscillatoria latevirens, Chrococcus minor and Microcystitis aeroginosa* were also found to have antifungal activity on *Candida albicans.* Other authors also reported that methanolic crude extract of *Aphanothece bullosacrude* was found more potent antifungal in comparision to *Lyngbya aestuarii* and crude extract and pure compounds from other freshwater cyanobacteria such as Anabaena, Nostoc, Aphanocapsa, Synechocystis, Synechococcus, Oscillatoria, Nodularia,Calothrix have shown antifungal activity [34], [35], [36], [37], [38], [39].The extracts of Oscillatoria latevirens, Chrococcus minor and Microcystitis aeroginosa were found to have antifungal activity on Candida albicans [40].

2.3 ANTIVIRAL ACTIVITY

In contrast to the large amount of antibacterial and antialgal compounds isolated from cyanobacteria there are only a few compounds that show antiviral propertie, although 2–10% of extracts of different cyanobacterial species have been shown to have antiviral activity [41]. These include acetylated sulfoglyco-lipids from *Oscillatoria raoi* and spirulan from *Spirulina platensis.* The compounds isolated from *Lyngbya lagerhaiman*i and *Phormidium tenue* has been shown to have anti-HIV activity [42]. Study carried out by researchers shown that hot water extract of spirulina part of the fractionated product inhibited the replication of several viruses, especially those with an envelope such as the measles virus, and the HIV-1 virus, in human T cells, peripheral blood mononuclear cells and Langerhans cells. This component was found to be a sulfated polysaccharide, calcium spirulan [43], [44]. In addition, in undernourished children spirulina has been found to improve weight gain and correct anemia in both HIV-infected and HIV-negative cases [45].

2.4 ANTICANCER ACTIVITY

One of the most important treatments currently available for cancer and other diseases is chemotherapy which has limited effectiveness due to some serious life-threatening side effects (like fatigue, irritation of oesophagus that can cause difficuty in swallowing and inflammation of lungs). It may also cause vomiting, neutropenia, anemia, another infectious complicatios [46] and development of drug resistance cancerous cells. The side effects of the anticancer drugs not only prevent effective chemotherapy, but also compromise the quality of life of the patients [47]. One Effective solution of the problem mentioned above can be using natural anticancer products. Presently 50% of the drugs used in the cancer treatment comprises of the natural sources like bacteria, actinomycetes, fungi sponges, plants and animals. Cyanobacterial anticancerous metabolites have also showed positive response. The presence of the bioactive compounds present in the crude extract of *Oscillatoria boryana* may posses the anticancer activity against the breast cancer cell lines (MCF-7)[48]. Marine cyanobacteria were found to produce a wide range of compounds that revealed apoptotic properties. It is reported that HL-60 cells exposed to aqueous extracts of *Synechocystis* sp. and *Synechococcus* sp. strains, presented cell shrinkage showing that cells were developing apoptosis, and membrane budding, that occurs when cell is fragmented into apoptotic bodies [49]. Biselyngbyaside, a macrolide glycoside produced by *Lyngbya* sp., was found to induce apoptosis in mature osteoclasts, revealed by nuclear condensation [50]. Marine benthic *Anabaena* sp. extracts were found to induce apoptosis in acute myeloid leukemia cell line, with cells showing several described typical morphological markers, such as chromatin condensation, nuclear fragmentation, surface budding and release of apoptotic bodies [51]. The potential of marine benthic cyanobacteria as a source of anticancer drug candidates was assessed in a screen for induction of cell death (apoptosis) in acute myeloid leukemia (AML) cells. Of the 41 marine cyanobacterial strains screened, more than half contained cell death-inducing activity. Several strains contained activity against AML cells, but not against non-malignant cells like hepatocytes and cardiomyoblasts. Ovarian carcinoma and breast carcinoma cells which are multiply drug resistant due to over expression of P-glycoprotein are markedly less resistant to cryptophycin than they are to vinbiastine, colchicine, and taxol. So, cryptophycin is a new antimicrotubule compound which appears to be a poorer substrate for P-glycoprotein than are the Vinca alkaloids. This property may confer an advantage to cryptophycin in the chemotherapy of drug resistant tumors [52]. Other cyanobacterial metabolites such as curacin A, dolastatin 10 ,Symplostatin 3 and Belamide A have been in preclinical

and/or clinical trials as potential anticancer drugs. In addition, these molecules served as drug leads for the development of synthetic analogues, e.g. compound 4, TZT-1027, ILX-651, and LU- 103793, usually with improved pharmacological and pharmacokinetic properties [53], [54], [55].

3 ANTIOXIDANT

'Antioxidants' are substances that neutralize free radicals or their actions [56]. Nature has endowed each cell with adequate protective mechanisms against any harmful effects of free radicals: superoxide dismutase (SOD), glutathione peroxidase, glutathione reductase, thioredoxin, thiols and disulfide bonding are buffering systems in every cell. α-Tocopherol (vitamin E) is an essential nutrient which functions as a chain-breaking antioxidant which prevents the propagation of free radical reactions in all cell membranes in the human body. Ascorbic acid (vitamin C) is also part of the normal protecting mechanism. Other non-enzymatic antioxidants include carotenoids, flavanoids and related polyphenols, α-lipoic acid, glutathione etc. Studies also indicate that cyanobacterial pigments carotenoids, phycobiliprotein, and c-phycocyanin are the compounds with higher antioxidant activity. Carotenoids isolated from the marine *Trichodesmium* are responsible for an antioxidative protection, observed with ferric reducing/antioxidant power assay [57]. In the same study, extracts from marine strains of *Anabaena*, *Cyanothece*, *Prochlorothrix* and *Synechococcus* showed antioxidant properties, but mainly in the protein extract. Also the major phycobiliprotein, c-phycocyanin, from both *Lyngbya* and *Phormidium*, is capable to scavenge ROS, in particular peroxyl and hydroxyl radicals [58]. It was also suggested that this antioxidant capacity is resultant from the covalent linked tetrapyrole chromophore with phycocyanobilin [58].

4 CYANOBACTERIA IN DIET

Strains of *Spirulina, Anabaena* and *Nostoc* are consumed as human food in many countries including Chile, Mexico, Peru and Philippines. *Arthrospira platensis* is grown in large scale and marketed in the form of powder, flakes, tablets and capsules. It is used as a food supplement because of its richness in nutrients and digestibility. It contains more than 60% proteins and is rich in beta-carotene, thiamine and riboflavin and is considered to be one of the richest sources of vitamin B12. *Nostoc commune* is rich in fibres and proteins and can play an important physiological and nutritional role in the human diet. Gamma linolenic acid (GLA) found rich in *S. platensis* and *Arthrospira sp*. is medically important since it is converted in the human body into arachidonic acid and then into prostaglandin E2. This compound has a lowering action on blood pressure and plays an important role in lipid metabolism. Some of the marine cyanobacteria constitute potential sources for large-scale production of vitamins, such as vitamins B and E. Futher, it has been also reported that Spirulina is rich in proteins, carbohydrates, polyunsaturated fatty acids, sterols and some more vital elements such as calcium, iron, zinc, magnesium, manganese and selenium. It is a natural source of vitamin B12, vitamin E, ascorbic acid, tocopherols and a whole spectrum of natural mixed carotene and xanthophylls phytopigments. *Spirulina* as a supplement serves to provide these nutrition requirements and seems to be a 'wonder food'. It has been stated by NASA that the nutritional value of 1000 kg of fruits and vegetables equals one kg of spirulina. Therefore in long-term space missions NASA (CELSS) and European space agency (MELISSA) proposed that spirulina serves as a major source of food and nutrition [59]. The United Nations has hailed spirulina as the possible "**best food for the future**" in its world conference held during 1974. Spirulina can be harvested by simple methods and can be processed into a variety of final forms such as powders, tablets, flakes, syrups, etc [60].

5 BIOREMEDIATION

In this present scenario industrial revolution has harmed our environment to much extent. Effluents released have contaminated water bodies and causing several serious health problems. Water bodies receiving the effluent show high BOD, COD and chloride levels that are well above the stipulated concentrations prescribed by the Indian Standard Institute (ISI). So there is a need to remove all these pollutants from our water bodies. There are several approaches for remediating pollutants among those is **"**Bioremediation". Bioremediation is gaining importance as a less expensive alternative to physical and chemical means of decomposing organic pollutants. Pathways of biodegradation have been characterized for a number of heterotrophic microorganisms, mostly soil isolates, some of which have been used for remediation of water. Recently, there has been increasing awareness about using cyanobacteria as bioremediation and pollution control agents, either as wild-type, mutant, or genetically engineered forms. As bioremediating agents, cyanobacteria possess many advantages over other microorganisms isolated from soil. These include their photoautotrophic nature and the ability of some species to fix atmospheric nitrogen. This enables them to be producers, as opposed to consumers, and makes their growth and maintenance inexpensive [61]. Blue green algae have been shown to be highly effective as accumulators and degraders of different kinds of environmental pollutants, including pesticides [62], crude oil [63], [64], naphthalene [65], [66],

phenanthrene [67], phenol and catechol [68], [69], and xenobiotics [70] blue green algae could also serve as effective biosorbant for removing heavy metals from contaminated waters [71], [72]. Worldwide, cyanobacteria have been used efficiently as a low-cost method for remediating dairy wastewater by converting the dissolved nutrients into biomass [73] and for biotreatment (removal) of dissolved inorganic nutrients from fish farms [74].The studies conducted by various shown biodegradation and biosorption capacity of some potential cyanobacterial species: *Oscillatoria* sp., *Synechococcus* sp., *Nodularia* sp., *Nostoc* sp. and *Cyanothece* sp. dominated the effluents. Some author also reported natural ability of two filamentous cyanobacteria *Anabaena* sp. and *N. ellipsosporum* degrade a highly chlorinated aliphatic pesticide, lindane (g-hexachlorocyclohexane) and this ability can be enhanced by genetic engineering. Soil bacteria [75], [76], [77], fungi, and an *E. coli* strain from rat feces [78] that use lindane as a primary carbon source degrade it to g-2,3,4,5,6-pentachlorocyclohexene, a-, b-, and g-tetrachlorocyclohexene, or pentachlorobenzene, depending on the strain.

Chromium is a heavy metal and its toxicity can cause serious carcinogenic, genotoxic and immunotoxic effects in humans and animals. Conventional methods used for the removal of hexavalent Cr use chemical procedures, which are expensive and lack specificity. So an alternative method was proposed by Kannan. V et al for the removal of chromium present in tannery effluent. Filamentous Cyanobacteria *Anabaena flos-aquae. Anabaena flos-aquae was found to grow* in effluent at various dilutions [79].

Heavy metals nickel (Ni) released into the environment over a long period of time through various anthropogenic activities like burning of fossil fuels and residual oils, coal mine spoils, sewage sludge, production of Ni-Cd batteries are the primary source of Ni and exhibit toxic effect on biota [80]. Remediation of nickel (Ni) by Anabaena doliolum has been suggested by M.K. Shukla et al in view that nickel ion has been shown to be an essential micronutrient for many microorganisms as it plays important role in four microbial enzymatic activities [81], [82]. In several other studies it was found that cultures of Oscillatoria sp. BDU 30501, Aphanocapsa sp. BDU 16 and a halophilic bacterium Halobacterium US 101 were used to treat a factory effluent and resulted in reduction of calcium and chloride to levels that did not inhibit survival and multiplication of fish [83]. Phormidium valderianum BDU 30501 was used to reduce phenol concentrations [84] while Oscillatoria boryana BDU 92181 was used to eliminate melanoidin pigment from distillery effluents [85]. Further in an study conducted by Slotton et al [86] it was found that *Spirulina platensis*, a cyanobacterium contained detectable levels of mercury and lead when grown under contaminated conditions implying that this cyanobacterium was taking up the toxic metal ions from its environment.

J. L. Gardea-Torresdey has also added a new approach in bioremediation techniques. They have silica-immobilized inactivated cells of *Synechococcus sp*. PCC 7942 to used as a biosorption resin for the removal and recovery of metal ions such as copper(II), lead(II), nickel(II), cadmium(II), and chromium(III) ions. from contaminated waters. Biosorption resin can also be used after one cycle of adsorption/desorption In further experiment it was also demonstrated that metallothionein were capable of binding more metal ions. [87]

Cyanobacteria based biosensor has also been generated that could be used to detect herbicides and other environmental pollutants. freshwater cyanobacterium, *Synechocystis* sp. strain PCC6803, was chromosomally marked with the luciferase gene *luc* (from the firefly *Photinus pyralis*) to create a novel bioluminescent cyanobacterial strain and expression of the *luc* gene during growth of *Synechocystis* sp. strain PCC6803 cultures was characterized by measuring optical density and bioluminescence [88].

5.1 BIOFUEL

5.1.1 BIODIESEL

Cyanobacteria are well suited for synthetic biology and metabolic engineering approaches for the phototrophic production of various desirable biomolecules, including substances with cytotoxic, antifungal, antibacterial and antiviral activities [89], [90]. Lipids, carotenoids, pigments, vitamins and aromatic compounds are also found in cyanobacteria. Lipids (accumulated in the thylakoid membranes) are associated with high levels of photosynthesis and rapid growth rate and are of particular interest, since they can be used as lipid feedstock for biodiesel production [91], [92], [93]. Microalgae accumulate large amounts of lipids as reserve material, but only in conditions of stress and slow growth [94]. Thus, cyanobacteria have a natural advantage to produce lipids in high-speed growth. The biosynthesis of fatty acid-based biofuels in cyanobacteria includes two steps, production and transesterification of fatty acids (FAs) to form alkyl FA esters [95]. Considering that fuel properties are largely dependent on the FA composition of the feedstock from which biodiesel is prepared. The presence of double bonds in the FAs from cyanobacterial lipids is related to their morphological complexity [96]. *Synechococcus* sp. PCC7942, *M. aeruginosa* NPCD-1 and *Trichormus* sp. CENA77 had the best set of properties to be

used as a feedstock source in the synthesis of biodiesel. They showed appropriate values of biomass and lipid productivity, as well as FA profiles similar to the oil seeds already used successfully in the synthesis of biodiesel.

5.1.2 HYDROGEN PRODUCTION

As we all know cyanobacteria are photosynthetic organism and have caliber to convert water to hydrogen by captured solar energy due to the presence of multiple hydrogen-producing enzymes. This ability of cyanobacteria has been demonstrated in production of biofuel in the form of hydrogen. In this procedure captured solar energy by the two photosystems is used to split water, producing oxygen, and generate a high-energy, low-potential reductant capable of reducing protons to hydrogen via a hydrogenase enzyme, a process that has been called biophotolysis. This method is more reliable and simple since we are using an abundant substrate, water, and a ubiquitous energy source, solar energy, to produce a highly diffusible and energy-dense fuel, hydrogen. It has been also observed that heterocystous cyanobacteria are mostly involved in hydrogen production due to the presence of nitrogenase provide a quasi-anaerobic microenvironment which allows the oxygen-sensitive nitrogenase to function and evolve hydrogen in case of an environment supersaturated with oxygen [97].

6 BIOFERTILISER

Biofertilizer has gained much importance in recent years and play vital role in maintaining long term soil fertility and sustainability by fixing atmospheric dinitrogen (N=N), mobilizing fixed macro and micro nutrients or convert insoluble phosphorus in the soil into forms available to plants, thereby increases their efficiency and availability. It has been observed that by applying biofertilizers crop production can be enhanced by 20-30% if are used properly. The microorganisms (Azotobacter, Blue green algae, Rhizobium Azospirillum) in biofertilizer are the major component promoting the adequate supply of nutrients to the host plants and ensuring their proper development of growth and regulation in their physiology. Biofertilizer can also protect plants from soil born diseases to a certain degree. The need for the use of biofertilizer has arisen, primarily for two reasons. First, because increase in the use of fertilizers leads to increased crop productivity, second, because increased usage of chemical fertilizer leads to damage in soil texture and raises other environmental problems. Due to the important characteristic of nitrogen fixation, cyanobacteria have a unique potential to contribute to enhance productivity in a variety of agricultural and ecological situations. Cyanobacteria play an important role to retain soil fertility by consequently increasing the yield by converting atmospheric nitrogen into an available form of ammonium. Dominant nitrogen-fixer blue-green algae are *Anabaena, Nostoc, Aulosira, Calothrix, Plectonema* etc. The activities of algae include: (1) Increase in soil pores with having filamentous structure and production of adhesive substances. (2) Excretion of growth-promoting substances such as hormones (auxin, gibberellin), vitamins, amino acids [98], [99]. (3) Increase in water holding capacity through their jelly structure. (4) Increase in soil biomass after their death and decomposition [100]. (5) Decrease in soil salinity [101]. (6) Preventing weeds growth [102]. (7) Increase in soil phosphate by excretion of organic acids [103]. Beneficial effects of cyanobacterial inoculation were also reported on paddy crop grown both under upland and low land conditions and on a number of other crops such as barley, oats, tomato, radish, cotton, sugarcane, maize, chilli and lettuce (126). BGA are not only source of N2 but also provides other advantages such as algal biomass accumulates as organic matter; produces growth promoting substances which stimulate growth of rice seedling; provides partial tolerance to pesticides and fungicides and also helps in reclamation of saline and alkaline soils.

7 CONCLUSION

Cyanobacteria are the most primitive organism and are known for creating oxygenic atmosphere through their photosynthetic activities. Cyanobacteria perform photosynthesis as plant and algae does by capturing sunlight by using chlorophyll a and various other accessory pigments. They are ubiquitous in nature and play a major role in the nitrogen, carbon, and oxygen dynamics of many aquatic environments. Cyanobacteria are found not only as free living organism but are also found in symbiotic association with plant and other organisms. In recent year cyanobacteria have gained importance in various areas of research viz agriculture, drug discovery, treatment of deadly disease such as HIV and cancer, bioremediation and now a days it is also exploited as alternative source of fuel i.e. biofuel. Various pharmacological effect of cyanobacteria are due to the presence of bioactive compounds found in cyanobacteria and are being used in agricultural field due to its ability to fix atmospheric nitrogen into ammonium which promote growth of plants. Cyanobacteria has also attracted attention of environmentalist in bioremediation due to its ability to degrade pollutants including pesticides, crude oil, naphthalene ,phenanthrene, phenol and catechol () and xenobiotics , could also serve as effective biosorbant for removing heavy metals from contaminated water bodies. Not only has this cyanobacteria might be used to solve problem of food crisis and malnutrition. Several strains of cyanobacteria eg *Spirulina, Anabaena* and *Nostoc* are consumed as human

food in many countries including Chile, Mexico, Peru and Philippines. *Arthrospira platensis*. *Spirulina* as a supplement serves to provide nutrition requirements and seems to be a 'wonder food'. It has been stated by NASA that the nutritional value of 1000 kg of fruits and vegetables equals one kg of spirulina. Inspite of all these advantages and discovery cyanobacteria need to be explored more and more research should be conducted so that more fruitful results will come out.

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REFERENCES

[1] S. A. Kulasooriya, "Cyanobacteria: Pioneers of Planet Earth", *Ceylon Journal of Science* (*Bio. Sci.*), vol. 40, no. 2, pp. 71-88, 2011.

[2] W. F. Vincent, "Cyanobacteria", Laval University, Quebec City, QC, Canada, Elsevier *Inc*, 2009. All rights reserved.

[3] J.P. Overington, B. Al-Lazikani, A.L. Hopkins, "How many drug targets are there?", *Nat Rev Drug Discov,* vol. 5, pp. 993-996, 2006.

[4] N. V. Wase, and P. C. Wright, "Systems biology of cyanobacterial secondary metabolite production and its role in drug discovery", *Expert Opinion on Drug Discovery*, vol. 3, pp. 903-929, 2008.

[5] R. K Singh, S. P. Tiwari, , A. K Rai, and T. M Mohapatra,"Cyanobacteria: an emerging source for drug discovery", *Journal of Antibiotics*, vol. 64, pp. 401-412, 2011.

[6] A.C. Jones, E.A. Monroe, E.B. Eisman, L. Gerwick, D.H. Sherman and W.H Gerwick, "The unique mechanistic transformations involved in the biosynthesis of modular natural products from marine cyanobacteria", *Nat. Prod. Rep,* vol. *27*, pp. 1048–1065, 2010.

[7] T.L. Simmons, K.L. McPhail, E. Ortega-Barria, S.L. Mooberry and W.H. Gerwick, "Belamide A, a new antimitotic tetrapeptide from a Panamanian marine cyanobacterium". *Tetrahedron Lett*, vol. *47*, pp. 3387–3390, 2006.

[8] M.T. Sisay, S. Hautmann, C. Mehner, G.M. Konig, , J. Bajorath, and M. Gutschow, "Inhibition human leukocyte elastase by brunsvicamides A–C: Cyanobacterial cyclic peptides", *ChemMedChem ,* vol. 4, pp. 1425–1429, 2009.

[9] L.M. Nogle, T. Okino and W.H Gerwick, "Antillatoxin B, a neurotoxic lipopeptide from the marine cyanobacterium *Lyngbya majuscula*', *J. Nat. Prod,* vol. *64*, pp. 983–985, 2001.

[10] B. Han, D. Goeger, C.S. Maier, and W.H. Gerwick, "The wewakpeptins, cyclic depsipeptides from a Papua New Guinea collection of the marine cyanobacterium *Lyngbya semiplena*" *J. Org. Chem,* vol. *70*, pp. 3133–3139, 2005

[11] I.E. Soria-Mercado, A. Pereira, Z. Cao, T.F. Murray and W.H. Gerwick, "Alotamide A, a novel neuropharmacological agent from the marine cyanobacterium *Lyngbya bouillonii*" *Org. Lett,* vol. 11, pp. 4704–4707, 2009.

[12] T.T Chang, S.V. More, I.H. Lu, J.C. Hsu, T.J. Chen, Y.C. Jen, C.K. Lu and W.S. Li, "Isomalyngamide A, A-1 and their analogs suppress cancer cell migration *in vitro"*, *Eur. J. Med Chem,* vol. *46*, pp. 3810–3819, 2011

[13] E.H Andrianasolo, H. Gross, D. Goeger, M. Musafija-Girt, , K. McPhail, R.M, Leal,

[14] S.L. Mooberry, and W.H. Gerwick, "Isolation of swinholide A and related glycosylated derivatives from two field collections of marine cyanobacteria", *Org. Lett,* vol. *7,* pp. 1375–1378, 2005.

[15] T.Teruya, H Sasaki, K. Kitamura, T. Nakayama, K. Suenaga, "Biselyngbyaside, a macrolide glycoside from the marine cyanobacterium *Lyngbya* sp.", *Org. Lett.*, vol. *11*, pp. 2421–2424, 2009.

[16] L.A Salvador, V.J. Paul, H Luesch, "Caylobolide B, a macrolactone from symplostatin

[17] 1-producing marine cyanobacteria *Phormidium* spp. from Florida". *J. Nat. Prod.*, vol. *73*, pp. 1606–1609, 2010.

[18] M. Namikoshi and K.L. Rinehart, "Bioactive compounds produced by cyanobacteria", *J Ind Microbiol Biotechnol,* vol. 17, pp. 373-384, 1996.

[19] A.M. Burja, B. Banaigs, E. Abou-Mansour, J.G. Burgess and P.C. Wright, "Marine cyanobacteria- a prolific source of natural products", *Tetrahedron*, vol. 57, pp. 9347- 9377, 2001.

[20] E. Dittmann and C. Wiegand, "Cyanobacterial toxins-occurrence,biosynthesis and impact on human affairs", *Mol Nutr Food Res*, vol. 50, pp. 7-17, 2006

[21] H.U. Dahms, Y. Xu, and C. Pfeiffer, "Antifouling potential of cyanobacteria: a mini-review", *Biofouling*, vol. 22, pp. 317–327, 2006.

[22] Ø. Østensvik, O.M. Skuberg, B. Underdak, and V. Hormazabal, "Antibacterial properties of extracts from selected planktonic cyanobacteria – a comparative study of bacterial bioassays", *J Appl Microbiol* vol. 84, pp. 1117–1124, 1998.

[23] R.B. Volk, and F.H. Furkert, "Antialgal, antibacterial and antifungal activity of two metabolites produced and excreted by cyanobacteria during growth", *Microbiol Res*, vol. 161, pp. 180–186, 2006.

[24] Maheep kumar, "*LYNGBYA* SP.: A suitable cyanobacterium for harvesting antimicrobial compounds", *Asian journal of pharmaceutical and clinical research*, vol. 7, Issue 1, 2014.

[25] M.A. Rania, M. Abedin Hala Taha, Antibacterial and Antifungal Activity of Cyanobacteria and green Microalgae, evaluation of medium components by plackett – Burman Design for Antimicrobial activity of Spirulina *platensis*", *Global J. Biotech. Biochem*, vol. 3(1) pp. 22-31, 2008.

[26] M. De Mule, G. De Caire, M. De Cano, D. Haaperin, Bioactive compound from *Nostoc muscorum* (Cyanobacterium), *Cytobios*, vol. 66, pp. 169-172, 1991.

[27] K. Ishida, H. Matsuda, M. Murakami and K. Yamaguchi, "Kawaguchipetin B an antibacterial cyclic undecapeptide from the cyanobacterium Microcystis aeruginosa", *J. Nat. Prod*., vol. 60, pp. 724-726, 1997.

[28] S. Mundt, S. Kreitlow and R. Jansen, "Fatty acids with antibacterial activity from the cyanobacterium Oscillatoria redekei HUB051", *J. Appl. Phycol*., vol. 15, pp. 263–267, 2003.

[29] P. Bhateja, T. Mathur, M. Pandya, T. Fatma, and A. Rattan, " Activity of blue- green microalgae extracts against in vitro generated Staphylococcus aureus with reduced susceptibility to vancomycin", *Fitoterpia*, vol. 77, pp. 233–235, 2006.

[30] B. Jaki, J. Orjala, and O. Sticher, "A novel extracellular diterpenoid with antibacterial activity from the cyanobacterium. Nostoc Comm", *J. Nat. Prod*., vol. 62, pp. 502–503, 1999.

[31] T. N. Bui, R. Jansen, T. L. Pham and S. Mundt. " Carbamidocyclophanes A-E, chlorinated paracyclophanes with cytotoxic and antibiotic activity from the vietnamese cyanobacterium Nostoc sp", *J. Nat. Prod.,* vol. 70, pp. 499–503, 2007.

[32] M.A. Pfaller and D.J. Diekema, 'Epidemiology of invasive candidiasis: a persistent public health problem (Review)", *Clin Microbiol*, vol. 20, pp. 133-163, 2007

[33] M.A. Pfaller, D.J. Diekema, D.L. Gibbs, V.A. Newell, D. Ellis, V. Tullio, et al., "Results from the ARTEMIS DISK global antifungal surveillance study, 1997 to 2007: a 10.5-year analysis of susceptibilities of Candida species to fluconazole and voriconazole as determined by CLSI standardized disk diffusion testing", *J Clin Microbiol*, vol. 6, pp. 1366-1377, 2010.

[34] R.E. Moore, G.M.L. Patterson and W.W. Carmichael, "New pharmaceuticals from cultures blue-green algae", In Biomedical Importance of Marine Organisms ed. Fauntin, D.G.. Memoires Californian Academy of Science, San Francisco: Californian Academy of Science, vol 13, pp. 143–150, 1988.

[35] K.E. Milligan, B.L. Marquez, R.T. Williamson and W.H. Gerwick, *"Lyngbya*bellin B, a Toxic and Antifungal Secondary Metabolite from the Marine Cyanobacterium *Lyngbya majuscule" Journal of Natural Product*, vol. 63, pp. 1440-1443, 2000.

[36] B. Ghazala, B. Naila and M. Shameel, "Fatty acids and biological activities of crude extracts of freshwater algae from Sindh" *Pak J Bot*, vol. 42, pp. 1201-1212, 2010.

[37] R.B. Volk and F.H. Furkert, "Antialgal, antibacterial and antifungal activity of two metabolites produced and excreted by cyanobacteria during growth" , *Microbiol Res,* vol. 161, pp. 180-186, 2005.

[38] J.D. Kim, "Screening of cyanobacteria (blue-green algae) from rice paddy soil for antifungal activity against plant pathogenic fungi", *Microbiol*, vol. 34(3), pp. 138-142, 2006.

[39] A.Asadi, R. Khavari-Nejad, N Soltani, F. Najafi and A. Molaie-Rad, "Physiological and antimicrobial characterizations of some cyanobacteria isolated from the rice fields in Iran", *J Agri Technol,* vol. 7(3), pp. 649-663, 2011.

[40] A.V. Drobac-Åik, T.I. Duliã, D.B. Stojanoviã and Z.B. Sviråev, "The importance of extremophile cyanobacteria in the production of biological active compounds", *Proc Nat Sci Matica Srpska Novi Sad* vol. 112, pp. 57-66, 2007.

[41] S.T. Pawar and P.R. Puranik, "Screening of terrestrial and freshwater halotolerant cyanobacteria for antifungal activities", *World J Microbiol Biotechnol*, vol. 24, pp. 1019-1025, 2008.

[42] Vijayakumar Madhumathi, Pitchai Deepa, Savarimuthu Jeyachandran, Chockaiya Manoharan and Subramaniyan Vijayakumar, "Antimicrobial Activity of Cyanobacteria Isolated from Freshwater Lake", *International Journal of Microbiological Research vol*. 2 (3), pp. 213-216, 2011.

[43] Y. Cohen, B.B. Jørgensen, N.P. Revsbech, and R. Poplawski, "Adaptation to hydrogen sulfide of oxygenic and anoxygenic photosynthesis among cyanobacteria", *Appl Environ Microbiol*, vol. 51, pp. 398–407, 1986.

[44] K.J. Rajeev and Z. Xu, "Biomedical compounds from marine organisms", *Mar Drugs,* vol. 2, pp. 123–146, 2004.

[45] Y. Akao, T. Ebihara, H. Masuda, et al., "Enhancement of antitumor natural killer cell activation by orally administered Spirulina extract in mice", *Cancer Sci*, vol. 100 (8) pp. 1494–501, 2009.

[46] T. Mishima, J. Murata, M. Toyoshima, et al., "Inhibition of tumor invasion and metastasis by calcium spirulan (Ca-SP), a novel sulfated polysaccharide derived from a blue-green alga, *Spirulina platensis*", *Clin Exp Metastasis*, vol. 16(6), pp. 541–550, 1998.

[47] T. Chen and Y.S. Wong, "In vitro antioxidant and antiproliferative activities of selenium-containing phycocyanin from selenium-enriched Spirulina platensis", J *Agric Food Chem*. 2008 vol. 25, 56(12), pp. 4352–4358, 2008.

[48] J.B. Henry, "Clinical diagnosis and management by laboratory methods", *Philadelphia: W.B Saunders Co*, 1996.

[49] S.S. Feng and S.Chien, *Chem. Eng. Sci*, vol. 58, pp. 4087-4114, 2003.

[50] Shalini Nair And B.Valentin Bhimba, "Bioactive Potency Of Cyanobacteria *Oscillatoria Sp", International Journal of Pharmacy and Pharmaceutical Sciences* ISSN- 0975-1491, vol. 5, Issue 2, 2013

[51] R.F. Martins, M.F. Ramos, L. Herfindal, J.A. Sousa, K. Skaerven and V.M. Vasconcelos, "Antimicrobial and cytotoxic assessment of marine cyanobacteria—Synechocystis and Synechococcus", *Mar. Drugs*, vol. *6*, pp. 1–11, 2008.

[52] T. Yonezawa, N. Mase, H. Sasaki, T. Teruya, S. Hasegawa, B.Y Cha, K.Yagasaki, K. Suenaga, K. Nagai and J.T. Woo, "Biselyngbyaside, isolated from marine cyanobacteria, inhibits osteoclastogenesis and induces apoptosis in mature osteoclasts", *J. Cell Biochem,* vol. 113, pp. 440–448, 2012.

[53] L. Oftedal, F. Selheim, M. Wahlsten, K. Sivonen, S.O. Doskeland and L. Herfindal, "Marine benthic cyanobacteria contain apoptosis-inducing activity synergizing with daunorubicin to kill leukemia cells, but not cardiomyocytes", *Mar. Drugs*, vol. *8*, pp. 2659–2672, 2010.

[54] C. D. Smith, X. Zhang , S. L. Mooberry, G.M.L. Patterson and R.E. Moore, *Cancer Res*, vol 54, pp. 3779-3784, 1994.

[55] L. T. Tan, *phytochem*, vol. 68, pp. 954–979, 2007.

[56] T. L. Simmons, K.L. McPhai, Eduardo Ortega-Barria, S.L. Mooberry. and H. Gerwick

[57] William, "Belamide A", *Tetrahedron Lett*, vol. 47, pp. 3387–3390, 2006.

[58] W. H. Gerwick, R.C. Coates, N. Engene , L. Gerwick, R.V Grindberg, A. C Jones and C. M Sorrels, Giant, *Microbe*, vol. 3, pp. 277-284, 2008.

[59] H.Sies, "Antioxidants in Disease, Mechanisms and Therapy", Academic Press, New York, 1996.

[60] D. Kelman, A. Ben-Amotz, I. Berman-Frank, "Carotenoids provide the major antioxidant

[61] defence in the globally significant N2-fixing marine cyanobacterium *Trichodesmium", Environ. Microbiol,* vol. *11*, pp. 1897–1908, 2009.

[62] A.Patel, S.Mishra and P.K. Ghosh, "Antioxidant potential of C-phycocyanin isolated from cyanobacterial species *Lyngbya*, *Phormidium* and *Spirulina* spp", *Indian J. Biochem. Biophys.* vol. *43*, pp. 25–31, 2006.

[63] J.F. Cornet and G. Dubertret, "The cyanobacterium Spirulina in the photosynthetic compartment of the MELISSA artificial ecosystem", Workshop on artificial ecological systems.; Marseille, France: DARA-CNES, 1990 October 24–26.

[64] A.Vonshak, "Spirulina platensis (Arthrospira)", *Physiol Cell-Biol Biotechnol*. London: Taylor & Francis, 1997.

[65] R.W. Castenholz, J.M. Waterbury, "Oxygenic photosynthetic bacteria. Group I. Cyanobacteria. In: Hensyl, W.R. (Ed.), Bergy's Manual of Systematic Bacteriology. Williams and Wilkins, Baltimore, MD", pp. 1710–1727,1989.

[66] M. Megharaj, D.R. Madhavi, C. Sreenivasulu, A. Umamaheswari, K. Venkateswarlu, "Biodegradation of methyl parathion by soil isolates of microalgae and cyanobacteria", *Bulletin of Environmental Contamination and Toxicology*, vol. 53, pp. 292–297, 1994.

[67] N.A. Sokhoh, R.H. Al-Hasan, S.S. Radwan, T. Hopner, "Self cleaning of the Gulf", *Nature* (London), vol. 359, pp. 109, 1992.

[68] R.H. Al-Hasan, M. Khanafer, M. Eliyas, S.S. Radwan, "Hydrocarbon accumulation by picocyanobacteria from the Arabian Gulf", *Journal of Applied Microbiology,* vol. 91 (3), pp. 533–540, 2001.

[69] C.E. Cerniglia, C. Van Baalen, D.T. Gibson, "Oxidation of naphthalene by cyanobacteria and microalgae", *Journal of General Microbiology*, vol. 116, pp. 495–500, 1980b.

[70] C.E. Cerniglia, C. Van Baalen, D.T. Gibson, "Metabolism of naphthalene by the cyanobacterium Oscillatoria sp. strain JCM", *Journal of General Microbiology,* vol. 116, pp. 485–494, 1980a.

[71] M.L. Narro, C.E. Cerniglia, C. Van Baalen, D.T. Gibson, "Metabolism of phenanthrene by the Marine cyanobacterium Agmenellum quadriplicatum PR-6", *Applied and Environmental Microbiology* vol. 58, pp. 1351–1359, 1992.

[72] B.E. Ellis, 'Degradation of phenolic compounds by freshwater algae", *Plant Sciences Letters,* vol. 8, pp. 213–216, 1997.

[73] S. Shashirekha, L. Uma, G. Subramanian, "Phenol degradation by the marine cyanobacterium Phormidium valderianum BDU-30501", *Journal of Industrial Microbiology and Biotechnology*, vol. 19, pp. 130–133, 1997.

[74] M. Megharaj, K. Venkateswarlu, A.S. Rao, "Metabolism of monocrotophos and quinalphos by algae isolated from soil", *Bulletin of Environmental Contamination and Toxicology* vol. 39, pp. 251–256, 1987.

[75] Z. Khalil, "Toxicological response of a cyanobacterium, *Phormidium fragile* to mercury", *Water Air Soil Poll* , vol. 98, pp. 179-185, 1997.

[76] B.B. Mishra and D.R. Nanda, "Reclamation with cyanobacteria: Toxic effect of mercury contaminated waste soil on biochemical variables", *Cytobios*, vol. 92, pp. 203- 208, 1997.

[77] E.P. Lincoln, A.C. Wilkie, B.T. French, "Cyanobacterial process for renovating dairy wastewater", *Bioengineering,* vol. 10, pp. 63–68, 1996.

[78] Duma, G. Lalibertk, P. Lessard, V. J. de la Noiiea, "Biotreatment of fish farm effluents using the cyanobacterium Phormidium bohneri", *Aquacultural Engineering*, vol. 17, pp. 57–68, 1998.

[79] Imai, R., Y. Nagata, M. Fukuda, M. Takagi, and K. Yano, "Molecular cloning of a *Pseudomonas paucimobilis* gene encoding a 17-kilodalton polypeptide that eliminates HCl molecules from g-hexachlorocyclohexane", *J. Bacteriol*, vol. 173, pp. 6811–6819, 1991.

[80] C.M. Tu, "Utilization and degradation of lindane by soil microorganisms", *Arch. Microbiol*, vol. 108, pp. 259–263, 1976.

[81] W. N. Yule, M. Chiba, and H. V. Morley, "Fate of insecticide residues. Decomposition of lindane in soil", *J. Agric. Food Chem*, vol. 15, pp. 1000–1004, 1967.

[82] A. J. Francis, R. J. Spanggord, and G. I. Ouchi, "Degradation of lindane by *Escherichia coli*", *Appl. Microbiol,* vol. 29, pp. 567–568, 1975

[83] V. Kannan, M. Vijayasanthi and N. Rajmohan ,"Bioremediation of Tannery Effluents by Filamentous Cyanobacteria Anabaena Flos-Aquae", *West: Hydrology Current Research,* vol. 2, pp. 5, 2011, http://dx.doi.org/10.4172/2157-7587.1000122.

[84] A.L. El-Enany, and A.A. Issa, "Cyanobacteria of heavy metals in sewage water", *Environ. Toxicol. Pharma*., vol. 8, pp. 95-101, 2000.

[85] R. K. Thauer, G. Diekert and P. Schonheit, "Biological role of nickel", *Trends Biochem. Sci*., vol. 5, pp. 304-306, 1980.

[86] R.M. Welch, "MIronutrient nutrition plant Rev", *Plant Sci*., vol. 14, pp. 49-82, 1995.

[87] L. Uma, and G. Subramanian, "Effective use of cyanobacteria in effluent treatment", *In Proceedings of the National Symposium on Cyanobacterial N2 fixation* IARI, New Delhi, 1990, pp. 437–444, 1990.

[88] S.Shashirekha, , L Uma,. and G Subramanian, "Phenol degradation by the marine cyanobacterium Phormidium valderianum BDU 30501", *J Ind Microbiol Biotechnol,* vol. 19, pp. 130–133, 1997.

[89] F.D. Kalavathi, L. Uma, and G. Subramanian, "Degradation and metabolization of the pigment melanoidin in distillery effluent by the marine cyanobacterium Oscillatoria boryana BDU 92181", *Enz Microb Technol*, vol. 29, pp. 249–251, 2001.

[90] D.G. Slotton, C.R. Goldman, and A. Frank, "Commercially Grown *Spirulina* Found to

[91] Contain Low Levels of Mercury and Lead", "*Nutrition Reports International*", 40, 2, pp. 1165-1172, 1989.

[92] J. L. Gardea-Torresdeya , J. L. Arenasb, N.M.C. Franciscob, K. J. Tiemanna, "Ability of immobilized cyanobacteria to remove metal ions from solution and demonstration of the presence of metallothionein genes in various strains", Journal of Hazardous Substance Research, Volume 1 Mar. Drugs 2013, 11 2379

[93] C. Y. Shao, C. J. Howe, A. J. R. Porter, and L. A. Glover, "Novel Cyanobacterial Biosensor for Detection of Herbicides" , *Applied and environmental microbiology*, vol. 68, No. 10 pp. 5026–5033, Oct. *2002: 0099-2240/02/$04.00_0 DOI: 10.1128/AEM.68.10.5026–5033.2002*

[94] A.M. Burja, B. Banaigs, E. Abou-Mansour, J.G. Burgess, P.C. Wright, "Marine cyanobacteria: A prolific source of natural products" , *Tetrahedron Lett.,* vol. 57, pp. 9347–9377, 2001.

[95] M.E. Silva-Stenico, C.S.P. Silva, A.S. Lorenzi, T.K. Shishido, A. Etchegaray, S.P. Lira, L.A.B. Moraes and M.F. Fiore, "Non-ribosomal peptides produced by Brazilian cyanobacterial isolates with antimicrobial activity", *Microbiol. Res.*, vol. 166, pp. 161–175, 2011.

[96] S.E. Karatay, G. Donmez, "Microbial oil production from thermophile cyanobacteria for biodiesel production", *Appl. Energ*., vol. 88, pp. 3632–3635, 2011.

[97] J.A.V. Costa and M.G Morais, "The role of biochemical engineering in the production of biofuels from microalgae", *Bioresour. Technol.*, vol. 102, pp. 2–9, 2011.

[98] H. Taher, S. Al-Zuhair, A.H. Al-Marzouqi, Y. Haik,; M.M. Farid, "A review of enzymatic transesterification of microalgal oil; -based biodiesel using supercritical technology" , *Enzyme Res*. 2011. *468292; doi:10.4061/2011/468292.*

[99] B.E. Rittmann, "Opportunities for renewable bioenergy using microorganisms", *Biotechnol*. *Bioeng*, vol. 2, pp. 203–212, 2008.

[100] L. Balasubramanian, G. Subramanian, T.T. Nazeer, H.S. Simpson, S.T. Rahuman, P. Raju, "Cyanobacteria cultivation in industrial wastewaters and biodiesel production from their biomass: A review", *Biotechnol. Appl. Biochem*, vol. 59, pp. 220–225, 2012.

[101] M.A. Vargas, H. Rodriguez, J. Moreno, H. Olivares, J.A. Delcampo, J. Rivas and M.G. Guerrero, "Biochemical composition and fatty acid content of filamentous nitrogen-fixing cyanobacteria", *J. Phycol*, vol. 34, pp. 812–817, 1998

[102] Patrick C. Hallenbeck: Hydrogen production by cyanobacteria P.C. Hallenbeck (ed.), *Microbial Technologies in Advanced Biofuels Production*,: DOI 10.1007/978-1-4614-1208-3_2, © Springer Science+Business Media, LLC, 2012

[103] P.A. Roger and P.A. Reynaud, "Free-living Blue-green Algae in Tropical Soils", Martinus Nijh off Publisher, La Hague, 1982.

[104] A.A. Rodriguez, A.A. Stella, MM. Storni, G. Zulpa, M.C. Zaccaro, "Effects of cyanobacterial extracelular products and gibberellic acid on salinity tolerance in *Oryza sativa* L. Saline System", *2*, 7, 2006.

[105] Saadatnia and Riahi, "Cyanobacteria from paddy fields in Iran as a biofertilizer in rice plants", *Plant Soil and Environment,* vol. 55(5), pp. 207-212, 2009.

[106] G. Subramanaian and L. Uma, "Cyanobacteria in pollution control", *Journal of. Science. Industrial research*, vol. 55, pp. 685-692, 1996.

[107] L.T. Wilson, "Cyanobacteria: A Potential Nitrogen Source in Rice Fields", *Texas Rice vol.* 6, pp. 9–10, 2006

[108] N. Thajuddin and G. Subramanian,"Cyanobacterial biodiversity and potential applications in biotechnology", *Current Science* 89 47–57, 2005.

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Global e-Government: What needs to be Learned? A Reflection on UN e-Government Survey 2014

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ABSTRACT: In June, the United Nations E-Government Survey 2014 was released. Its theme is "E-Government for the Future We Want." The report provides a comprehensive collection of U.N. global surveys regarding the status of e-government and related practices around the world. South Korea once again topped the report's rankings. Many countries have climbed the standings since release of the last report in 2012. This indicates worldwide growth in e-government. The leaders in e-government have many lessons to teach those grasping the concept. This paper will deliver an unbiased view of these e-government leaders. It also will detail the critical elements other countries must adopt in their drive for e-government.

KEYWORDS: online services index, e-government, human capital index, telecom infrastructure index, e-government development index, UN Survey.

1 INTRODUCTION

In June, the United Nations E-Government Survey 2014 was released. Its theme is "E-Government for the Future We Want." The report is viewed as especially pertinent to dealing with the issues many societies wrestling with today.

The e-government definition was updated to better coincide with this visionary approach. The 2004 UN E-Government report used the following e-government definition, "the use of ICT and its application by the government for the provision of information and public services to the people" (Global E-Government Readiness Report 2004). In the 2014 report, the definition was extended to say "the use and application of information technologies in public administration to streamline and integrate workflows and processes, to effectively manage data and information, enhance public service delivery, as well as expand communication channels for engagement and empowerment of people."

The UN Survey reveals an extended view of e-government that encompasses opportunities provided by the recent growth and development of digital communication, including big data, online services, mobile apps, cloud computing, and social media. However, the report's conceptual framework continues to rest upon three critical dimensions: (i) human capacity, (ii) availability of online services, and telecommunication infrastructure.

2 OVERVIEW OF THE UN E-GOVERNMENT SURVEY REPORT 2014

South Korea remained on top in 2014, continuing its preeminence and concentration on innovation in e-government. Ranking second was Australia, with Singapore in third, both moving up the ranks considerably versus 2012, when they were twelfth and tenth, respectively.

In the 2014 survey, Europe continues its lead from previous years, recording the top regional E-Government Development Index (EGDI), followed next by the Americas, led by the seventh-ranked United States; South Korea leads the Asia region and Australia leads the Oceania region; Tunisia, ranked seventh-fifth in the world, leads the Africa region.

Still, the 2014 survey illustrates that every geographic region displays extensive diversity internally. Europe's leading nations include France, ranked fourth globally; the Netherlands, ranked fifth; the United Kingdom, ranked eighth globally; and Finland, ranked tenth. Undoubtedly, the foundation of these rankings reflects the countries' economic, social, and political development. Current and previous investment in provisioning of online services, investment in telecommunication and human capital are important factors resulting in a high level of e-government development.

The 2014 survey included new questions regarding Open Government Data (OGD), such as the types of technical formats and location information, the possibility for users to propose new data sets, the existence of dedicated portals, and the availability of user guidelines and support. It discovered that although many countries share data by utilizing government websites, a mere 46 counties use dedicated data portals.

One can see most primary government divisions make OGD available, primarily in machine-readable format. However, a lack of Open Government Data is regarded as a lack of availability of government information/transparency, which has resulted in many countries dropping down in the rankings versus 2012.

In contrast, this has helped several countries to improve their E-Government Development Index. The amazing thing is the leading countries have overtaken those from 2012 by improving several spots from 2012, which is illustrated in Table 1 below.

Table 1: Top 12 of the e-government development index

Country	Region	2014 EGDI	2014 Rank	2012 Rank	Change in Rank (2012-2014)
Republic of korea	Asia	0.9462	1	1	-
Australia	Oceania	0.9103	2	12	10 ▲
Singapore	Asia	0.9076	3	10	7 ▲
france	Europe	0.8938	4	6	2 ▲
Netherlands	Europe	0.8897	5	2	3 ▼
Japan	Asia	0.8874	6	18	12 ▲
United States of America	Americas	0.8748	7	5	2 ▼
United Kingdom	Europe	0.8695	8	3	5 ▼
New Zealand	Oceania	0.8644	9	13	4 ▲
Finland	Europe	0.8449	10	9	1 ▼
Canada	Americas	0.8418	11	11	-
Spain	Europe	0.8410	12	23	11 ▲

Figure 1 below shows the E-Government Development Index (EGDI) Distribution, with most countries ranging between 0.2 and 0.6. This scope of EGDI shows 114 countries of the 193 surveyed. This reveals a broad disparity between developed and developing countries, illustrating the poor levels of human capital availability, online services and technical infrastructure. The survey shows the Telecom Infrastructure Index has helped weight down the overall EGDI of these countries, access to broadband Internet on mobile and fixed devices has been found particularly lacking.

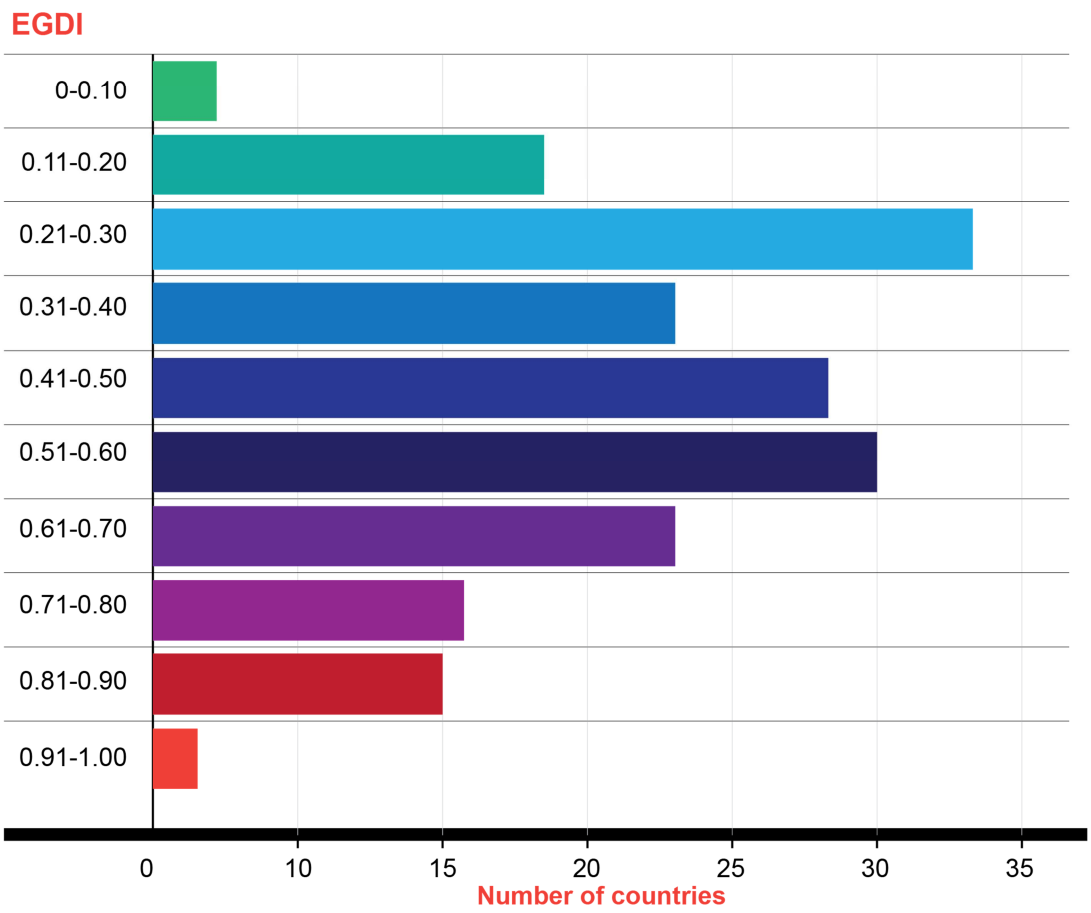


Figure 1: E-Government development index (EGDI) distribution

3 REGIONAL DEVELOPMENT

Strong regional growth continues to be seen in Europe. A wide range of growth amid individual countries can be seen in all the other regions. Figure Two illustrates this point. It displays amazing consistency among European Union nations, evidently because of concentrated efforts throughout the region.

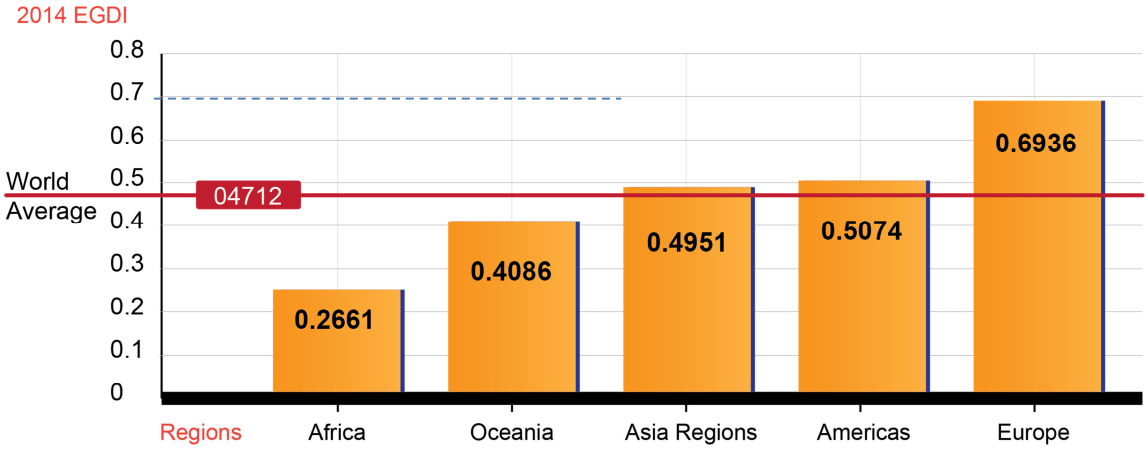


Figure 2: Averages of e-government development by region

The European Union's EGDI average a region is far above the world's average, placing in the high EGDI category. By contrast, Asia and the Americas display a low average, signaling a broad disparity in the countries' EGDI. This is in spite of Asia having some of the individual leaders. In North America, only the United States and Canada have high EGDIs while the region's other countries are far behind, depressing the region's average.

In this framework it is quite interesting to notice Uruguay's strong growth. The South American country improved 24 places, rising from 50th in 2012 to 26th in 2014. See also Table 2. So how did Uruguay improve as much as 24 places from its 2012 ranking? Let's try looking into some of these circumstances in the following section.

Table 2: High Growth Countries Include Uruguay

Country	Level of Income	EGDI	2014 Rank	2012 Rank	Change in Rank
		Very High EGDI			
United States of America	High	0.8748	7	5	**2** ▼
Canada	High	0.8418	11	11	**-**
		High EGDI			
Uruguay	High	0.7420	26	50	**24** ▲

3.1 AGENCY FOR E-GOVERNMENT DEVELOPMENT IN URUGUAY

In 2007, Uruguay created a national e-Government agency. The Agency for Electronic Government and Information Society was the basis for the country's swift progress in e-government. The agency's primary duties were developing and promoting broad access to ICT; providing innovative solutions to improve public services and quality of care; providing under one umbrella user support for initiatives and consultations related to the agency's competence; simplifying procedures and processes; and acquiring the knowledge and skills for greater social integration and better-equipped young people in the future.

During the past few years the agency bolstered links with international organizations that had similar purposes, civil society and academia to handle issues together and propose standards, policies and rules; worked to enhance the cooperation businesses and the state; and advocated creation of national software.

Another of Uruguay's national initiatives is the e-Government Platform. It aims to enable and promote development of the country's e-government services. The platform pursues a two-pronged strategy. It consists of a set of "Cross-cutting Services" and an "Interoperability Platform. It pursues a service-oriented architecture, leveraging web services technology, to combine, expose and use government functionality put to use by government agencies. The platform is envisioned as being an important enabler for created an integrated e-government approach in Uruguay. Evidently, the important lesson for other countries is the need for providing "a unified and simplified national approach for adoption of ICT in the country."

3.2 ASIA REGION

Singapore ranked second in the Asia region. It has displayed meaningful improvement during the past two years, improving from tenth place to third place globally. It was followed by Japan, which improved from eighteenth to sixth place globally. Table 3 follows, showing Asia's top-ranking nations.

Table 3: Asia's top-ranking countries

Country	Level of Income	EGDI	2014 Rank	2012 Rank	Change in Rank
Very High EGDI					
Republic of korea	High	0.9462	1	1	-
Singapore	High	0.9076	3	10	7 ▲
Japan	High	0.8874	6	18	12 ▲
Israel	High	0.8162	17	16	1 ▼
Bahrain	High	0.8089	18	36	18 ▲
High EGDI					
Kazakhstan	Upper Middle	0.7283	28	38	10 ▲
United Arab Emirates	High	0.7136	32	28	4 ▼
Saudi Arabia	High	0.6900	36	41	5 ▲
Qatar	High	0.6362	44	48	4 ▲
Oman	High	0.6273	48	64	16 ▲
Kuwait	High	0.6268	49	63	14 ▲

Oman, Saudi Arabia, Kazakhstan and Bahrain moved up in the worldwide rankings into 48th, 36th, 28th, and 18th places, respectively. See also Table 4. At this point, let's examine more closely the GCC bloc. One can see Bahrain has markedly improved its position from 36th in the world in 2012. All GCC countries are classified as high EGDI countries. Bahrain has breached the "glass ceiling" to join other very high EGDI countries. The GCC's average is almost identical to the European Union bloc, displaying parity in development of e-government.

Table 4: UN 2014 survey of GCC countries

Country	Level of Income	EGDI	2014 Rank	2012 Rank	Change in Rank
Very High EGDI					
Bahrain	GCC Member	0.8089	18	36	18 ▲
High EGDI					
United Arab Emirates	GCC Member	0.7136	32	28	4 ▼
Saudi Arabia	GCC Member	0.6900	36	41	5 ▲
Qatar	GCC Member	0.6362	44	48	4 ▲
Oman	GCC Member	0.6273	48	64	16 ▲
Kuwait	GCC Member	0.6268	49	63	14 ▲
Regional Average		0.6838			
World Average		0.4712			

3.3 WHAT HAS MADE BAHRAIN DIFFERENT?

Bahrain is yet another case of coordinated and determined efforts to deliver e-Government services to its citizens that allowed a major improvement from the rankings in 2012. Bahrain rose to 18th globally in 2014 from 36th in 2012. The

country's Supreme Committee for Information and Communication Technology (SCICT) under the Deputy Prime Minister's Chairmanship created their lofty goals for e-government and set up the e-Government Authority (eGA) in August 2007 by Royal Decree 69. It coordinated and executed initiatives that adhered to the plans and strategies created by the SCICT. The eGA mandate is providing direction in implementing and developing a comprehensive e-Government strategy. Bahrain has started numerous international discussions and forums to handle current issues related to mobile trends, innovation and open data, overall e-Government development and social networks, shared services and cloud computing. These concentrated efforts guaranteed high visibility for Bahrain's e-Government initiatives and guaranteed effective e-services delivery. Remarkably, Uruguay and Bahrain seem to display similarities in how they reached their current EGDI rankings.

3.4 E-GOVERNMENT IN THE EU?

At this point it's worth noting the European Union's success in not only maintaining its steady EGDI growth but also its growth as a region. Its collective average is far above the worldwide average and, more significantly, the European Union as a whole displays a High EGDI even though none of its nations are in the top three and only four are in the top ten (Finland, U.K., Netherlands, France).

As a region, Europe concentrates its e-government endeavors through the European Commission's Digital Agenda for Europe (DAE), which is guided by the Government Action Plan 2015. The 28 European Union members' e-government strategies, along with to some degree those of the region's non-member states, are shaped by the seven pillars of fast and ultrafast Internet access, the digital single market, research and innovation, interoperability and standardization, enhancement of digital literacy, trust and security, and social inclusion and skills delivering ICT-enabled benefits for European Union society. These seven distinct goals were set up by DAE as important areas for achievement through the action plan released at the end of 2012.

The DAE's success and that of the action plan can be credited to a long-term plan to developing e-government, inserting it into broader frameworks of socio-economic development instead of viewing e-government a mostly technical or stand-alone activity. Also critical is the European Union countries' voluntary commitment toward working together in working toward common goals through the Open Method of Coordination approach. European Union countries, with their concentrated e-government efforts with the action plan and the DAE, ranked high in the e-Government Development Index. Fifteen of the 28 European Union countries were in the top 30 worldwide.

4 A MICRO VIEW OF THE E-GOVERNMENT DEVELOPMENT INDEX (EGDI)

It is critical to look at the inner workings of the e-government ranking system overall, for example, the e-Government Development Index and the scoring system, to comprehend why and how some countries fared the way they did. The EGDI is made up of three parts with sub-sections in each. The three parts are weighted equally. See also Figure 3.

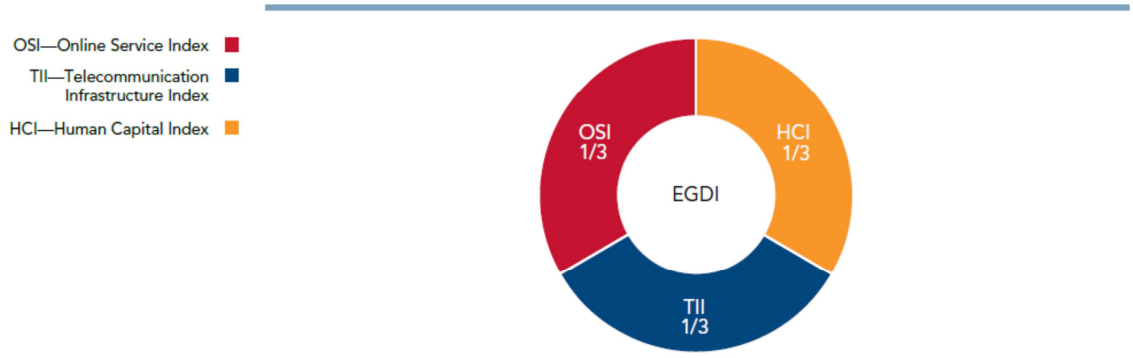


Figure 3: EGDI Score Systems

We should look at these indicators with regard to the five top countries and see what set those countries apart. These countries are depicted in Table 5.

Table 5: EGDI- Top 5 countries

Rank	Country	EGDI	Online Service Component	Telecome. Infrastructure Component	Human Capital Component
1	Republic of korea	0.9462	0.9764	0.9350	0.9273
2	Australia	0.9103	0.9291	0.8041	0.9978
3	Singapore	0.9067	0.9921	0.8793	0.8515
4	France	0.8938	1.0000	0.8003	0.8812
5	Netherlands	0.8897	0.9291	0.8175	0.9224

Numerous countries scored low on the Human Capital component and Telecom Infrastructure component in spite of all their telecommunications facilities and other IT infrastructure. This seems a bit inconsistent when you consider some of the countries that ranked lower in the survey have vast ICT infrastructure and the highest mobile telephone penetration. The answer lies in the details. The sub-component of mobile broadband has very low scores, significantly bringing down the overall telecom index. Let us examine the individual components and evaluate the scoring.

4.1 Online Service Index

Data was gathered in 2014 on providing basic e-services, attention to e-participation, adoption of open data initiatives, whole-of-government and bridging digital divides, expanding usage, and multichannel service delivery that might exist between and within countries.

In 2014, France ranked number one in online service delivery, followed by Singapore and South Korea. Among other reasons, these countries stand out because of their expanded roll-out of mobile applications, provision of opportunities for e-participation and integration of e-services. Spain (fourth), Uruguay (fourteenth), New Zealand (fifteenth), and Chile (sixteenth) all climbed into the top twenty of 2014, surpassing former 2012 leaders Malaysia, Sweden, Norway and Denmark.

Why has France topped this Index?

Securing the top spot in the 2014 Online Service Index, France scored well throughout all practice areas and online service development stages because of continuing efforts toward improving the quality of public services, integrating government websites and encouraging citizen consultation on both service delivery methods and public policy. Also see Table 6. The national administration's official website (http://www.servicepublic.fr) guides associations, businesses and individuals to necessary services by subject as well as event, encourages suggestions for administrative simplification, connects citizens with current consultations and debates, and helps interaction with government through use of a single sign-on. It not only acts as a single access point for government services but also streamlines government service by providing users with a wealth of information.

Table 6: Online Service Index's top twelve countries

Country	Online Service Index
France	1.0000
Singapore	0.9921
Republic of Korea	0.9764
Japan	0.9449
Spain	0.9449
United States	0.9449
Bahrain	0.9370
Australia	0.9291
Netherlands	0.9291
Canada	0.9134
United Kingdom	0.8976
United Arab Emirates	0.8819

Using France's perfect 1.0 as a benchmark, let's look at where other countries fell short. As shown in Table 7, the Online Service Index utilizes a four-stage model to measure online services' effectiveness.

Table 7: Four stages for measuring online services

		Stage 1 Emerging presence	Stage 2 Enhanced presence	Stage 3 Transactional presence	Stage 4 Networked presence	
Country	OSI	Stage 1	Stage 2	Stage 3	Stage 4	Total
		percentage				
France	1.0000	100	73	91	91	88
Singapore	0.9921	100	89	88	71	87
Republic of Korea	0.9764	100	82	77	88	86
Japan	0.9449	97	73	79	88	83

The picture presented here is a clear one. Countries ranking low appeared to have floundered in their Online Transactional presence and, as a result, the "whole of Government." A definite need certainly exists for an enhanced online presence to allow actual service delivery and e-transactions. The other significant contributor to "whole of government" is integrated government agencies indicated by a networked presence. These two key factors appear to have hampered other countries, using the top five countries as a benchmark.

4.2 TELECOM INFRASTRUCTURE INDEX

In the 2014 survey report, the computation of Telecommunication Infrastructure Index (TII) included a new wireless broadband subscription indicator. See also Table 8. The TII is an arithmetic average of five separate indicators: Number of Main Fixed Telephone Lines per 100 Inhabitants, Estimated Internet Users per 100 Inhabitants, Number of Fixed Broadband Subscriptions per 100 Inhabitants, Number of Wireless Broadband Subscriptions per 100 Inhabitants, and Number of Mobile Subscribers per 100 Inhabitants. The primary data source in each case is the International Telecommunication Union. Numerous countries appear to have rather low in the TII. Let's take a look at why that might be.

Table 8t: The Top 5 in the Telecommunication Infrastructure Index (TII) in detail

Country	TII	Percentage of Individuals using the Internet	Fixed telephone subscriptions per 100 inhabitants	Mobile-cellular telephone subscriptions per 100 inhabitants	Fixed (wired)-broadband subscriptions per 100 inhabitants	Wireless broadband subscriptions per 100 inhabitants
Republic of Korea	0.9350	84.10	61.42	109.43	37.25	105.14
Australia	0.8041	82.35	45.43	105.59	24.91	102.07
Singapore	0.8793	74.18	37.51	152.04	25.85	123.76
France	0.8003	83.00	61.45	97.41	37.47	51.77
Netherlands	0.8175	93.00	42.40	117.52	39.44	60.98

Looking at France, one can see that telephone connections and the number of broadband connections negatively impact the lower-ranked countries on the EGDI list. Countries such as the United Arab Emirates and India have scored lower due to these factors, in spite of widespread mobile penetration and Internet access. Fixed and mobile broadband access appears to have been viewed by the United Nations as an indicator for remote and e-services. This is a primary reason transactions, Internet access and services on mobile devices becomes so important to the service providers. Knowing that the unique demographics of African countries prohibit large-scale construction of fixed telephone lines that provide broadband Internet, mobile device usage is viewed as a method for improving access. Thus, technology needs to be capitalized and leveraged.

4.3 HUMAN CAPITAL INDEX

The 2014 survey used two new components in the Human Capital Index (HCI), (i) expected years of education; and (ii) average years of education. They were combined with the existing components of adult literacy rate and combined primary, secondary and tertiary gross enrollment ratio utilized in surveys since 2002. Once again, let's compare with the top five to see what other countries need to do to catch up.

Once again we will look at the EGDI Sub-Indexes of the Top 5 in Table 9. Aside from the TII, the HCI is viewed as weighing down the nations' composite index.

Table 9: EGDI sub-indexes of the Top 5

Rank	Country	EGDI	Online Service Component	Telecome. Infrastructure Component	Human Capital Component
1	Republic of korea	0.9462	0.9764	0.9350	0.9273
2	Australia	0.9103	0.9291	0.8041	0.9978
3	Singapore	0.9067	0.9921	0.8793	0.8515
4	France	0.8938	1.0000	0.8003	0.8812
5	Netherlands	0.8897	0.9291	0.8175	0.9224

In Table 10, we can see why this is the case.

Table 10: Education Index

Country	HCI	Adult Literacy (%)			Gross enrolment ratio (%)			Expected years of schooling			Mean years of schooling		
		Index value	Year	Source	Index value	Year	Source	Index value	Year	Source	Index value	Year	Source
Republic of Korea	0.9273	99.00	2005	UNESCO	99.00	2005	UNESCO	99.00	2005	UNESCO	99.00	2005	UNESCO
Australia	0.9978	99.00	2005	UNESCO	99.00	2005	UNESCO	99.00	2005	UNESCO	99.00	2005	UNESCO
Singapore	0.8515	95.86	2010	UNESCO	95.86	2010	UNESCO	95.86	2010	UNESCO	95.86	2010	UNESCO
France	0.8812	99.00	2005	UNESCO	99.00	2005	UNESCO	99.00	2005	UNESCO	99.00	2005	UNESCO
Netherlands	0.9224	99.00	2005	UNESCO	99.00	2005	UNESCO	99.00	2005	UNESCO	99.00	2005	UNESCO

It is evident from this table that education – particularly adult literacy and enrollment must be addressed aggressively. A shocking point that can be seen here is low number for expected years of education. Nonetheless, this data appears outdated for many countries compared to the top-ranking countries, with sources dating back as far as 2011.

5 Observations and Considerations of the Circle of Attention

Every one of the top-ranked countries has displayed exceptional growth from 2012, moving up several places. According to the survey, this is due to several reasons, including the following:

1. Lack of e-Government participation by the general population;
2. Lack of widespread mobile broadband penetration due to its cost;
3. Lack of an integrated e-service delivery mechanism in the Government;
4. Perceived low education levels in the country; and
5. Perceived low interoperability in government agencies, leading to a lesser "Whole of Government" approach.

Based upon the evidence and arguments presented so far, we have *circle of attention* recommendations for improving a country's e-Government Index. The ten recommendations follow next.

1. **Open Government Data**: The survey appears to have outdated data, especially regarding HCI. This highlights countries' Open Data requirements and the requirement for government agencies to participate and share information with the public. This is apparent from some of the statistics published on government and open data websites. Maybe these were not accessible or available when the UN survey was conducted.
2. **Online Transactions-** E-Commerce: This yet another of the low-ranking elements that can be fixed easily. It is evident there's more to it than simply submitting online applications with service requests or having an online presence. It is an issue of successful service fulfillment. That is accomplished only by bringing a paradigm shift to the ability to conduct secure online transactions. Achieving the volume required for is shown by the performance of the top-ranking EGDI countries.
3. **Enabling the National ID Card for Digital Payments-** This is viewed as contributing greatly to online and e-payments creating exponential growth in digital transactions.
    a. **Financial Inclusion –** of the population that is underserved by banks or not served at all with digital payment-enabled Smart ID Cards will dramatically change the number of digital transactions nationwide.
    b. **Trust in Online Services –** Using the National ID Card for digital transactions will increase the level of trust in online transactions and enhance e-service usage and delivery.
4. **Integration Platform –** A national-level Integration Platform that merges government departments with the National ID as the primary key must be established. It not only will help create integrated and seamless delivery of government services but countries that adopt it also will go up several notches on the Whole of Government Approach. Horizontal Integration instead of Vertical Integration must be pursued.
5. **Access to Broadband Internet**: Several countries ranked low in TII because of perceived limited access to broadband Internet. Adopting the latest technologies should provide low-cost, high-speed Internet access to the general population. This can be seen around the world with the managed spectrum roll-out and public allocation of the spectrum.
6. **Smart Government Services- Integrated** Services, as provided by countries such as the United Arab Emirates, are destined to upgrade Government Service Deliveries. This is viewed as a key component of universal service delivery across all mobile and fixed channels.

a. **Mobile ID-** It is a critical component of mobile transactions; an important part of smart services footing that enables governments' mobile presence with commercial transactions.

7. **Primary and Secondary Education-** This must be made mandatory. The minimum requirements for 12 years of education must be spelled out for all students. It will increase the national average of countries' expected years of education to more than 17, given that white-collar workers would average 21 years of education. The United Nations also outlined this as one of its MDGs.
8. **Social Benefits-** Identifying connected digital transactions in social benefits delivery will create auditable reports on the beneficiaries and benefactors, allowing improved reporting on the social benefits systems.
9. **Innovation Index-** must be created in the country and actively advertised. Innovation must be encouraged, creating strong knowledge economies.
10. **National e-Government Development Index**- Similar to what the United Nations did, governments around the world should adopt a plan for developing e-government and directing government agencies toward e-government maturity. An example is the United Arab Emirates' recent announcement that it is launching its e-government readiness and e-government readiness index. Performance indicators are determined for evaluation and measurement at the country's highest level.

6 CONCLUSION

The 2014 UN e-government survey certainly emerges as a global benchmarking tool for judging the world's progress in e-government. The survey gives governments an opportunity to judge their progress overall, re-order priorities and rework their e-government plans to respond to the digital age's needs.

Nonetheless, it is worth noting the amount of confusion around e-government overall. One item to keep in mind here is no right or wrong approach exists when developing e-government. Several elements might support one or another approach's success or failure; every country has its own cultural elements and uniqueness to consider.

However, simply stated, e-government's objective – its limitations notwithstanding – is reaching out and contributing to the happiness of a country's citizens. That might come across as purely symbolic but such simple goals are necessary to allow delivery of tangible outcomes and measurement of success.

Governments throughout the world have invested huge sums of money in ICT capabilities during the past two decades. In spite of these investments, the desired results remain far from being fulfilled. Thus, e-government must be re-examined without the current technical limitations, using a more holistic implementation approach that strives for citizen happiness and satisfaction.

E-government programs have operated with the same engine as when they began in the 1990s. In spite of the new realities and forces, governments throughout the world have been wary in their progress toward e-government.

If governments want noticeable results in this important area, they must fundamentally re-examine their existing mindset and ways of doing things and concentrate on achieving the goal of citizen happiness. The only workable solution may be reinventing government's mindset.

REFERENCES

[1] United Nations - UN (2004) Global E-Government Readiness Report 2004, http://unpan3.un.org/egovkb/Portals/egovkb/Documents/un/2004-Survey/Complete-Survey.pdf

[2] United Nations - UN (2014) UN Global e-Government Survey 2014, http://unpan3.un.org/egovkb/Portals/egovkb/Documents/un/2014-Survey/E-Gov_Complete_Survey-2014.pdf

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Prospects of Solar home system in Bangladesh and a case study for tariff calculation

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ABSTRACT: The increasing demand of electric power and shortage of present energy resources lead today engineers and scientists to think about the alternative sources of energy, the sunlight is a potential sources for generating electric power. In recent years, it is increasingly used to generated power .The use of solar energy is attractive for solar home system application also. Solar home systems are quite needing no fuel and require very little maintenance. Other advantage of a PV system are free energy, reliable power, flexibility and quick installation. Author discussed Solar Photo-voltaic based Renewable energy system in Bangladesh**.** Finally, author try to analyze solar home system per unit cost. The government institute is "Infrastructure development companylimited"(IDCOL) established from 2003 to 2013 solar home system 20lakh and produce100 MW electricity. We know that 70% people lived in rural area. So, this project is not sufficient for development in rural area. Sun is the source of all energy available in the world. The initial cost of the solar energy would be much higher but the experts believe that it would be a cost effective alternative to other source of energy. So, we can take initiative to increase solar energy in our house hold system and able to find an alternate way of renewable energy.

KEYWORDS: Tariff, Solar home system, Rural electrification, IDCOL, Bangladesh.

1 INTRODUCTION

Bangladesh is one of the densely populated countries which have not sufficient supply of energy. In Bangladesh, almost 80% of the people live in the village and only 32% of total population is connected to grid electricity (Rahman, 2006).In light of the present demand for electricity; by 2020 the energy mix will be changed considerably from what it is today. The possibilities of using solar power are already being tested and will mostly increase. But still, most households meet their daily needs with biomass fuel. With only 60% of Bangladeshis having access to electricity, the per capita energy consumption is only 292 kWh per annum. Even people who are connected with the national grid are experiencing frequent load shedding .So electricity source with ownership getting popular day by day without dependency on the national grid supply. As average solar radiation varies here from 4 kWh/m2 day in winter to 6.5 kWh/m2 day in summer, Solar Home System (SHS) has become one of the most popular sources of electricity in rural areas of Bangladesh. And now in some places Solar PV panels have installed commercially. There is no resource constraint for application of SHS as solar energy is abundant throughout the country. Decentralized and standalone systems could effectively become a viable option in rural areas .In the perspective of Bangladesh several NGOs like IDCOL (Infrastructure Development Company Limited), GS (Grameen Shakti), Rahim Afrooz, BRAC (Bangladesh Rural Advancement Committee), CCDR(Center for Community Development & Research)foundations are working to develop our electricity sector with renewable energy sources. The government also has set a target of generating

500 megawatts (MW) of green energy almost ten times the current amount by 2015, in an attempt to narrow the gap between current supplies of grid electricity and the needs of the people .Fossil fuels account for almost all the current capacity of 5,500 MW, with renewable sources mostly solar power contributing just 55 MW.

2 PHYSICAL PERSPECTIVE OF RENEWABLE ENERGY IN BANGLADESH

Today our electricity installed capacity is 10312 MW. Where public sector contribution is 5962 (58%) and private is 4291 (42%) Currently only 62 percent of total population in Bangladesh has access to electricity and per capita generation being 321 kWh which is very low compared to other developing countries. our power generation is dominated by indigenous natural gas which are 90 % during FY2010.share to natural gas for power generation is 80.37% during FY2012 which is declined by 9.63%.it is estimated that share of natural gas for power generation will be reduced by 52% and 20% during 2016 and 2030 respectively. Depletion of gas reserve has forced to shift primary fuel option from natural gas to coal and liquid fuel. Bangladesh trying to reduce its more dependence on natural gas by diversifying sources of primary fuel. At present the average cost of power generation is TK 6.3 /KWh while the cost of diesel based generation is 15.80/kwh. Yet cost of renewable is expensive compare to conventional energy but the difference is decreasing day by day.

Government has vision to provide electricity to all citizen by 2021 at reasonable and affordable prices. But it is fact that grid power will not available in some remote and isolated area for the next 20 years. That area, we must depend on solar energy. Renewable Energy Policy of Bangladesh sets targets for developing renewable energy resources to meet 5 percent of the total power demand by 2015 and 10 percent by 2020 [9]. Bangladesh already has achieved some remarkable successes in the implementation of renewable energy technologies (RET).

Bangladesh is situated between20.30-20.38 degrees north latitude and 88.04-92.44 degrees east which is an ideal area for solar energy. Utilization of solar energy potential is very important for the impact analysis of SHS in our country. Daily average solar radiation varies between 4-6.5 KWh per square meter [10]. We can get maximum amount of radiation on March-April and minimum from December – January. The average bright sunshine duration in Bangladesh in the dry season is about 7.6 hours a day, and that in the monsoon season is about 4.7 hours. The highest sunlight hours received is in Khulna with readings ranging from 2.86 to 9.04hours and in Barisal with readings ranging from 2.65 to 8.75 hours. These are very good statistics when compared to the 8 hours of daylight in Spain which produced 4 GW of energy covering 2.7% of national demand by the end of 2010. Moreover Germany produces 18 GW of energy which is 2% of their national demand with only half the solar Bangladesh. According to recent studies, yearly average insolation availability in Dhaka is 1.73MWh per squaremeter on a horizontal surface and 1.86MWh per square meter on a tilted surface. Again the annual amount of radiation is varies from1840-1575 KWh/m2 .which is 50-100% more than the Europe. Taking an average solar radiation of 1900 KWh per square meter, total annual solar radiation in Bangladesh is equivalent to 1010*1018 J. Present total yearly consumption of energy is about 700* 1018 J. It shows that even if 0.07% of the incident radiation can be utilized, total requirement of our energy can be met [11]. At present energy utilization in Bangladesh is about 0.15 Watt/sq. meter land area, whereas the availability is above 208 Watt/sq. This shows the enormity of the potentiality of SHS in Bangladesh by using this huge solar energy. What fraction of it can be used for our use will depend on the availability of the technologies suited to local conditions.

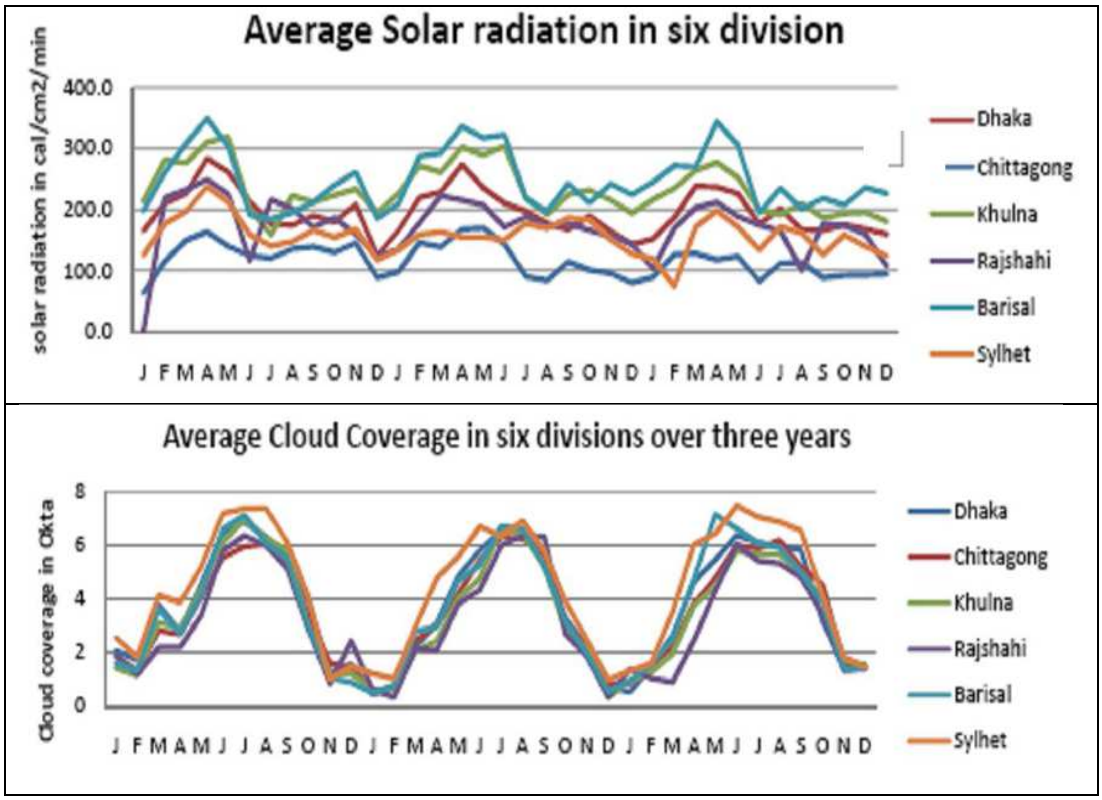


Fig:1.1: Average solar radiation in six divisions and average cloud coverage in six divisions.

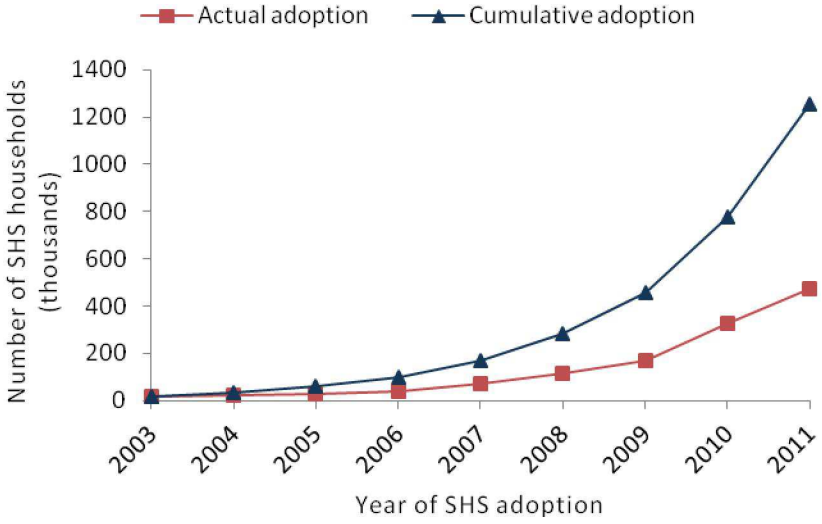
3 PRESENT STATUS OF SOLAR ENERGY IN BANGLADESH

Bangladesh is an agricultural country in South Asia with 163 million people, where sustainable development, energy crisis and food security is of great concern. Nearly 75% of the population lives in rural areas and only about 30% of the rural households have access to grid electricity. Alternative solution is to introduce solar home systems for the rural households in off-grid areas and to introduce solar grid.

Hybrid system for the rural grid areas. Financial initiatives as a result of policy push have major role to play in developing the market in Bangladesh. The basic applied forms of solar PV in rural Bangladesh are solar home system (SHS) and micro utility (electrification of rural markets). Feedback from the users of these system syndicates that solar energy-based electricity has been providing very satisfactory service to consumers. IDCOL, a government-owned agency equipped to develop private sector deploying private public partnership model, was selected as the implementation and monitoring agency of the solar energy program. Worthwhile to mention, IDCOL solar energy program is on of the fastest growing renewable energy programs in the world. It has brought in positive changes in the livelihood of people in remote rural areas of Bangladesh by providing access to electricity. The Chairman of the Senate Foreign Relation Committee of the United States, John Kerry in his speech at the World Bank Head office on 19 November 2009 mentioned IDCOL SHS project as a good example of literally life-altering project of the World Bank. IDCOL promotes dissemination of solar home system (SHS) in the remote rural areas of Bangladesh through its Solar Energy Program with the financial support from the World Bank, Global Environment Facility (GEF), KFW (German Development Bank), GIZ (German Technical Corporation),

Asian Development Bank, USAID and Islamic Development Bank. IDCOL started the program in January 2003 and its initial target was to finance 50,000 SHSs by the end of June 2008. The target was achieved in September 2005, 3 years ahead of schedule and US$ 2.0 million below estimated project cost. IDCOL then revised its target to install 1 million systems by 2012. This was also achieved ahead of schedule by june 2011. IDCOL celebrated installation of 2 million Solar Home Systems under its Renewable Energy Programs on 12 May 2013. Now IDCOL target to finance 4 millions SHSs by the and of year 2015.Up to November 2013, a total of 2,677,896 SHSs have already been installed under the program. IDCOL is implementing this programme with financial assistance from the World Bank, ADB, IDB, GEF, GIZ, CIDA,JICA and KFW. IDCOL implements through 47 partner organizations (POs) and solar PV growth market improves quality of life through access to electricity, which provides access to electricity to 200,000 people per month while adding 2.0 MW to national power generation by

installing 50,000 systems, creates additional income, generates activities in the rural areas, promotes local entrepreneurs, creates jobs in rural areas for both skilled and unskilled people, promotes domestic industries, and reduces carbon.



4 SOLAR ENERGY SOURCE OF BANGLADESH

First solar PV was disseminated by Rural Electrification Board (REB) in 1993 then Local Government Engineering Department (LGED), and then Infrastructure Development Company Limited (IDCOL) started their solar energy program (Islam & Marufa 2012). Currently, a numerous Government Organizations (GOs) and Non-Government Organizations (NGOs) are disseminating SHSs throughout the country under various renewable energy program financed by IDA, GTZ, KFW, GEF, ADB and IDB. IDCOL is the pioneer organization supporting its 47 Partner Organization (PO) to disseminate SHSs So far, up to November 2013, a total of 2,677,896 SHSs have already been installed under the program. A snapshot of SHSs dissemination by various GOs and NGOs in Bangladesh is shown in Table 1.

Table 1: Dissemination of SHSs by different organizations in Bangladesh

Organization	Number of SHSs Installed	Capacity
IDCOL's PO		
GS	1020,014 SHSs all over the country	10-130Wp each
RSF	389,583 SHSs all over the country	
BRAC	77,019 SHSs all over the country	40Wp (20%), 50Wp (60%) and 75Wp (20%)
Srizony Bangladesh	58,927 SHSs	
HFSKS	37,078 SHSs	
UBOMUS	25,234 SHSs	
BRIDGE	20,449 SHSs	
IDF	14,238 SHSs	
TMSS	13,059 SHSs	30–75Wp each
PDBF	10,672 SHSs	
SEF	21,720 SHSs	
AVA	12,817 SHSs	
DESHA	10,931 SHSs	
BGEF	50,000 SHSs	
RDF	20,027 SHSs	
COAST Trust	6,181 SHSs especially in coastal areas	
INGENI Ltd.	9,871 SHSs	
NUSRA	9,372 SHSs	
RIMSO Foundation	8,196 SHSs	
GHEL	6,138 SHSs	
SFDW	9,485 SHSs	
Other	29661 SHSs	
LGED	SHSs, centralized units, and water pump in different remote and coastal off-grid areas all over the country	53.84 kW
BPDB	1212 SHSs at off-grid Hill areas, 6 solar vaccination refrigerators, 3 solar water pump, 30 solar street light, 4 centralized solar PV power plant at Juraichari upazilla	374.26 kW
REB	23,412 SHSs Plants and Solar Power	1,937.855 kW
BCSIR	82 SHSs, 1 pump, 2 solar data logging units	1.5 kW
Total	About 2 million SHSs/SHLSs with solar water pump, solar central unit of total capacity 94 MW	

4.1 COST ANALYSIS OF SHS

Normally 40~85 Wp systems are mostly used in the rural areas. The cost of a 40 Wp system was 23,600 BDT, whereas for a 85 Wp system, the cost was 44,800 BDT. Table 4 represents the cost of SHSs with detail equipments provided by the POs. Battery, PV panel and charge controller are the three main components of the PV system. POs also provide structure for panel and battery, lamps and ballast, switch, switch board and necessary wires during the installation period. But, the owner or user had to buy other equipments if they need, such as, adapter, DC-DC converter for radio, cassette and mobile charger, etc. The breakdown of total cost of a 50 Wp system is shown in table 5. The Battery and solar panel were found to be the main reasons of the high cost of the PV system. Solar panel contributed to 28%, whereas battery cost was around 30% of the total cost though most of the batteries were produced in Bangladesh. Three years after sale service and installation cost 13.50%, overhead cost 10%, cable, switches and others 7.50% and lamp shade 5% were the significant others costs.Except these, tube lights and steel structure for panel contributed 2% and 1% of total cost respectively. This break down of cost was

also similar for 40 and 60 Wp system as price variation was not much. On the other hand, percentage of battery and panel cost was little bit higher for 80 and 85 Wp system. It was found that for 80 and 85 Wp battery and panel cost were 33% and 30% of the total cost respectively

Table 2: Current Cost of SHSs system

System Wp	Total cost (BDT)	Equipments
40	23600	One 40 Wp Solar Module , one 55/60 Ah Industrial Battery, 1No. 10 Amps Charge Controller, 1 No. Structure, 3 Nos. 7 Watt Lamp, Switch, Switch Board, Installation & Other Accessories.
50	28500	1 No. 50 Wp Solar Module, 1 No. 80 Ah Industrial Battery (Tabular Plate), 5 or 10 Amps Charge Controller, 1 No. Structure, 4 Nos. 7 Watt Lamp, Switch, Switch Board, Installation & Other Accessories
60	34400	1 No. 60 Wp Solar Module, 1 No. 80 Ah Industrial Battery (Tabular Plate), 1No. 10 Amps Charge Controller, 1 No. Structure, 5 Nos. 7 Watt Lamp, Switch, Switch Board, Installation & Other Accessories
65	36000	1 No. 65 Wp Solar Module, 1 No. 100 Ah Industrial Battery (Tabular Plate), 1 No. 10 Amps Charge Controller, 1 No. Structure, 5 Nos. 7 Watt Lamp, Switch, Switch Board, Installation & Other Accessories.
80	42200	1 No. 80 Wp Solar Module, 1 No. 100 Ah Industrial Battery (Tabular Plate), 1 No. 10 Amps Charge Controller, 1 No. Structure, 7 Nos. 7 Watt Lamp, Switch, Switch Board, Installation & Other Accessories
85	44800	1 No. 85 Wp Solar Module, 1 No. 130 Ah Industrial Battery (Tabular Plate), 1 No. 10 Amps Charge Controller, 1 No. Structure, 8 Nos. 7 Watt Lamp, Switch, Switch Board, Installation & Other Accessories.

CASE STUDY

Consumer name : Abdur Sattar .

Address :Raniganjo,kapasia, Gazipur.

Installed by : grameen Shakti.

Installment date : 21.08.10

Price : 24702 tk (actual price is 21400tk. But they gave 15% (3210tk) down payment first then rest 85% paid in 6% flat rate include service charge(597tk) through 36 installment. so total price is 24702 tk.

SOLAR HOME SYSTEM(40W)

Solar panel : 40Wp (warranty 20 years)

Battery : 55 Ah (warranty 5 years)

Charge controller: 10A (warranty 3 years)

Tube light : 3piece ,10W

Fan :12V DC, 10W

TV : 12” black and white, 20W

Mobile charge :1 piece ,15W.

ENERGY CONSUMPTION IN A DAY

Date : 31.03. 14

Weather situation: fully sunny day

Consumption	Morning	Afternoon	Evening	Night	Total Wh
Fan, 10W	11-12			10-012	30Wh
Tube light reading room,10W			6.30-7.00	7.00-8.30	20 Wh
Tube light bed room,10W				8.30-9.00 10-10.30	10Wh
Tube light bath room,10W	At least 30 minutes				5Wh
TV,20W				9.00-10.0	20 Wh
Mobile charger,15W	At least 30 minutes				7.5Wh

Total Wh=92.5Wh

Date : 01.04. 14

Weather situation: fully sunny day

Consumption	Morning	Afternoon	Evening	Night	Total Wh
Fan, 10W	11-12			10-01	40Wh
Tube light reading room,10W				7.00-9.00	20Wh
Tube light bed room,10W				8.30-9.00 10-11.00	15Wh
Tube light bath room,10W	At least 30 minutes				5Wh
TV				9.00-10.00	20Wh
Mobile charger.15W	At least 30 minutes				7.5Wh

Total Wh=107.5Wh

So average is =92.2+107.5=200/2=100Wh.

Here we use this generation constant for all over year. So yearly generation is =100Wh ×365= 36500Wh =36.5 KWh.

And life time generation = 36.5×20 = 730 KWh

4.2 CALCULATION FOR SOLAR HOME SYSTEM: PRESENT FORMULA

This consumer take 40W solar home system with this condition that he pay 15% of the total price as down payment. The remaining 85% of the total cost is to be repaid within 36 months with 6% (flat rate) service charges.

Total price of the 40Wp SHS is = 21400. tk

Down payment 15% = 3210 tk

Due = 18190 tk

So principal installment per month = 18190/36 = 505.27 tk

Interest installment per month = (18190 × 6%)/12 = 90.95 tk

Total installment per month = 505.27+90.95 =596.27 tk .

TARIFF CALCULATION

Total price of SHS is 24702 tk.

Solar module is warranty for 20 years. So we do not need to change it.

Battery warranty is 5 years. In the first installation battery cost is included. So they need change battery for 3 times. The cost of changing the battery in 20 years is =3*6000= 18000 taka (6000 for each battery)

Now, charge regulator is warranty for 3 years. In first installation Charge regulator cost is included. Approximately 6 charge regulator need for 20 years. So the cost of changing the charge regulator in 20 years is:6*600=3600tk. (600 for each battery)

Battery need at least two time distilled water and charge in a year .this operation and maintenance cost approximately 100 tk per year. So for live time O&M cost is =100 × 20=2000tk

So total cost need to use SHS(40Wp) for 20 years is=24702+18000+3600 + 2000 =48302tk.

So per Unit cost for SHS(40Wp) is= 48302/730KWh= 66.17 tk per KWh

PVIFA FORMULA

PVIFA means Present Value Interest Factor Of Annuity. Its a most popular formula to calculate monthly payment needed to repay a loan. PVIFA is used in finance theory to refer to the output of a calculation, used to determine the monthly payment needed to repay a loan. The calculation has a number of variable factors, which include the quantity borrowed **P**, the given interest rate **r**, the number of regular intervals **n** at which the loan is to be repaid and the term of the loan.

85W SOLAR HOME SYSTEM

Principal = 40800 tk Down payment = 6120 tk Due = 34680 tk Interest = 6% Nominal interest **r** = .5% Installment = 36 We know

$$\text{Principal} = A \times \text{PVIFA}$$

$$\Rightarrow 34680 = A \times \left[= \frac{\{1-\frac{1}{(1+r)^n}\}}{r}\right]$$

$$\Rightarrow 1{,}455{,}348{,}300 = A \times \left[\frac{\{1-\frac{1}{(1+0.005)^{36}}\}}{0.005}\right]$$

A = 1055.03 tk

TARIFF CALCULATION

Unit Generation	1 st year	2 nd year	3 th year	4th year	5th year	6th year	7th year	8th year	9th year	10th year
Inslaiied capacity(KW)	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Total generation(KWh)	36.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5

Unit Generation	11 th year	12 th year	13 th year	14th year	15th year	16th year	17th year	18th year	19th year	20th year
Inslaiied capacity(KW)	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Total generation(KWh)	36.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5

Fixed cost	1 st year	2 nd year	3 th year	4th year	5th year	6th year	7th year	8th year	9th year	10th year

O & M (TK)	100	100	100	100	100	100	100	100	100	100
Replacement	1080	1080	1080	1080	1080	1080	1080	1080	1080	1080
Installment	9274	6064	6064	0	0	0	0	0	0	0
interest on term lone	963.227	584.4	210.87	0	0	0	0	0	0	0
Total fixed cost	11417.2	7828.4	7454.87	1180	1180	1180	1180	1180	1180	1180
Tariff per year	312.801	214.477	204.243	32.329	32.329	32.3288	32.329	32.329	32.329	32.32877

Fixed cost	1 st year	2 nd year	3 th year	4th year	5th year	6th year	7th year	8th year	9th year	10th year
O & M (TK)	100	100	100	100	100	100	100	100	100	100
Replacement	1080	1080	1080	1080	1080	1080	1080	1080	1080	1080
Installment	0	0	0	0	0	0	0	0	0	0
interest on term lone	0	0	0	0	0	0	0	0	0	0
Total fixed cost	1180	1180	1180	1180	1180	1180	1180	1180	1180	1180
Tariff per year	32.329	32.329	32.329	32.329	32.329	32.3288	32.329	32.329	32.329	32.32877
Tariff	64.0555									

COMPARISON OF TWO METHOD

Monthly installment in Present formula is 1137 tk.

But PMT formula monthly installment is 1055.03 tk .

So different is (1137 – 1055.03) = 81.97 tk per installment. and finally different is =81.97 × 36 =2950.92 tk.

Tariff in present formula = 85.98 tk per KWh

Tariff in PVIFA formula = 81.92 tk per KWh So different is (85.98- 81.92) = 4.06 tk per KWh

5 CONCLUSION

The summary of this paper exhibits that, there is a considerable opportunity of Bangladesh to meet its future power demand and thus economic growth through renewable resources. Solar energy sources discussed above can help Bangladesh to produce more power in order to reduce Load-shedding problem. Time has come to look forward and work with these renewable energy fields to produce electricity rather than depending wholly on conventional method. Already SHS (Solar home system) established in our country. This paper showed the tariff difference between present formula and PVIFA formula. Which is 2.12 tk/KWh for 40Wp and 4.06tk/KWh for 85Wp. Here author also try to prove solar PV most cheaply then diesel generator. Authors also include this paper Sandwip solar power plant which is established by a private organization. They sell their electricity to the rural consumer where grid connection will not extend within 30 years. And they give electricity to the consumer cheaply compeer then diesel generator electricity distributor. Solar PV based power plant can be a big solution to fill our lacking on power sector. So government and privet sector should focus this point. It also reduces the solar PV electricity unit cost compare then SHS. Here also consumer can be use conventional ac load. This paper will help solving current power crisis and at the same time will have a positive impact over social and economic status of rural society using green energy technology. If we go ahead as planned, it will be possible for all citizens to have access to power within 2021. In addition, a six year plan up to 2016 has been adopted to improve power scarcity and provide excess power for future. Vision of increasing economic growth to 8 percent by 2014 and 10 percent by 2017 through industrialization will be a reality with the implementation of this plan. Other countries with similar socio-economic status can utilize the same policy to develop their electricity sector. With the help of these resources Bangladesh can generate electricity & May able to meet the required demand in the future. Therefore, the Government and the Private sector should work hand to hand to emphasize more on renewable energy sources to produce electricity to solve our power crisis problem.

REFERENCES

[1] http://wiki.answers.com/q/do_nuclear_power_plants_cause_any_type_of_pollution
[2] Environmental protection agency
[3] http://en.wikipedia.org/wiki/world_energy_resources_and_consumption
[4] http://www.energybangla.com
[5] http://en.wikipedia.org/wiki/world_energy_resources_and_consumption
[6] http://en.wikipedia.org/wiki/solar_energy]
[7] http://en.wikipedia.org/wiki/solar_power_by_country
[8] http://www.solarika.org/blog/-/blogs/top10-solar-pv-countries-world-overview
[9] http://www.powercell.gov.bd/
[10] Cyber journals: multidisciplinary journals in science and technology, journal of selected areas in renewable and sustainable energy (jrse), june edition, 2012
[11] International journal of renewable energy research s.m. najmul hoque et al., vol.3, no.2, 2013
[12] Sadeque, zubair km. implementation status & results: bangladesh- rural electrification and renewable energy development (p071794), sequence 22 (english), the world bank (page- 2), june 2012.
[13] Idcol solar home system program in bangladesh. nazmul haque director & head of investment infrastructure development company limited (idcol), bangladesh.
[14] Progress scenario of solar home systems (shss) in bangladesh p. k. halder1*, n. paul2, t. ghosh2, imran khan1 and p. mondal3.
[15] Gs solar home system program, grameen shakti, bangladesh. www.gshakti.org, 2012. accesssed on 26th may 2012.
[16] http://www.powerdivision.gov.bd/user/brec/50/91
[17] Md. m. hasan and md. f. khan, “a comparative study on installation of solar pv system for grid and non grid rural areas of bangladesh,” international conference on the developments in renewable energy technology, january2012, dhaka, bangladesh.
[18] M. eusuf, prospect and problem of solar energy in bangladesh: implementation stage of solar system, bangladesh center for advance studies, dhanmondi, dhaka1209, bangladesh 1997.
[19] http://www.gshakti.org/index.php?option=com_content&view=article&id=58&itemid =62
[20] A. keyhani, “energy and civilization,” in *design of smart power grid renewable energy systems*, new jersey: john wiley and sons, 2011, pp. 1-12
[21] http://en.wikipedia.org/wiki/sandwip.
[22] http://www.bpdb.gov.bd

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Foreign exchange market and contagion: The evidence through GARCH model

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ABSTRACT: The goal of this study is to measure contagion phenomenon between foreign exchange markets during Subprime crisis & Eurozone crisis using daily data from 03/01/2005 to 02/01/2014 for fourteen selected countries namely Algeria, Argentina, Australia, china, India, Iceland, Great Britain, Malaysia, Nigeria, New-Zealand, Norway, Mexico, the Philippines and Russia via GARCH (1,1), GJR-GARCH(1,1), EGARCH(1,1), APARCH(1,1) models.

In our analysis, we will have discriminated between independent floaters and managed floaters exchange rate. We also separated the period estimate in two period's crises. Firstly, the US Subprime crisis period covers from 17/07/2007 through 31/08/2009 (See Dungey, 2009, Celik, 2012). Secondly, the period of the Euro-zone crisis that we have covered from 19.11.2009 to 31.12.2012 (See Wasim. A et all 2013).

In summary, we concluded of all exchange rates returns series influenced by the contagion effects come from USA and euro area over 2007-2012 periods. In addition to that, we documented that persistence volatility have been high shock in the countries adopting independent floating exchange rates compare the countries they supported managed floaters.

KEYWORDS: contagion, subprime and Eurozone crises, GARCH model, Exchange Rate Regimes.

JEL CLASSIFICATIONS: F31, G01, G15.

1 INTRODUCTION

In the past recent years, particularly After July 2007, the global economy has been living the worst financial crisis since the Great Depression of the 1930s, so, it led to decline macroeconomic variables as recession, slower GDP growth and other consequences effects as unemployment rates, inflation, National and Multinational institutions collapse, stock markets crashes ……

In addition, Suffer in the world economy doesn't stop from The U.S. Subprime mortgage crisis, while, it's followed by Eurozone crisis (2010-May 2013). It has sizeable effects not only of the euro area member states' economies, but in several markets around the world.

Contagion phenomenon during Subprime crisis and Eurozone crisis is not limited to transmit shocks on the macroeconomic and stock markets fundamentals, but it considerate contagion phenomenon in the Foreign exchange market**,** while led rapidly to massive declines of the major currency see **Figure 1….**

The goal of this study is to try and measure contagion phenomenon between foreign exchange markets during The U.S. subprime mortgage and Eurozone crises through an empirical analysis using GARCH methodology upon daily data from 03/01/2005 to 02/01/2014 for 14 countries 2003-2013. But Before illustrating this aim of our results, we shall discriminate

between independent floaters and managed floaters exchange rate for appearing the best exchange rate system performance over 2005-2014 period.

The rest of the paper is organized as follows. In section 2 we present a Literature Review on Contagion phenomenon; Section 3 presents the Model and the Methodology, followed by the results and discussion showed in Section 4, and finally, Section 5 presents the main conclusion.

2 LITERATURE REVIEW

The currency markets are the larger an asset market size. The trading in foreign exchange markets is averaged $5.3 trillion per day in April 2013 compared by $3.3 trillion in April 2007 **(Bank for International Settlements, 2013).** Moreover, the exchange rate volatility does increase more than proportionally with the global financial stress, when, evidence regional contagion effects is spread **(Virginie Coudert et all, 2011)**.

Several studies are classified the exchange rates regimes for capturing currencies vulnerability during crisis periods. Jean-Louis Combes (2012) rejected that intermediate regimes are more vulnerable to crises compared to the hard peg and the fully floating regimes. **Atish R. Ghosh (2010)** suggested that the growth performance for pegs was not different from that of floats during the crisis. For the recovery period 2010–11, pegs appear to be faring worse.

In the crises history during two last decades, the fixed exchange rate regimes are more vulnerable and fragile when the crisis occurrence*:* the Mexican peso crisis (1994), The Asian financial crisis (1997), the Russian and Brazilian financial crises (1998, 1999), the devaluation of the Argentina peso (2002); **(see, Jean-Louis Combes (2012), Ahmed Atil (2008) , Levy-Yeyati et al. (2006), Fischer (2001))**

Van Horen et all (2006) investigated whether the contagion has transmit from Thailand to the other crisis countries through the foreign exchange market during the Asian crisis. Results show that there is evidence of contagion from Thailand with 13% and 21 % respectively to Indonesia and Malaysia currencies attributable to that contagion. On the Contrary, for Korea and the Philippines there is no evidence of contagion from Thailand.

Eichengreen et al. (1996) used thirty years of panel data from twenty industrialized countries for finding that is spread more easily contagion currency crises among the countries which are closely tied by international trade linkages. they paper propose inspired for late research to estimate similar approach and find that trade linkages are important evidence h on the contagion transmission in geographic proximity. (See **Eichengreen and Rose (1998), Tornell and Velasco (1996) Huh and Kasa (1997); Rigobon (1998))**

Glick and Rose (1999) provide to five episodes of currency (in 1971, 1973, 1992, 1994, and 1997) and 161 countries that trade linkages help explain cross-country correlations in exchange market pressure during crisis episodes. **Celik (2012)** found strong evidence of contagion across foreign exchange markets on 10 emerging and 9 developed markets for the period 2005–2009 using DCC-GARCH model.

In contrast, many studies have highlighted of contagion evidence are not propagated when existed linked directly by macroeconomic fundamentals as Trade links (**Eichengreen et al. (1996),** or common shocks and Financial links (**Calvo (1999), Forbes and Rigobon , (2001) Rijckeghem and Weder, 2001)** …. but just to transmit when there are down on Stock Markets (Directly) during the financial crisis **(Bouaziz et al., 2012, Flavin and Panopoulou, 2010, Hutchison 2009, Khan andPark, 2009; Cho and Parhizgari, 2008…..)**

Aloui et all (2011) showed out in their study strong evidence of time-varying correlation and persistence between stock markets of each of the BRIC (Brazil, Russia, India, China) and the US markets Using daily return data for the period 2004 to 2009.

Dajcman et al. (2012) applied a Dynamic Conditional Correlation-Generalized Autoregressive Conditional Heteroskedastic (DCC-GARCH) on a daily return series for the period 1997 to 2010 for examine the co-movement dynamics across the stock markets of U.K., Germany, France, and Austria. **Kazi et al. (2013)** finds on the same model in sixteen OECD countries' stock markets for detecting same results while, that consist the co-movement dynamics between those markets and found a significant evidence of contagion effects after the GFC. **Hwang et al. (2010)** used a DCC-GARCH model on 38 country data. He found evidence of financial contagion not only in emerging markets but also in developed markets during U.S. subprime.

The study of **Naoui et al. (2010)** examined financial contagion using the DCC GARCH (1,1) technique and a correlation test for 10 emerging markets from 1 January 2005 to 01 July 2010. Their results indicate a contagion effect from the US towards Argentina, Brazil, Korea, Honk-Kong, Malaysia, Mexico and Singapore except for the Shanghai market (China) during the subprime crisis. **Yiu, Ho and Choi, (2010)** examined the dynamics of correlation between 11 Asian stock markets and the

US stock market from 1993 to early 2009 within asymmetric DCC-GARCH model. Their study finds strong evidence of contagion from USA to Asian markets in the period from late of 2007, while, they found no such evidence of having contagion between markets in Asia during the Asian financial crisis. **Aka (2009)** investigated the transmission of the contagion from the US stock market to the West African Regional Stock Market (BRVM) from January 2, 2007, through January 30, 2009. it finds that contagion effects in the mean and volatility from the US market to the BRV. **Khallouli. W and Sandretto. R, (2012)** carried out a similar analysis for the Middle East and North African countries (MENA) and they provide the evidence of mean and volatility contagion in MENA stock markets caused by the US stock market.

3 MODEL AND METHODOLOGY

3.1 DATA SOURCE

In our analysis we try to examine contagion phenomenon among foreign exchange markets during Subprime crisis and Eurozone crisis using daily data from 03/01/2005 to 02/01/2014 for fourteen selected countries representing American, European, Middle East, Oceania, Asian and African countries.

For seven countries followed floating exchange markets namely Australia, Great Britain, Iceland, New-Zealand, Norway, Mexico, the Philippines and sven countries followed managed float rate regimes namely Algeria, Argentina, china, India, Nigeria, Malaysia, and Russia. We use euro/US dollar exchange rate as a proxy for exchange rate variation across to Subprime crisis & Eurozone crisis. The sources of these exchange rates are collected from Thomson Reuters DataStream. The return on exchange rate is defined as:

We calculate foreign exchange rate returns as:

$$R_{it} = \ln(\frac{T_{it}}{T_{t-1}}) \text{..... (1)}$$

Where:

T_{it}: Foreign exchange rate at time t

T_{t-1}: Foreign exchange rate at time t-1

R_{it}: Return on exchange rate at time t

3.2 DEFINITION OF THE GARCH MODEL

In this study, the model we used is a **generalized autoregressive conditional heteroskedasticity** (**GARCH**, while, Bollerslev (1986)) suggested the generalized ARCH of Engle (1982)

. The GARCH model considers conditional variance to be a linear combination between squired of residual and a part of lag of conditional variance.

The mathematical representation of a GARCH (p, q):

$$h_t = a + \sum_{i=1}^{q} b_i \varepsilon_{t-i}^2 + \sum_{j=1}^{p} c_j h_{t-j}^2 \qquad (2)$$

$$\text{Where } a > 0, b_i \geq 0\ , c_j \geq 0 \forall \text{ i, } \forall \text{ j}$$

Where a a variance in long term is, $\sum_{i=1}^{q} b_i \varepsilon_{t-i}^2$ is squired of residual and $\sum_{j=1}^{p} c_j h_{t-j}^2$is a lag of conditional variance. In this context, we can be applied others models of asymmetric volatility to test the existence of contagion during Global Financial Crisis as the exponential GARCH (EGARCH) model, Glosten, Jogannathan, and Rankle (1992) GJR-GARCH model, asymmetric power ARCH (APARCH), Zakoian (1994) threshold ARCH (TARCH) see more Olowe, Rufus Ayodeji (2009).

4 RESULTS AND COMMENT

4.1 DESCRIPTIVE STATISTICS OF FOREIGN EXCHANGE RATE RETURNS

In this section, we shall separate the period estimate in tree periods. Firstly, US Subprime crisis period covers from 17/07/2007 through 31/08/2009 **(See Dungey, 2009, Glik, 2012)**. Firstly, the US Subprime crisis period covers from

17/07/2007 through 31/08/2009 **(See Dungey, 2009, Glik, 2012)**. Secondly, the period of the Euro-zone crisis that we have covered from 19.11.2009 to 31.12.2012 **(See Wasim. A et all 2013)**.

4.2 DESCRIPTIVE STATISTICS

Table 1 and 2 show descriptive statistics of floaters and managed floaters exchange rate returns respectively from17.07.2007 to 31.08.2009 (financial Crisis)

The mean returns for all series are close to zero. We observe the kurtosis coefficients of the foreign exchange rate returns in the first arrangement are a lower to secondly regime, (with a kurtosis value> 3). In the first hand, these results explain the big shocks in two foreign exchange rate markets, on the other hand, this result reveal with their central banks intervening in forex market to defend their currencies (managed float rate exchange regime) to stabilize the situation over crisis period within monetary policy targets. The skewness coefficients were different than zero, while, it is indicates a non-symmetric series. The Jarque-Bera test and for normality for all the currencies in Table 1 and 2 are significant, which mean the exchange returns are not normal distribution.

In Table 3 and 4, reports descriptive statistics of independently floating and managed float rate exchange rate returns respectively from 19.11.2009 to 31.12.2012 (Eurozone crisis), the kurtosis coefficients were greater than three of all series, Jarque– Bera (JB) test indicates non–normality of most of the foreign exchange rate returns.

Entire period results presented in table 4 and 5 shows their kurtosis of the exchange rate returns exceed 3, while, the skewness (positive or negative) and Jarque– Bera results rejects the null hypothesis and indicates non- normal distribution of series. Finally, the mean of the log exchange rate returns range from to zero.

4.3 ESTIMATION RESULTS OF GARCH (1, 1) MODEL

Before illustrating the results of generalized autoregressive conditional heteroscedasticity (GARCH) models, it is necessary to examine Heteroscedasticity test. The ARCH LM test proposed by **Engle (1982)** indicates the presence of ARCH effects of all foreign exchange markets returns residuals **(See figure 02).**

In the secondly examine, we make evaluates using tests of the **Akaike information criterion (AIC), (1974, 1976), Hannan-Quinn criter (HQC), (1979) and Schwarz Criterion, (SC), (1978)** for detecting the best models between ARCH family models was selected (GARCH (1,1), GJR-GARCH(1,1), EGARCH(1,1), APARCH(1,1) models). The GARCH (1, 1) appears more advantages which has a less values in formers tests most equations estimating.

In table 7, 8, 9,10,11,12, the results of parameter estimates using GARCH (1, 1) model are significant at 5% significance level**.** In particularly, the estimate y_1 parameter is positive on all currencies and for each period. This finding is reveal the role of the US dollar rates with exogenously determined to effect transmits on the other foreign exchange rates.

We also note in those tables high persistence of shocks in the volatility on all currencies (ARCH term α + GARCH term β are statistically significant at the 1%). Therefore and Based on same model, the results show when we datable

Independently floating and managed float rate regimes that persistence volatility have been high shock in the countries adopting first regime compare the countries they supported independently floating exchange rates. The sum of the estimated persistence volatility (α and β parameters) are exceed than one for Great Britain, Iceland and Mexico during financial crisis period. in the cases of Australia, N-Zealand, Norway and the Philippines, the sum of the two estimated ARCH and GARCH coefficients is very close to one which indicating that volatility shocks are quite persistent in the first group compare to second's. In same table and in all countries followed managed float rate regime, results show that the sum of persistence volatility are significant and it appear very high the sum of the estimated persistent coefficients very high but less than one except India exchange rate.

In contrast and during Eurozone crisis, the seven independently floating exchange rate the sum of the volatilities persistence's around than one. In same period and for almost all countries followed other regime are the sum of the volatilities persistence's are less than 1.this results of the two regimes reveals the stability exchange rate volatility for each period. In summary, we concluded of all exchange rates returns series influenced by the contagion effects come from USA and euro area over 2007-2012 periods.

5 CONCLUSION

In this paper, we measure contagion phenomenon between foreign exchange markets during Subprime crisis & Eurozone crisis using daily data from 03/01/2005 to 02/01/2014 for fourteen countries used different regimes exchange rate by employing GARCH (1.1) model.

The main finding showed in Table 7 to 12 indicates that volatility persistence is higher in the independently floating exchange rate than manager's exchange regime and same results appear the US Subprime crisis are more contagion than Eurozone crisis.

REFERENCES

[1] Aloui, R., Aissa, M.S.B., Nguyen, D.K., 2011. Globalfinancial crisis, extreme interdependences, and contagion effects: the role of economic structure? Journal of Banking and Finance 35 (1), 130–141.

[2] Ahmet Atıl (2007), "Parametric and Non-parametric Approaches to Exits from Fixed Exchange Rate Regimes", GIIS Working Paper seriesNo: 14

[3] Akaike, H. (1974) "A New Look at the Statistical Model Identification," I.E.E.E. Transactions on Automatic Control, AC19, 716-723.

[4] Akaike, H. (1976) "Canonical Correlation Analysis of Time Series and the Use of an Information Criterion," in R. K. Mehra and D. G. Lainotis (eds.), System Identification: Advances and Case Studies, Academic Press, New York, 52-107.

[5] Bouaziz, M.C., Selmi, N., Boujelbene, Y., (2012). Contagion effect of the subprimefinancial crisis: evidence of DCC multivariate GARCH models. European Journal of Economics, Finance and Administrative Sciences (44), 66–76.

[6] Brou Emmanuel Aka (2009), Subprime crisis and contagion: evidence from the BRVM, African Review of Money Finance and Banking 2009, pp. 51-71

[7] Calvo, G. (1999), "Fixed versus Flexible Exchange Rates: Preliminaries of a Turn-ofMillennium Rematch", mimeo, University of Maryland.

[8] Dajcman, S., Festic, M., & Kavkler, A. (2012). European stock market comovement dynamics during some major financial market turmoils in the period 1997 to 2010: A comparative DCC-GARCH and wavelet correlation analysis. Applied Economics Letters, 19, 1249-1256. http://dx.doi.org/10.1080/13504851.2011.619481

[9] Dungey, M., (2009). The tsunami: measures of contagion in the 2007–08 credit crunch. Cesifo Forum 9 (4), 33-34.

[10] Eichengreen, B., Rose, A., Wyplosz, C., (1996) "Contagious Currency Crises" CEPR Discussion Paper 1453.

[11] Eichengreen, Barry (1998), "Exchange Rate Stability and Financial Stability", Open Economies Review, vol. 9. pp. 569-607.

[12] Eichengreen, Barry, and A. Rose (1998), "Staying Afloat When the Wind Shifts: External Factors and Emerging Market Banking Crises", NBER Working Paper, No: 6370.

[13] Engle, R.F. (1982). "Autoregressive Conditional Heteroscedasticity with Estimates of the Variance of UK. Inflation", Econometrica, 50: 987–1008

[14] Engle, R.E., (2002). Dynamic conditional correlation: a simple class of multivariate generalized autoregressive conditional heteroskedasticity models. Journal of Business and Economic Statistics 20, 339–350.

[15] Fisher, S., (2001) "Exchange Rate Regime: Is the Bipolar view correct" Journal of Economic Persp[1]ectives 15, 3-24.

[16] Hammoudeh, S. and Li, H. (2008). Sudden changes in volatility in emerging markets: The case of Gulf Arab mar[1]kets, International Review of Financial Analysis, 17: 47–63.

[17] Hansen, P.R. and Lunde, A. (2005). "A Forecast comparison of Volatility Models: Does Anything Beat a GARCH (1,1)?", Journal of Applied Econometrics, 20: 873–889.

[18] Horen, N.V., Jager, H., Klaassen, F., (2006). Foreign exchange market contagion in the Asian crisis: a regression based approach. Review of World Economics 142 (2), 374–401

[19] Hwang, I., Haeuck In, F., Kim, T.S., (2010). Contagion effects of the U.S. subprime crisis on international stock markets. Finance and Corporate Governance Conference 2010 Paper.

[20] Forbes, K., Rigobon, R., (2002). No contagion, only interdependence: measuring stock market co-movements. Journal of Finance 57 (5), 2223–2261.

[21] Glick, R., Rose, A.K., (1999). Contagion and trade: why are currency crises regional? Journal of International Money and Finance 18 (4), 603–617.

[22] Hannan, E. J. (1980) "The Estimation ofthe Order of an ARMA Process", Annals of Statistics, 8, 1071-1081.

[23] Hannan, E. J., and B. G. Quinn (1979) "The Determination of the Order of an Autoregression," Journal of the Royal Statistical Society, B,41, 190-195.

[24] Jean-Louis Combes & Patrick Plane & Tidiane Kinda, (2011). "Capital Flows, Exchange Rate Flexibility, and the Real Exchange Rate,"IMF Working Papers 11/9, International Monetary Fund.
[25] Kazi, A., Guesmi, K., & Kaabia, O. (2013). Does shift contagion exist between OECD stock markets during the financial crisis? Journal of Applied Business Research, 29, 469-484.
[26] khallouli, Wajih & Sandretto, René, (2012). "Testing for "Contagion" of the Subprime Crisis on the Middle East and North African Stock Markets: A Markov Switching EGARCH Approach," Journal of Economic Integration, Center for Economic Integration, Sejong University, vol. 27, pages 134-166.
[27] Khan, S. and Park, K. (2009) Contagion in the Stock Markets: The Asian Financial Crisis Revisited, Journal of Asian Economics 20, 561-569.
[28] Levy-Yeyati, Eduardo, Federico Sturzenegger and Iliana Reggio (2006), "On the Endogeneity of Exchange Rate Regimes", KSG Working PaperNo. RWP06-047
[29] Matthew Yiu & Wai-Yip Alex Ho & Daniel Choi, (2010). "Dynamic correlation analysis of financial contagion in Asian markets in global financial turmoil," Applied Financial Economics, Taylor & Francis Journals, vol. 20(4), pages 345-354.
[30] Naoui, K., Liouane, N., Brahim, S., (2010). A dynamic conditional correlation analysis of financial contagion: the case of the subprime credit crisis. International Journal of Economics and Finance 2 (3), 85–96
[31] Olowe, Rufus Ayodeji (2009), Modelling Naira/Dollar ExchangeRate Volatility: Application Of Garch And Assymetric Models, International Review ofBusiness Research Papers Vol.5 No. 3 April Pp. 377- 398
[32] Schwarz, G. (1978) "Estimating the Dimension of a Model," Annals of Statistics, 6, 461-464.
[33] Schwert, G.W. (1989), "Why does Stock Market Volatility Change over Time?" Journal of Finance, 44: 1115–1153.
[34] Reinhart, Carmen M, and Kenneth S. Rogoff. 2009. The aftermath of financial crises. American Economic Review 99, no. 2: 466-472.
[35] Van Rijckeghem, C. and B. Weder (2001), "Sources of contagion: is it finance or trade?", Journal of International Economics, 54, 2, pp. 293-308.
[36] Thomas J. Flavin & Ekaterini Panopoulou, (2010). "Detecting Shift And Pure Contagion In East Asian Equity Markets: A Unified Approach," Pacific Economic Review, Wiley Blackwell, vol. 15(3), pages 401-421, 08.
[37] Tornell, A. and A. Velasco (1999), "Fixed versus flexible Exchange Rates: Which Provides More fiscal Discipline?", Forthcoming, Journal of Monetary Economics.
[38] Virginie Coudert et all, (2011) exchange rate volatility across financial crisis, Exchange rate volatility across financial crises, journal of banking & Finance, vol 35, Nov, pp3010-3018.
[39] Wasim Ahmad, Sanjay Sehgal, N.R. Bhanumurthy (2013), Eurozone crisis and BRIICKS stock markets: Contagion or market interdependence? , Economic Modelling, Volume 33, July, Pages 209-225Pages 209-225.

ANNEX

Figure 1: foreign exchange rates

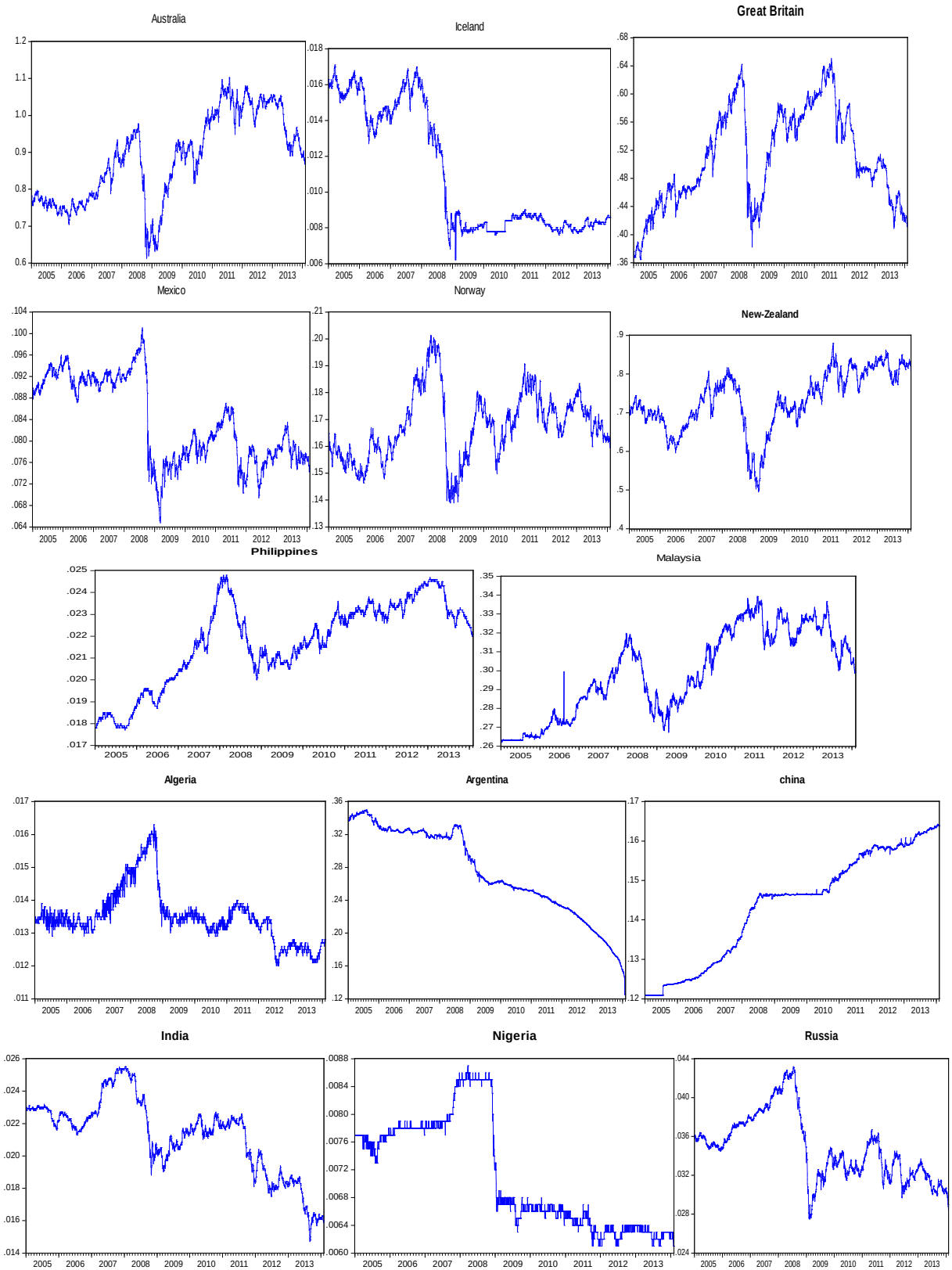


Table 01: descriptive statistics of independently floating exchange regimes from 17.07.2007 to 31.08.2009 (financial Crisis)

	Australia	Great Britain	the Philippines	Iceland	Mexico	Norway	N-Zealand
Mean	0.0000	-0.0003	-0.0001	-0.0009	-0.0003	-0.0001	-0.0002
Maximum	0.053	0.031	0.018	0.362	0.039	0.042	0.047
Minimum	-0.061	-0.040	-0.019	-0.350	-0.089	-0.045	-0.047
Std. Dev.	0.010	0.006	0.004	0.027	0.008	0.008	0.009
Skewness	-0.390	-0.732	-0.165	-1.254	-2.472	-0.251	-0.378
Kurtosis	10	10	4	117	31	8	7.34
Jarque-Bera	1731	1771	59	420336	26742.	723.	628.
Observations	777	777	777	777	777	777	777

Table 02: descriptive statistics of managed float rate regimes from 17.07.2007 to 31.08.2009 (financial Crisis)

	Algeria	Argentina	china	India	Malaysia	Nigeria	Russia
Mean	-0.0001	-0.0003	0.0001	-0.0003	0.0000	-0.0003	-0.0003
Maximum	0.042	0.035	0.007	0.032	0.031	0.040	0.031
Minimum	-0.046	-0.026	-0.008	-0.025	-0.026	-0.031	-0.043
Std. Dev.	0.010	0.004	0.001	0.005	0.004	0.007	0.006
Skewness	-0.085	0.724	-0.142	0.566	0.183	-0.202	-1.245
Kurtosis	8.291	22.564	17.142	9.587	9.388	7.415	15.005
Jarque-Bera	907	12459	6477	1446	1325	636	4867
Observations	777	777	777	777	777	777	777

Table 03: descriptive statistics of independently floating exchange regimes from 19.11.2009 to 31.12.2012 (Eurozone crisis)

	Australia	Great Britain	the Philippines	Iceland	Mexico	Norway	N-Zealand
Mean	0.0002	-0.0001	0.0001	0.0000	0.0000	0.0000	0.0001
Maximum	0.024	0.012	0.022	0.074	0.028	0.019	0.022
Minimum	-0.032	-0.018	-0.014	-0.062	-0.035	-0.023	-0.037
Std. Dev.	0.006	0.004	0.004	0.006	0.005	0.006	0.006
Skewness	-0.400	-0.303	0.041	0.848	-0.581	-0.406	-0.442
Kurtosis	5.252	4.329	5.099	50.314	8.901	4.220	5.283
Jarque-Bera	191	72	148	75091	1212	72	201
Observations	804	804	804	804	804	804	804

Table 04: descriptive statistics of managed float rate regimes from 19.11.2009 to 31.12.2012 (Eurozone crisis)

	Algeria	Argentina	china	India	Malaysia	Nigeria	Russia
Mean	0.0000	-0.0002	0.0001	-0.0001	0.0001	-0.0001	-0.0001
Maximum	0.030	0.011	0.008	0.023	0.025	0.031	0.027
Minimum	-0.030	-0.011	-0.008	-0.025	-0.017	-0.030	-0.029
Std. Dev.	0.007	0.002	0.001	0.005	0.004	0.007	0.005
Skewness	-0.050	0.055	0.039	-0.319	0.369	-0.009	-0.323
Kurtosis	6.420	8.053	15.024	6.657	7.880	5.329	6.454
Jarque-Bera	392	856	4844	462	816	182	414
Observations	804	804	804	804	804	804	804

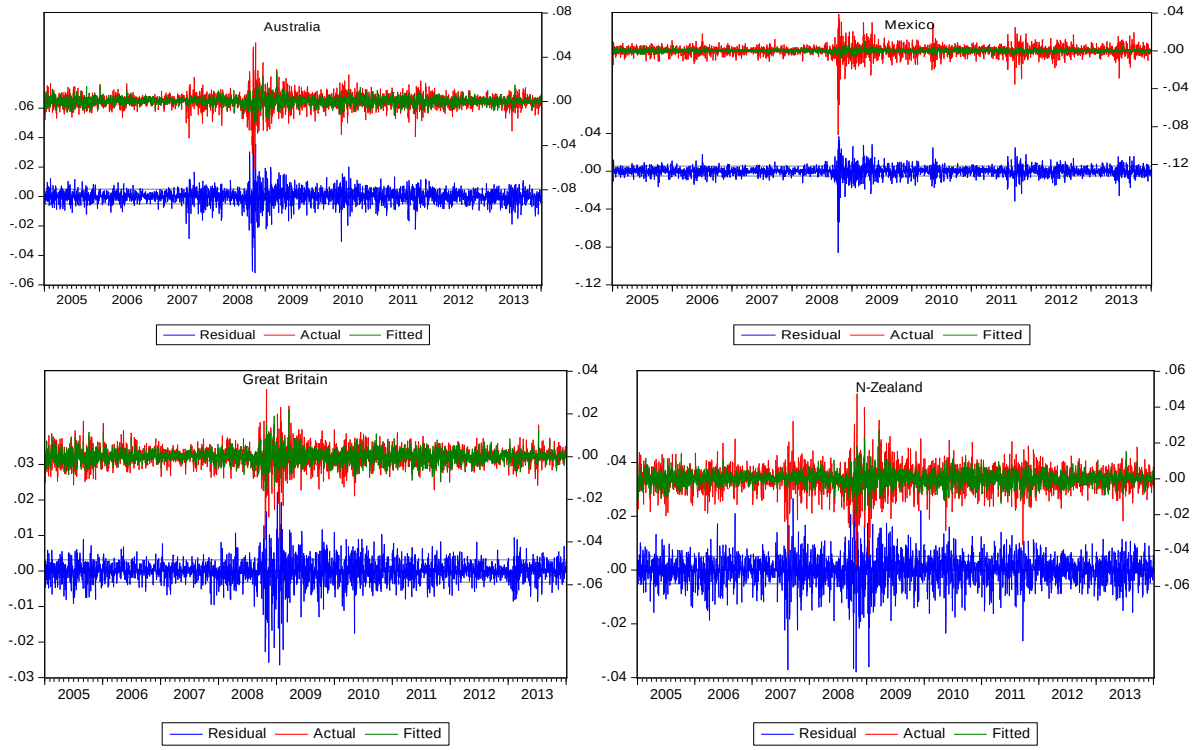
Table 05: descriptive statistics of independently floating exchange regimes from 03.1.2005 to 02.1.2014 (Entire period)

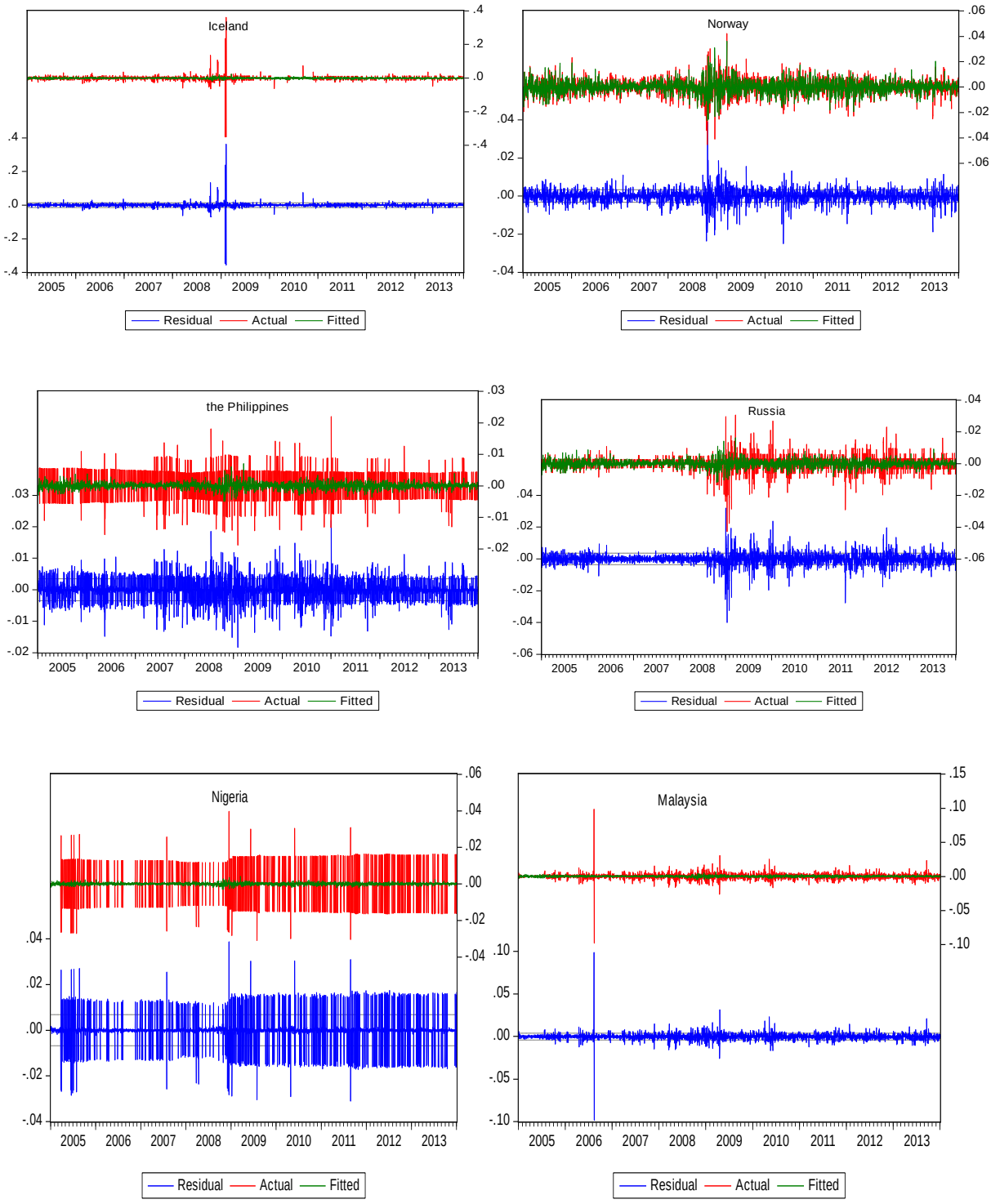
	Australia	Great Britain	the Philippines	Iceland	Mexico	Norway	N-Zealand
Mean	0.00004	-0.00005	0.00007	-0.00019	-0.00005	0.00000	0.00004
Max	0.053	0.031	0.022	0.362	0.039	0.042	0.047
Min	-0.061	-0.040	-0.019	-0.350	-0.089	-0.045	-0.048
Std. Dev.	0.006	0.004	0.004	0.014	0.005	0.006	0.006
Skewness	-0.458	-0.603	-0.107	-2.176	-1.979	-0.304	-0.448
Kurtosis	14.567	11.952	5.356	366.466	35.246	8.247	8.948
Jarque-Bera	18450	11182.	767	18106817	144640.	3823.	4957.
Observations	3287	3287	3287	3287	3287	3287	3287

Table 06: descriptive statistics of managed float rate regimes from 03.1.2005 to 02.1.2014 (Entire period)

	Algeria	Argentina	china	India	Malaysia	Nigeria	Russia
Mean	-0.00002	-0.00024	0.00009	-0.00011	0.00004	-0.00006	-0.00005
Max	0.065	0.035	0.020	0.032	0.098	0.040	0.031
Min	-0.046	-0.026	-0.010	-0.027	-0.098	-0.031	-0.043
Std. Dev.	0.009	0.002	0.001	0.005	0.004	0.007	0.004
Skewness	0.072	0.519	2.307	0.032	0.242	-0.093	-0.751
Kurtosis	9.986	31.077	72.430	8.624	198.670	6.470	14.011
Jarque-Bera	6691	108180	663526	4334	5246929	1655	16926
Observations	3287	3287	3287	3287	3287	3287	3287

Figure 02 : Arch effets




Iceland
Residual Actual Fitted
Norway
Residual Actual Fitted
the Philippines
Residual Actual Fitted
Russia
Residual Actual Fitted
Nigeria
Residual Actual Fitted
Malaysia
Residual Actual Fitted

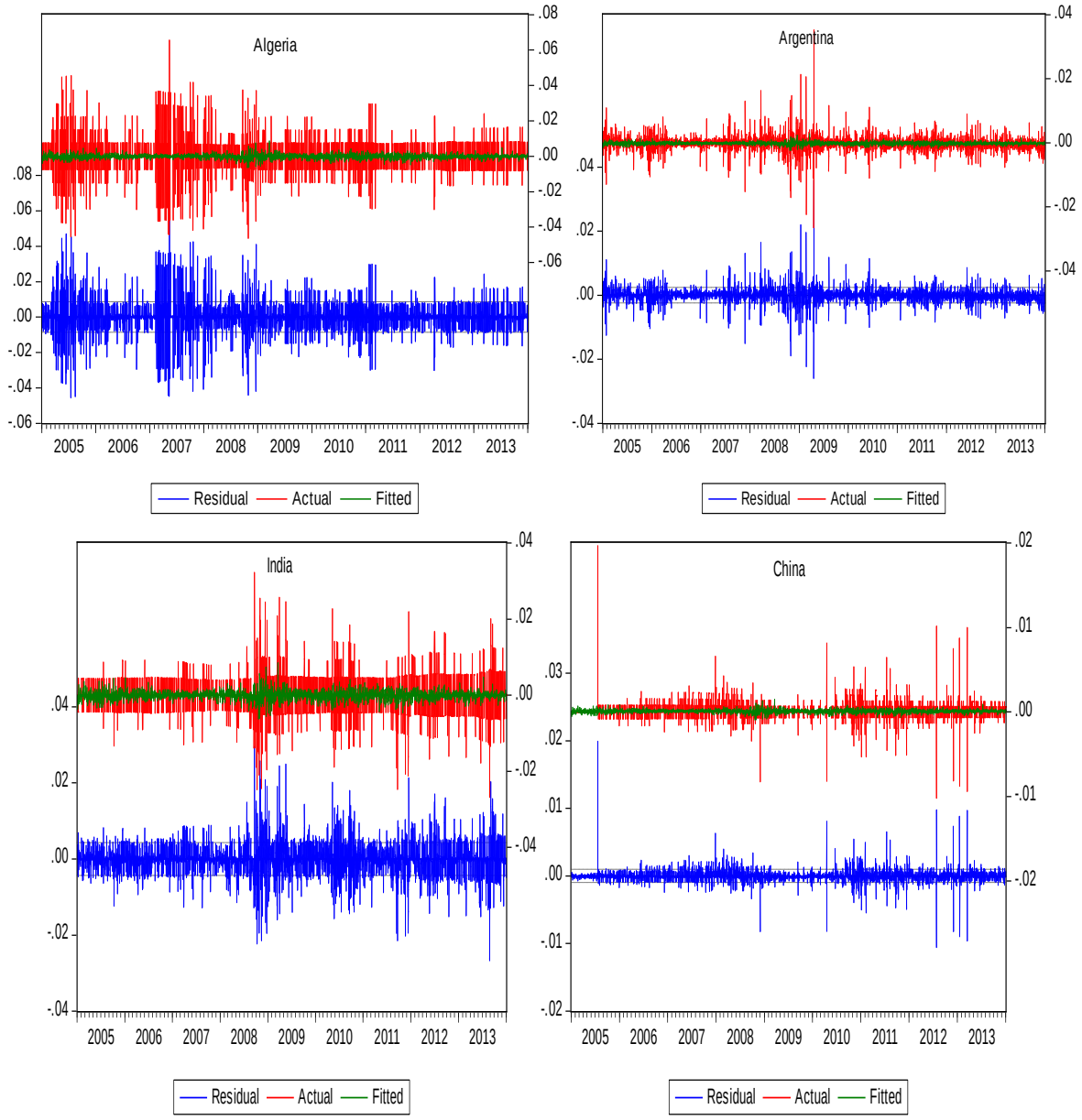


Table 7: Parameter Estimates for GARCH Model for independently float rate regimes from 17/07/2007 31/08/2009

Parameter	γ_0	γ_1	a	b	Persistance
Australia	8.97E-05*	0.969543*	0.124486*	0.833688*	0.958174
Great Britain	-0.00025	0.678107*	0.065186*	0.929636*	0.994822
Iceland	-0.001281	1.113158*	0.660635*	0.572185*	1.23282
N-Zealand	-0.000126*	1.008644*	0.079832*	0.890858*	0.97069
Mexico	0.000157	0.14541*	0.13243*	0.866455*	0.998885
Norway	0.000156	1.154827*	0.193152*	0.798383*	0.991535
Philippine	-0.000142*	0.223777*	0.015127*	0.976955*	0.992082

Table 8: Parameter Estimates for GARCH Model for managed float rate regimes from 19/11/2009 31/12/2012

Parameter	γ_0	γ_1	a	b	Persistance
Australie	0.000481*	0.78269*	0.105246*	0.798701*	0.903947
Great Britain	-1.73E-05	0.51133*	-0.008373*	1.001391*	0.993018
Iceland	0.000469*	0.360438*	-0.006615*	0.884087*	0.877472
N-Zealand	0.00053	0.79912*	0.194746*	0.080154*	0.2749
Mexico	0.000374*	0.446849*	0.200394*	0.760245*	0.960639
Norway	0.000297	1.017111*	0.426768*	-0.036841*	0.389927
Philippines	0.000196*	0.221827*	0.083896*	0.846249*	0.930145

Table 9: Parameter Estimates for GARCH Model for Independently float rate regimes from 17/07/2007 31/08/2009

Parameter	γ_0	γ_1	a	b	Persistance
Russia	1.86E-05	0.552558*	0.081106*	0.925979*	1.007085
Algeria	-0.000189	0.301162*	0.137718*	0.819069*	0.956787
Nigeria	0.000116	0.101552*	0.149936*	0.806468*	0.956404
Malaysia	1.12E-05	0.328576*	0.136888*	0.82636*	0.963248
India	-0.000134*	0.228683*	0.09067*	0.906474*	0.997144
chaina	0.000122	0.045964*	-0.011165*	0.579763*	0.568598
Argentina	-4.33E-05	0.067612*	0.408902*	0.594285*	1.003187

Table 10: Parameter Estimates for GARCH Model for managed float rate regimes from 19/11/2009 31/12/2012

Parameter	γ_0	γ_1	a	b	Persistance
Russia	0.000182*	0.534752*	0.189285*	0.768163*	0.957448
Algeria	-9.89E-06	0.245703*	0.195526*	0.678793*	0.874319
Nigeria	-6.73E-05	0.076194*	0.211149*	0.364486*	0.575635
Malaysia	0.000224*	0.324389*	0.05429*	0.90555*	0.95984
India	0.000101*	0.32593*	0.096907*	0.878541*	0.975448
chaina	8.82E-05	0.047245*	0.268823*	0.523848*	0.792671
Argentina	-0.00019	0.10003*	0.232885*	0.707651*	0.940536

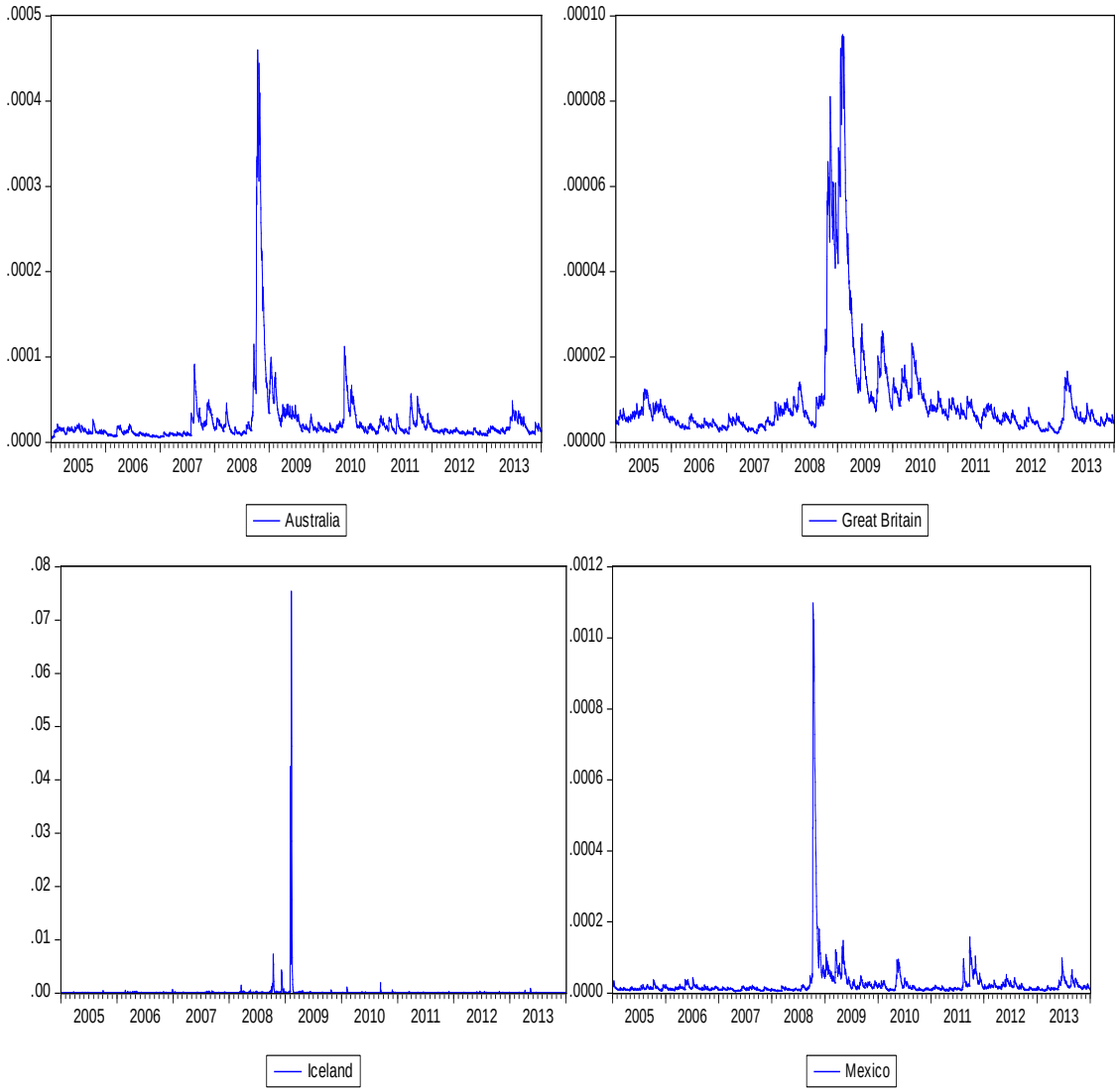
Table 11: Parameter Estimates for GARCH Model for Independently float rate regimes from 1/01/2005 1/02/2014

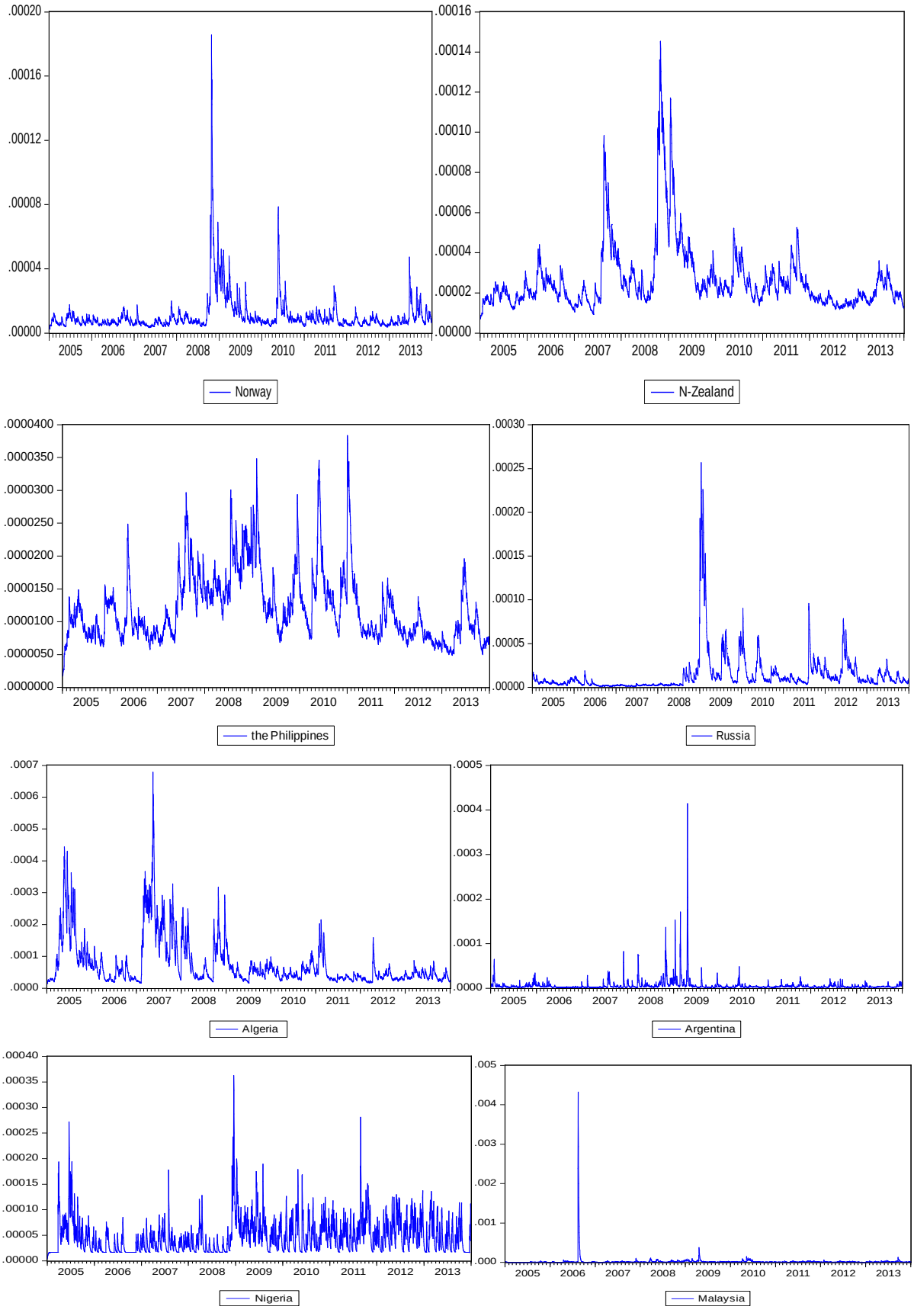
Parameter	γ_0	γ_1	a	b	Persistance
Australia	0.0000933	0.745604*	0.059159*	0.928003*	0.987162
Great Britain	0.000177	0.633037*	0.042441*	0.952221*	0.994662
Iceland	-0.000268	0.668543*	0.16874*	0.816874*	0.985614
Mexico	0.000127*	0.29982	0.093071*	0.889503*	0.982574
Norway	0.000632*	1.040295*	0.076505*	0.894843*	0.971348
N-Zealand	0.0000932	0.778014*	0.034932*	0.954436*	0.989368
Norway	0.0000632	1.040295*	0.076505*	0.894843*	0.971348
the Philippines	0.0000827	0.200708*	0.039043*	.947375*	0.986418

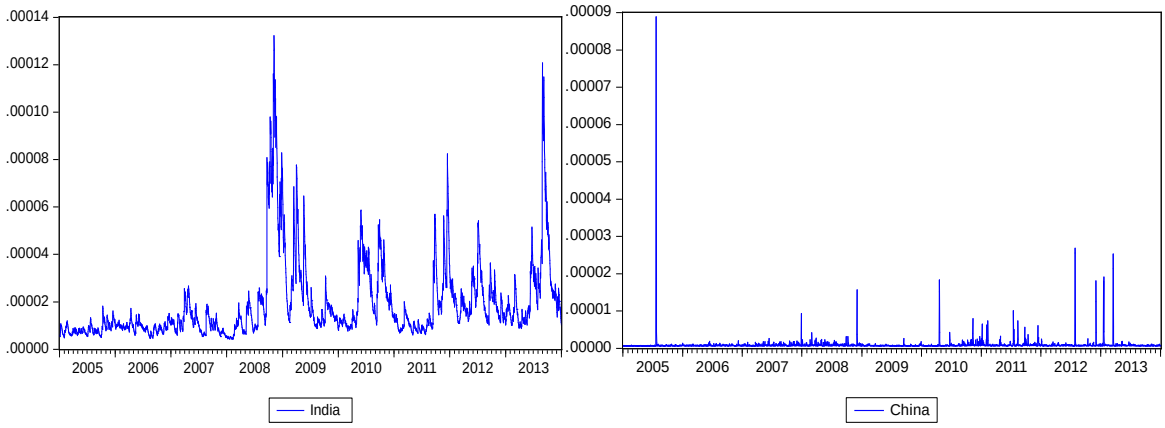
Table 12: Parameter Estimates for GARCH Model for managed float rate regimes from 1/01/2005 1/02/2014

Parameter	γ_0	γ_1	a	b	Persistance
Russia	0.0000661*	0.466395*	0.090915*	0.91208*	1.002995
Algeria	-7.51E-05	0.249473*	0.070244*	0.916539*	0.986783
Nigeria	5.10E-05	0.115169*	0.137492*	0.802299*	0.939791
Malaysia	0.0002	0.17892*	0.245152*	0.82376*	1.068912
India	-2.36E-05	0.245481*	0.06709*	0.92233*	0.98942
chaina	1.05E-04	0.040035*	0.222034*	0.2057*	0.427734
Argentina	-1.76E-04	0.085796*	0.246103*	0.69729*	0.943393

Figure 03: Conditional Variance




Norway
N-Zealand
the Philippines
Russia
Algeria
Argentina
Nigeria
Malaysia


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CONTRIBUTION A L'INVENTAIRE ET ECOLOGIE DES ESPECES DES MOLLUSQUES DULCICOLES DES PETITS COURS D'EAU DE LWIRO ET SES ENVIRONS, EST DE LA RD CONGO

[CONTRIBUTION TO THE INVENTORY AND ECOLOGY OF FRESHWATER SNAILS OF SMALL STREAMS OF LWIRO AND ITS SURROUNDINGS, EASTERN OF DR CONGO]

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ABSTRACT: A malacological fauna survey was done in the Katana region in South Kivu, Democratic Republic of Congo were intestinal schistosomiasis (*Schistosoma mansoni*) was signaled. Sampling was done in 23 Streams using the technique of Olivier and Scheirderman (1956). About 14 species was collected: *Biomphalaria pfeifferi* (Krauss, 1948)*, Lymnaea natalensis* (Krauss, 1948)*, B. forskalii (*Ehrenberg, 1931), *B. globosus* (Morelet, 1866), *P. ovata* (Olivier, 1804), *Tomichia kivuensis* (Mandahl-Barth, 1974), *Tomichia hendrickxi* (Verdcourt, 1950), *Lentorbis junodi* (Connolly, 1922), *Segmentorbis kempi* (Preston, 1912), *Potadoma ignobilis* (Thiele, 1911), *Potadoma freethii* (Thiele, 1911)*, Ferrissia burnupi (*Walker, 1912), *Pisidium casernatum* (Poli, 1791) and *Physa acuta* (Brackenbury et Appleton, 1991; Draparnaud, 1805), in which 5 species (*Biomphalaria pfeifferi, Bulinus forskalii, Bulinus globosus, Physa acuta* and *Ferrissia burnupi*) are recognized as intermediate effective or potential host of schistosomiasis (*Schistosoma manasoni* and *Schistosoma haematobium*). The ecological characteristic of the species in the Katana region are present in this work.

KEYWORDS: Survey, Ecology, Snails, Streams, DRCongo.

RESUME: Une enquête malacologique a été réalisée dans la région de Katana, Sud Kivu, République Démocratique du Congo où la schistosomiase à *Schsitosoma mansoni* a été signalée. L'échantillonnage a été réalisé dans 23 ruisseaux suivant la technique proposée par Olivier et Scheiderman (1956). Au total, 14 espèces ont été récoltées : *Biomphalaria pfeifferi* (Krauss, 1948)*, Lymnaea natalensis* (Krauss, 1948)*, B. forskalii (*Ehrenberg, 1931), *B. globosus* (Morelet, 1866), *P. ovata* (Olivier, 1804), *Tomichia kivuensis* (Mandahl-Barth, 1974), *Tomichia hendrickxi* (Verdcourt, 1950), *Lentorbis junodi* (Connolly, 1922), *Segmentorbis kempi* (Preston, 1912), *Potadoma ignobilis* (Thiele, 1911), *Potadoma freethii* (Thiele, 1911)*, Ferrissia burnupi (*Walker, 1912), *Pisidium casernatum* (Poli, 1791) et *Physa acuta* (Brackenbury et Appleton, 1991; Draparnaud, 1805), parmi les quelles 5 espèces (*Biomphalaria pfeifferi, Bulinus forskalii, Bulinus globosus, Physa acuta* et *Ferrissia burnupi*) sont reconnues comme hôtes intermédiaires effectifs ou potentiels des schistosomiases (*Schistosoma mansoni* et *Schistosoma haematobium*). Les caractéristiques écologiques de chaque espèce sont présentées dans ce travail.

MOTS-CLEFS: Inventaire, Ecologie, Mollusques, Ruisseaux, RD Congo.

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1 INTRODUCTION

Depuis longtemps, les études malacologiques effectuées au laboratoire de Malacologie du Centre de Recherche en Sciences Naturelles de Lwiro ont été orientées principalement vers les mollusques hôtes intermédiaires des schistosomiases humaines [1]; [2]; [3] [4]. Les autres mollusques dulcicoles n'ont pas été étudiés profondément par les chercheurs dans ce laboratoire, à part les études récentes du mollusque *Pila ovata* comme compétiteurs de *Biomphalaria pfeifferi* dans les étangs piscicoles de la région de Lwiro [5]. Et pourtant, il est vrai que les mollusques dulcicoles présentent une double importance, sanitaire et alimentaire, tant pour l'homme que pour les animaux [6]. Du point de vue sanitaire, certains mollusques sont des hôtes intermédiaires des trématodes qui causent des maladies à l'homme et aux animaux notamment la schistosomiase intestinale à *S. mansoni* et la schistosomiasevésicale à *S. haematobium* pour l'homme, fascioloses à *Fasciola haepatica*, à *Fasciola gigantica* et schistosomiase à *Schistosoma bovis* chez les bétails. Ces maladies existent aussi à Lwiro et ses environs, [1] ; [7].

Du point de vue alimentaire, certains mollusques dulcicoles tels que *Pila ovata, Iridina sp, Aspatharia sp* sont comestibles [3]. *Pila ovata* est à mesure de produire environ 30 % des protéines totales par rapport au poids sec animal, ce qui peut suppléer à la carence alimentaire tant chez l'homme que chez les animaux [8]. Par ailleurs, la publication de [4] sur la distribution des mollusques hôtes intermédiaires de la schistosomiase dans la région de Katana donne des informations fragmentaires sur les autres malacofaunes aquatiques de la région. Les études quantitatives de peuplement malacofaunique dulcicole de petits cours d'eaux africains en général et de la République Démocratique du Congo en particulier, sont encore rares [2]. Pour l'Est de la République Démocratique du Congo, mis à part le travail de [2] et [4], il n'existe aucune autre étude dans ce contexte. Cette région a connu des changements considérables dû aux mouvements de la population fouillant l'insécurité dans certaines parties et qui s'est concentrée en des endroits plus sécurisés ces dernières années, avec le risque de transmission des maladies hydriques. Cette population utilise les eaux des petits cours d'eau pour leurs activités anthropogéniques, mais sans traitement et/ou autres précautions. Une étude de peuplement en mollusques dans ces cours d'eaux fournirait de connaissances de base solides sur les espèces hôtes intermédiaires des maladies, la source d'infestation et sur les potentialités de la production des mollusques comestibles.

L'objectif de ce travail est de faire un inventaire des mollusques d'eau do.uce dans la région de Katana et de préciser la fréquence des diverses espèces pouvant intervenir dans la transmission des trématodes animales et humaines. Mais aussi, de connaître les interactions entre les espèces malacologiques et autres dans la région.

2 MATERIELS ET METHODES

2.1 DESCRIPTION DU MILIEU D'ETUDE ET SITES DE PRELEVEMENT

La région de Katana se trouve dans la zone de transition submontagnarde située sur la côte occidentale du lac Kivu, au versant oriental de la chaîne du Grabben Est Africain ($28^{o}45'$ E-28^{o} 85'E et 2^{o} 15'S-2^{o} 30'S), entre 1465 m d'altitude (bord du lac Kivu) et 2000 m d'altitude (mont Kahuzi Biega).

Elle possède un climat doux, de type tropical humide tempéré par l'altitude, pluvieux à courte saison sèche allant du mois de Juin à Août. Sa température moyenne, relativement fraîche, est stable au cours de l'année avec des petites variations entre 19,52 ^{o}C et 20,62 ^{o}C (moyenne 10 ans de 2001 à 2010). Sa pluviosité moyenne varie d'un mois à l'autre avec des fortes pluies enregistrées en Novembre (185,82 mm en moyenne), Juillet étant le mois le plus sec (24,65 mm en moyenne) (Rapport Service climatologique de Lwiro, 2001-2010) (Figure 1).

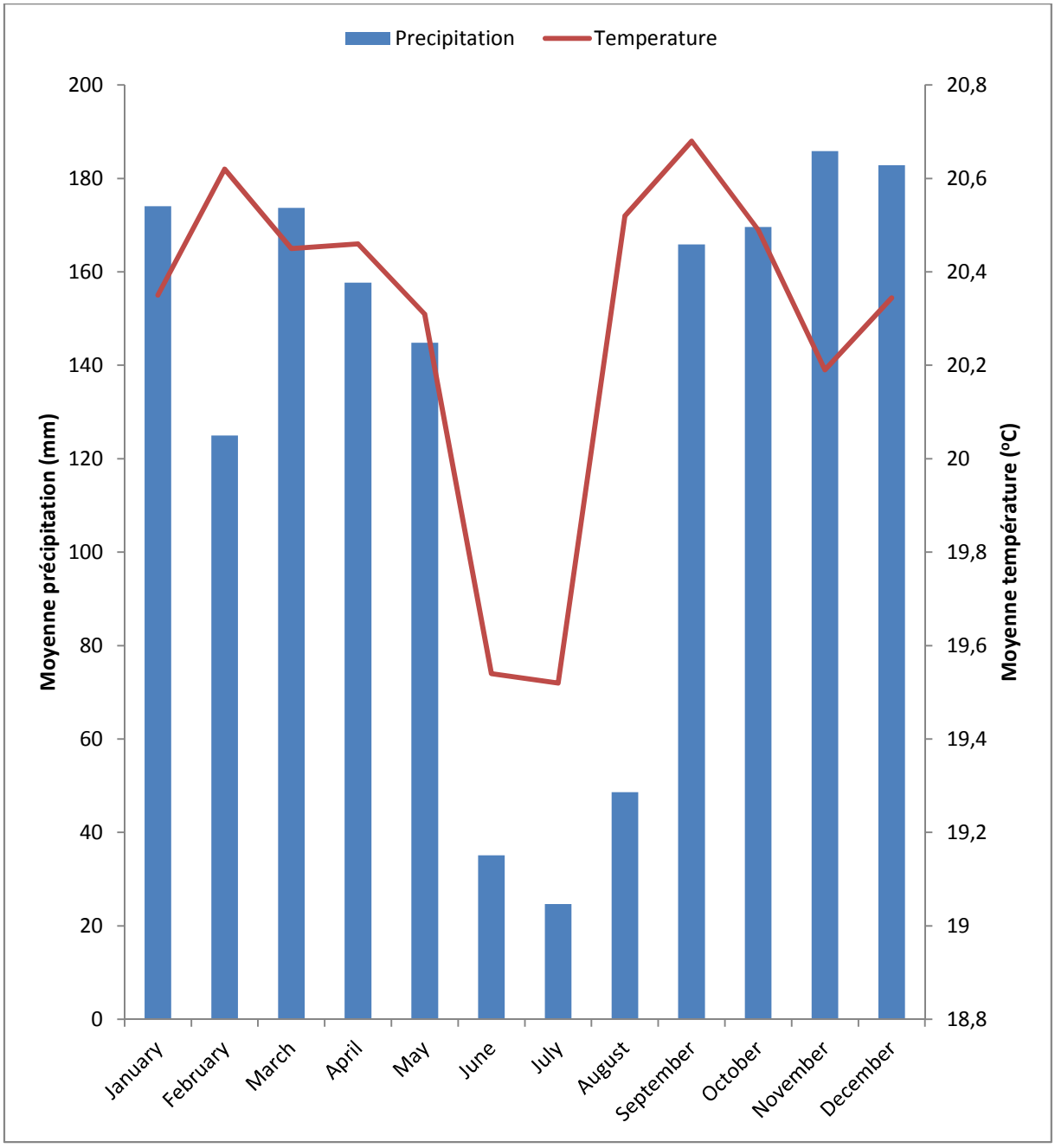


Figure 1 : Variations de la pluviosité et la température moyennes dans la station climatologique de Lwiro durant la période de 2001-2010

La région est arrosée par de nombreux petits cours d'eau permanents ou non. Sa végétation est dominée par la savane mixte arbustive et herbeuse, fortement dégradée et cédant progressivement la place à une savane cultivée [1].

Les ruisseaux visités durant cette étude sont: Bidagarha, Gaho, Kaleba, Busengura, Birunga, Chashonzi, Chiduha, Chihembe, Chirindiro, Karhakumbwa, Kashukabatware, Kalengo, Kamirihembe, Kamunyerere, Kanyamalogo, Kayumanga, Lulonge, Muchanga, Mushaba, Nyabikonongo, Nyabizenga, Nkene et Choga. La figure 2 montre la carte de la région étudiée ainsi que les cours d'eau prospectés.

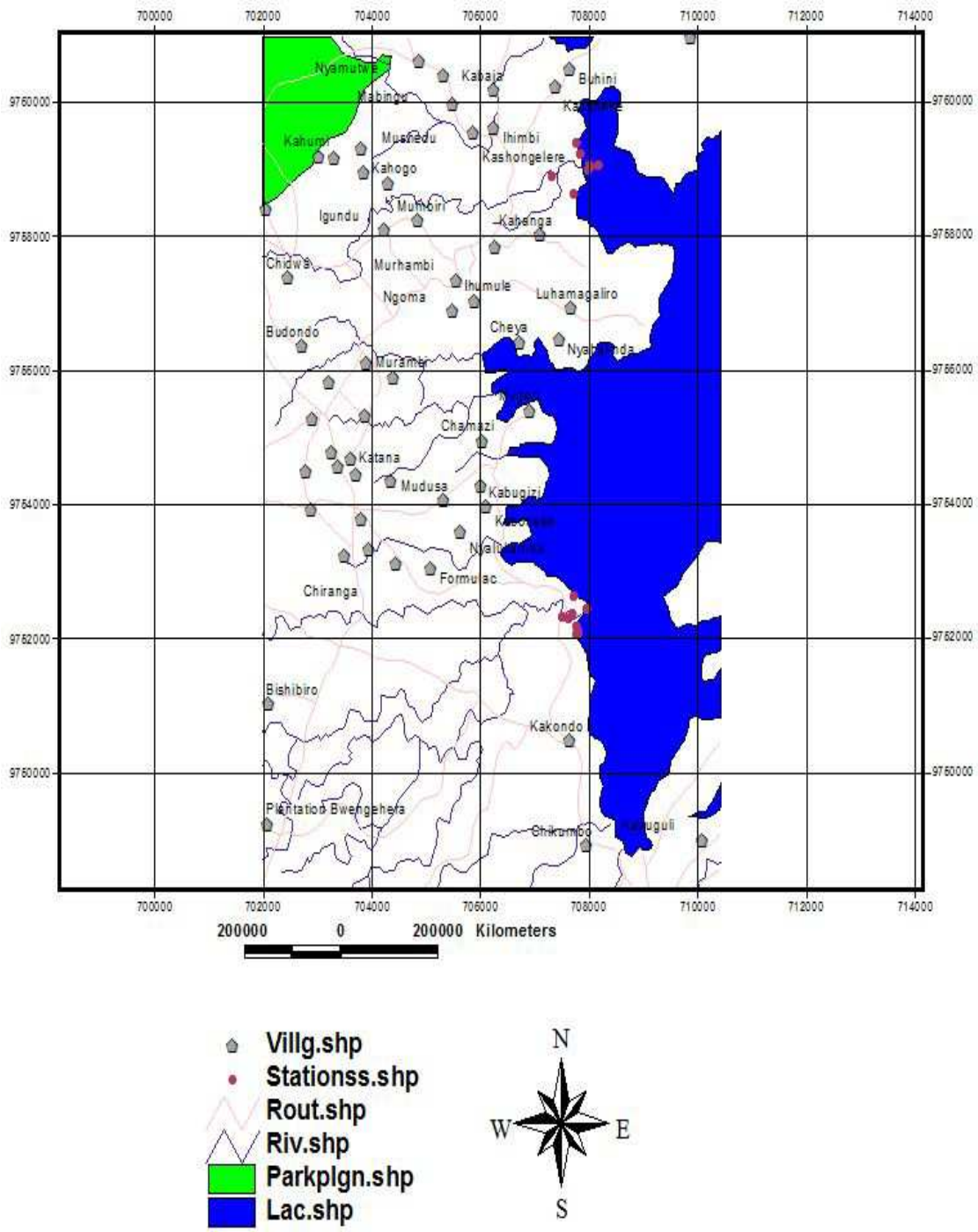


Figure 2 : Carte de la région de Katana, avec les ruisseaux étudiés

Les sites de prélèvement dans ces ruisseaux ont été choisis à cause de la présence des mollusques lors de nos enquêtes malacologiques préliminaires. Les caractéristiques physico-chimiques des ruisseaux étudiés, obtenues lors de notre travail de terrain, sont reprises dans le tableau 1 de ce présent travail.

Tableau 1 : Caractéristiques physico-chimiques des ruisseaux de la région de Katana

Ruisseaux	Vitesse (m/s)	Température (^{o}C)	Nature de fond	Végétation morte	Végétation vivante	Couverture végétale
Bidagarha	0	28	V + Ar	+	+++	0
Gaho	4,5	23,5	V + C	++	+++	1
Kaleba	8,5	22	V + C	+++	+++	3
Busengura	4,2	20,5	V	+	+++	2
Birunga	4,2	22,5	V	+++	+++	0
Chashonzi	5,2	23	V	+++	+++	2
Chiduha	1,5	21	V	+++	+	3
Chihembe	2	21	V + C	+	+++	2
Chirindiro	4	21	V + C	+++	++	1
Karhakumbwa	1	22	V	+++	++	2
Kashukabatware	7	22	V + C	++	++	2
Kalengo	5,4	22	V	++	+++	2
Kamirihembe	3	21	C + S	+	+++	2
Kamunyerere	9	24	C + S	++	+++	2
Kanyamalogo	4	21	V	++	++	2
Kayumanga	4,1	21	V	-	++	0
Lulonge	6	24	V + C	++	++	3
Muchanga	0	21,5	V	++	+++	3
Mushaba	5	22	V	++	++	3
Nyabikonongo	0	22	V + C	-	++	1
Nyabizenga	4	23,5	V + C	++	++	2
Nkene	5	22	V	++	+++	3
Choga	4,1	22	C + Ar	++	++	1

Légende :

A=nature du fond accessoire. Ar=argile. C=cailloux. D=nature du fond dominant. G=gravier. Couverture végétale : O= 0 % , 1=25%, 2=50 %, 3=75%, 4=100% S=sable. V=vase. +=indice d'abondance, - = indice d'absence

2.2 ECHANTILLONNAGE DES MOLLUSQUES

A chaque échantillonnage des mollusques, les facteurs environnementaux ci-après ont été étudiés: la profondeur de l'eau, la vitesse du courant, la température de l'eau, le pH, la nature de fond, l'abondance de la végétation aquatique et la couverture végétale riveraine. Les méthodes suivies ont déjà été décrites par [2].

La période d'échantillonnage s'étalait de Janvier 2002 à Décembre 2012 et les prélèvements se faisaient chaque mois. L'échantillonnage des mollusques a été fait suivant la méthode d'unité de temps de récolte standardisée [9]. Le temps de récolte par personne était fixé à 10 minutes par site. Les mollusques étaient prélevés à l'aide d'un filet troubleau, à petite maille (> 2 mm) et à ouverture rectangulaire (30 cm x 20 cm), à raison de 3 sites par cours d'eau et par mois. Ceux trouvés, ont été comptés par espèces et les facteurs environnementaux de chaque site ont été notés sur les fiches de prélèvement par ruisseau. La détermination des mollusques a été faite au laboratoire de Malacologie du Centre de Recherche en Sciences Naturelles de Lwiro, suivant la clé de détermination de [10] et [3].

L'étude parasitologique des mollusques *Biomphalaria pfeifferi, Lymnaea natalensis, Bulinus forskalii, Bulinus globosus, Physa acuta et Ferrissia burnupi* a été faite au laboratoire.

A cet effet, après triage et comptage, chaque mollusque hôte intermédiaire effectif ou potentiel était mis dans un tube à essai rempli de l'eau jusqu'au ¾. Le tube était exposé au soleil pendant 2 heures pour la recherche des cercaires [11]. Celles trouvées ont été observées puis identifiées au microscope optique suivant la clé de détermination de [12].

La fréquence annuelle des mollusques dans l'échantillonnage était calculée par la formule suivante:

$$\text{Fréquence (\%)} = \frac{\text{Nombre des sites positifs à une espece de mollusque X 100}}{\text{Nombre total de gites prospectés par an et par ruisseau}}$$

L'abondance annuelle des mollusques récoltés par an et par espèce était aussi calculé par:

$$\text{Abondance(\%)} = \frac{\text{Nombre de mollusques recoltés par espèce X 100}}{\text{Total des mollusques recoltés toute l'année}}$$

3 RESULTATS

3.1 LISTE DES ESPÈCES MALACOLOGIQUES INVENTORIÉES

Quatorze espèces de mollusques ont été inventoriées. Il s'agit de: *Biomphalaria pfeifferi* (Krauss, 1948)*, Lymnaea natalensis* (Krauss, 1948)*, Bulinus forskalii (*Ehrenberg, 1931), *Bulinus globosus* (Morelet, 1866), *Pila ovata* (Olivier, 1804), *Tomichia kivuensis* (Mandahl-Barth, 1974), *Tomichia hendrickxi* (Verdcourt, 1950), *Lentorbis junodi* (Connolly, 1922), *Segmentorbis kempi* (Preston, 1912), *Potadoma ignobilis* (Thiele, 1911), *Potadoma freethii* (Thiele, 1911)*, Ferrissia burnupi (*Walker, 1912), *Pisidium casernatum* (Poli, 1791) et *Physa acuta* (Brackenbury et Appleton, 1991; Draparnaud, 1805). Elles appartiennent à 2 classes (Gastéropodes et Lamellibranches), 3 sous-classes (Pulmonés, Prosobranches et Bivalve) et 9 familles (Planorbidae, Lymnaeidae, Ancylidae, Bulinidae, Thiaridae, Hydrobidae, Pilinidae, Physidae et Sphaeridae). Le tableau 2 montre bien cette répartition taxonomique des mollusques.

Tableau 2 : Répartition taxonomique des mollusques récoltés

CLASSES	SOUS-CLASSES	FAMILLES	GENRES	ESPECES
Gastéropodes	Pulmonés	Planorbidae	Biomphalaria	*B.pfeifferi*
	Pulmonés	Planorbidae	Segmentorbis	*S.kempi*
	Pulmonés	Planorbidae	Lentorbis	*L.junodi*
	Pulmonés	Lymnaeidae	Lymnae	*L.natalensis*
	Pulmonés	Ancylidae	Ferrissia	*F.burnupi*
	Pulmonés	Bulinidae	Bulinus	*B.forskalii*
	Pulmonés	Bulinidae	Bulinus	*B.globosus*
	Pulmonés	Physidae	Physa	*P.acuta*
	Prosobranche	Thiaridae	Potadoma	*P.freethi*
	Prosobranche	Thiaridae	Potadoma	*P.ignobilis*
	Prosobranche	Hydrobidae	Tomichia	*T.kivuensis*
	Prosobranche	Hydrobidae	Tomichia	*T.hendrickxi*
	Prosobranche	Pilinidae	Pila	*Pila ovata*
Lamellibranches	Bivalve	Sphaeridae	Pisidium	*P.casernatum*

3.2 FRÉQUENCE DES ESPÈCES RÉCOLTÉES

Suivant la fréquence d'espèces, le *Biomphalaria pfeifferi* est plus fréquente dans les ruisseaux de la région de Katana suivie de *Lymnaea natalensis*. Les espèces *B. globosus*, *L. junodi* et *Ferrissia burnupi* sont moins fréquentes. *Pila ovata* une espèce introduite est plus fréquente dans les ruisseaux (24,65 %) mais aussi l'espèce *Physa acuta*, signale pour la première fois dans la région est représentée avec 11, 92 %. Le tableau 3 montre bien la fréquence des espèces récoltées.

Tableau 3 : Fréquence des mollusques dans la région de Katana (23 sites de prélèvement)

Mollusques	Fréquence (%)	Caractérisations
Biomphalaria Pfeifferi	26,54	Espece accessoire
Physa acut	11,92	Espece accidentelle
Lymnaea natalensis	25,08	Espece accessoire
Pila ovata	24,65	Espece accessoire
Potadoma ignobilis	7,00	Espece accidentelle
Potadoma freethii	0,40	Espece accidentelle
Tomichia kivuensis	3,03	Espece accidentelle
Tomichia hendrickxi	0,22	Espece accidentelle
Bulinus forskali	0,98	Espece accidentelle
Bulinus globosus	0,01	Espece accidentelle
Pisidium casernatum	0,14	Espece accidentelle
Ferrissia burnupi	0,01	Espece accidentelle
Segmentorbis kempi	0,02	Espece accidentelle
TOTAL	100	-

3.3 ABONDANCE DES ESPÈCES RÉCOLTÉES

Suivant les sites visités, 5 mollusques sont surtout abondants dans les ruisseaux. Ce sont : *Biomphalaria pfeifferi, Lymnaea natalensis, Potadoma ignobilis, Potadoma freethii, P. casernatum, Tomichia kivuensis* est très commun dans tous les ruisseaux prospectés suivies de *Potadoma ignobilis* et *Tomichia kivuensis.* Les autres mollusques sont moins abondants ou rares dans les sites prospectés. Il s'agit de *Bulinus forskalii, Bulinus globosus, Pila ovata, Tomichia hendrickxi, Lentorbis junodi, Segmentorbis kempi* et *Ferrissia burnupi.* Le tableau 4 montre bien l'abondance des espèces récoltées

Tableau 4. Abondance des mollusques dans la région de Katana (23 sites de prélèvement)

Mollusque	Abondance (%)	Caractérisation
Biomphalaria pfeifferi	25,57	Espece abondante
Physa acuta	4,08	Espece peu abondante
Lymnaea natalensis	20,99	Espece moyennement abondante
Pila ovata	0,16	Espece rare
Potadoma ignobilis	19,42	Espece moyennement abondante
Potadoma freethii	12,75	Espece moyennement abondante
Tomichia kivuensis	0,06	Espece rare
Tomichia hendrickxi	0,04	Espece rare
Bulinus forskali	0,04	Espece rare
Bulinus globosus	0,03	Espece rare
Pisidium casernatum	16,81	Espece moyennement abondante
Lentorbis junodi	0,03	Espece rare
Ferrissia burnupi	0,01	Espece rare
Segmentorbis kempi	0,01	Espece rare
TOTAL	100	-

3.4 NOMBRE D'ESPÈCES PAR COURS D'EAU PROSPECTÉS

Les ruisseaux Kalengo et Nkene contiennent plus d'espèces que les autres ruisseaux (10 et 8 espèces respectivement), tandis que le ruisseau Kamunyerere ne possède qu'une seul espèce durant toute la période d'étude. Le ruisseau Kalengo constitue donc le site le plus riche en mollusques de la région. Tous les ruisseaux possèdent au moins une espèce de mollusque. Le tableau 5 montre bien le nombre d'espèces par cours d'eau prospectés.

Tableau 5 : Nombre d'espèces par cours d'eau prospectés

Cours d'eau	Nombre d'espèces
Bidagarha	2
Birunga	5
Busengura	3
Chashonzi	2
Choga	7
Cihembe	5
Cirhindiro	3
Gaho	4
Kaleba	2
Kalengo	10
Kamirihembe	7
Kamunyerere	1
Kanyamalogo	3
Karhakumbwa	3
Kashukabatware	3
Kayumaga	6
Kisima ciduha	6
Lulonge	5
Muchanga	2
Mushaba	4
Nkene	8
Nyabinkonongo	4
Nyabizenga	3

3.5 CARACTÉRISTIQUES ÉCOLOGIQUES ET PARASITOLOGIQUES DES ESPECES

Biomphalaria pfeifferi: cette espèce affectionne les eaux stagnantes ou à faible courant. Elle semble commune dans la région de Katana. Elle est en association, très souvent, avec *Lymnaea natalensis*. Ces deux espèces colonisent le même biotope. Elles sont parasitées par les furcocercaires: Xiphidiocercaire et Gymnocephalus.

Physa acuta: elle colonise les biotopes à faible courant où on trouve des pierres ou une végétation aquatique submergeante. Elle n'avait jamais été signalée dans la région, mais où son expansion est vraiment rapide. Sa parasitologie révèle la présence de Xiphidiocercaires et Gymnocephalus.

Pila ovata: cette espèce a été introduite pour lutter contre la malnutrition dans la région, depuis 1989, mais c'est après 10 ans qu'elle a apparu et maintenant colonise presque tous les milieux aquatiques de la région. C'est une espèce invasive qui peut être utilisée pour la lutte biologique contre le mollusque hôte intermédiaire de la schistosomiase intestinale, *Biomphalaria pfeifferi*. Elle réduit sensiblement la population de *Biomphalaria pfeifferi* dans les étangs piscicoles qu'elle colonise.

Potadoma ignobilis et *Potadoma freethii*: ces deux espèces colonisent les mêmes biotopes et se trouvent souvent ensemble. Elles préfèrent le milieu contenant les pierres et les feuilles mortes et où l'eau a un courant moyen. *Potadoma freethii* a été récolté très récemment et colonise maintenant plusieurs biotopes comme *Potadoma ignobilis,* qui est largement repandue.

Tomichia kivuensis et *Tomichia hendrickxi*: ces espèces colonisent les mêmes biotopes que les deux espèces du genre *Potadoma* récoltées dans la région. Elles sont souvent récoltées sur des pierres immergées dans l'eau. *Tomichia hendrickxi* n'est pas largement distribuée, elle se rencontre seulement près des sources d'eau.

Bulinus forskalii et *Bulinus globosus*: ces espèces se récoltent rarement dans la région mais actuellement, elles ont disparu dans nos récoltes. Elles sont récoltées dans les ruisseaux recevant les eaux des étangs piscicoles. Elles y seraient probablement venues par le transfert des alevins de la région voisine où ces espèces prolifèrent. Elles préfèrent des eaux

calmes, vaseuses et moins profondes, contenant des feuilles mortes. Les études parasitologiques de ces deux espèces, révèlent la présence de Xiphidiocercaires et de Gymnocephalus qu'elles contiennent.

Lentorbis junodi: cette espèce est rare dans la région et n'a été récoltée que dans un seul site(Ciduha) près de la source d'eau, sur les feuilles mortes immergées. Ce site est ombragé avec des eaux à courant lent sur un fond vaseux. La parasitologie de cette espèce dans la région n'a rien révélé jusqu'à présent comme cercaire.

Ferrissia burnupi: il s'agit d'une espèce des milieux ouverts, contenant des plantes aquatiques vivantes, comme *Echornia sp, Cyperus dives*, *Lemna gibba*. Elle est aussi récolte dans les sites de jonction avec les eaux provenant des étangs piscicoles sur ces plantes vivantes, mais aussi sur les feuilles mortes de *Cyperus dives*. L'examen parasitologique montre la présence de Xiphidiocercaires liberées par elle.

Segmentorbis kempi cette espèce est aussi rare, dans la région. Elle a été récoltée sur les feuilles mortes submergeantes dans le ruisseau, dans sa partie marécageuse. Elle n'a jamais été récoltée avec un grand effectif. Sa parasitologie n'a rien révélé.

Pisidium casernatum: cette espèce est un bivalve et se récolte dans la vase, sur les berges des ruisseaux. Elle se trouve dans plusieurs ruisseaux qui ont un fond vaseux. Sa parasitologie n'a rien révélé.

4 DISCUSSION

De Janvier 2002 à Décembre 2012 des enquêtes malacologiques ont été effectuées sur l'inventaire des espèces de mollusques dulcicoles et leur écologie dans la région de Lwiro et ses environs suivant la méthode d'unité de temps de récolte standard de [9]. Cette méthode a l'avantage d'être facile et efficace pour les récoltés dans les eaux courantes. Elle permet également de récolter les mollusques dans les fonds vaseux des ruisseaux et même les œufs fixés sur les feuilles mortes. Ce qui est le cas dans les petits cours d'eau qui ont été cibles dans cette étude.

Quatorze espèces de mollusques ont été inventoriées dans les différents sites associés à une diversité des végétations aquatiques dont les feuilles mortes constituaient la majorité suivies de *Lemnaea spp.* En effet, certaines associations des animaux et des plantes ont une influence sur les hôtes intermédiaires de la bilharziose et constituent les facteurs biologiques de l'environnement [13]; [14]; [15]; [16]. Dans cette région les espèces les plus associées sont *Biomphalaria pfeifferi – Lymnaea natalensis* ; *Biomphalaria pfeifferi – Physa acuta* ; *Lymnaea natalensis – Physa acuta* et aussi *Biomphalaria pfeifferi – Ferrissia burnupi.* L'association *Biomphalaria pfeifferi – Lymnaea natalensis* a déjà été signalée par [1] et montre qu'il y a une concordance entre ces deux espèces. Par contre les autres associations sont maintenant observées car l'espèce *Physa acuta* ne vient que d'apparaitre dans la région. Mais son expansion rapide mérite des études approfondies.

Des espèces inventoriées à Lwiro et ses environs, la classe de Gastéropodes est plus représentée dans nos échantillons. Elle comprend 2 sous classes et 7 familles dont les Planorbidae constituent la famille prédominante. Cette prédominance de la famille de Planorbidae est liée à son habitat et à sa préférence de la végétation aquatique, une des caractéristiques principales des petits ruisseaux du Congo oriental [2].

Dans cet inventaire, la fréquence de récolte de *Biomphalaria pfeifferi* est de 26,54 %. Cette fréquence est inferieure à celle trouvée dans la région d'Ituri ou cette espèce a atteint une fréquence de récolte de 27,6 % des gites ([17]; [18]. Ce mollusque attire notre attention car il est reconnu comme hôte intermédiaire de la schistosomiase à *Schistosoma mansoni* en République Démocratique du Congo.

Les autres espèces, qui ont une importance en médecine humaine et vétérinaire sont non négligeables dans la région et sont toujours en association avec le *Biomphalaria pfeifferi*. Il s'agit de *Lymnaea natalensis* (25,08 %) hôte intermédiaire des *Fasciola haepatica* et *Fasciola gigantica* [3], *Bulinus forskalii* (0,98 %), *Bulinus globosus* (0,01 %) et *Ferrissia burnupi* (0,01 %) hôtes intermédiaires de *Schistosoma haematobium* ([19] ; [20].

Les études parasitologiques ont été faites sur toutes les espèces des mollusques et ont montré l'existence de furcocercaires pathogènes pour l'homme (furcocercaires du *Schistosoma mansoni*), ainsi que des furcocercaires non pathogènes pour l'homme et des cercaires simples (*Schistosoma berghei*, *Schistosoma inflaticauda*, *Schistosoma bovis*, Xiphidiocercaires, gymnocephalus) [21].

L'abondance de *Potadoma ignobilis*, *Tomichia kivuensis*, *Pisidium casernatum* montre clairement que ces espèces sont communes dans cette région. L'abondance du genre *Potadoma* a été signale déjà dans la région de l'Ituri bien avant [22]. Ce genre est représenté dans notre milieu par l'espèce *Potadoma ignobilis* qui préfère les petits cours d'eau avec un courant d'eau et contenant des pierres qui constituent souvent sont support. Pour les espèces *Potadoma freethii* et *Tomichia*

hendrickxi elles ont été récemment récoltes et colonisent des biotopes spécifiques. Mais aussi, elles sont entrain de s'installer dans la région vue l'allure de leur colonisation du milieu.

Il ressort de ces constatations que les transmetteurs de deux bilharzioses humaines (intestinale et vésicale) existent dans les petits ruisseaux de Lwiro et ses environs. Il est maintenant nécessaire d'étudier la dynamique de ces mollusques en vue de décider sur le mode de lutte approprié [23] ; [15]. Or, les études de terrain consacrées à la dynamique de population de ces espèces sont rares à notre connaissance. A part l'étude comparative de la dynamique des populations de *Biomphalaria pfeifferi* dans deux cours d'eau du Congo oriental [24]; [17], il n'existe aucune autre qui est allée jusqu'à une analyse démographique approfondie dans cette région.

Quant aux autres mollusques dont l'importance sanitaire n'a pas encore été élucidée dans la transmission des différentes parasitoses, il serait souhaitable de connaître leur importance dans les associations avec les mollusques hôtes intermédiaires reconnus [3] ; [25]. La rareté des certaines espèces des mollusques dans l'échantillonnage peut s'expliquer par leur écologie et leur biologie. C'est le cas de *Segmentorbis kempi* et *Lentorbis junodi* qui préfèrent des milieux marécageux et ombrageux contenant des *Cyperus dives* [26]. Pour l'espèce *Pila ovata,* elle a été récoltée dans des endroits marécageux à *Papyrus* dont les eaux sont tièdes 28 ^{o}C [1]. Cette espèce a été introduite dans la région en provenance de la plaine de la Ruzizi où elle prolifère. Une étude approfondie sur la bioécologie de ce mollusque donnera la lumière sur leur rareté dans les ruisseaux de la région.

5 CONCLUSION

L'inventaire malacofaunique aquatique réalisé dans 23 petits cours d'eau de Katana a permis d'identifier 14 espèces des mollusques. La distribution des espèces *Biomphalaria pfeifferi* et *Lymnaea natalensis,* respectivement hôtes intermédiaires de la schistosomiase et de la Fasciolose, est homogène et montre bien le risque de contamination dans la région de Katana. La répartition des mollusques hôtes intermédiaires potentiels des autres schistosomiases est en extension. Il est donc important de préconiser les moyens de réduire cette expansion. Cette étude donne les bases sur les études écologiques futures des mollusques dulcicoles de la région de Katana.

REFERENCES

[1] Baluku Bajope, Contribution à l'étude des hôtes intermédiaires des bilharzioses. Ecologie des mollusques *Biomphalaria pfeifferi* dans deux cours d'eau du Zaïre Oriental. Thèse de Doctorat, ULB 487p, 1987.

[2] B. Baluku, G. Josens et M. Loreau, Etude préliminaire de la densité et de la répartition des mollusques dans deux cours d'eau du zaïre oriental. Rév., Zool., Afr. 103,pp 291-302, 1989

[3] Brown S. D, Freshwater snails of Africa and their medical importance. Taylor and Francis, London 487p, 1994

[4] M. Bagalwa et B. Baluku, Distribution des mollusques hôtes intermédiaires des schistosomoses humains à Katana, Sud – Kivu, Est du Zaïre. Méd Trop. 57, p p 369 – 372, 1997

[5] K. Ndegeyi, B. Baluku, M. Bagalwa et C. Batumike, Etude de la reproduction de *Pila ovata* (Gasteropode, pilidae) dans les étangs piscicoles du projet Bika, Est de la RD Congo. Annale de l'UEA, 16p, 2014

[6] G. Dreyfuss, D.Rondelaud, Les mollusques dans la transmission des helminthoses humaines et vétérinaires. Bull. Acad. Vét. France, 164, 1, pp 13 – 20, 2011.

[7] Bouyer T, Contribution à l'écologie des mollusques dulcicoles de Lwiro(Zaïre) avec une référence spéciale à *Biomphalaria pfeifferi.* Université libre de Bruxelles. Mémoire de licence en sciences zoologiques, 123p, 1990.

[8] L. U. Letty and M. B.Myrna, Performance of broilers fed with snail (*Pomacea caniculata*) meal as substitute to fish meal and bone meal. Tropicultura, 9, 2, pp 61-68, 1991.

[9] L.Oliviera and M. Scheiderman, A Method of estimation of the density of aquatic snail population. Exp. Parasitol., 5 , pp 109-117, 1956.

[10] G. Mandhl-Barth, Key to the identification of East and Central African freshwater snails of medical and veterinary importance *Bull. Wld. Hlth. Org, pp* 135-150, 1962.

[11] Berry E et Dobrovolny G., Emploi des molluscicides contre les mollusques aquatiques. Bull. OMS, 48, 27p, 1960.

[12] Fain, Contribution à l'étude des formes larvaires des trématodes au Congo Belge et spécialement de la larve de *Schistosoma mansoni*. Mémoires, Institut royal colonial Belge, 22, 1, 311p, 1952.

[13] R. Deschiens, Les actions molluscicides dans le cadre de la prophylaxie des bilharzioses. Bull Soc Pathol Exot Filiales. 49, 6, pp 1264–1284, 1956.

[14] Watson, Ecology and distribution of *Bulinus truncatus* in Middle East: with comments on the effect of some human activities in their relationship to the snail host on the incidence of haematobia in the Middle East and Africa. Bull. Wld. Hlth. Org., 18, pp 833 – 894, 1958.
[15] OMS, La Schistosomes (Bilharziose). WHO/WSH/ZZ/DFS, Genève, 2010
[16] D. Laurent et P. Alain, Synthèse sur la biologie des coques, Université U.C.O Bretagne Nord, Reserve Naturelle de la baie de Saint-Brieuc.pp 2-16, 2008.
[17] C. Chantier, M. Bushu, T. K. Kristensen, S. Nzeymana, M. Lubingo et J. Cabaret, Inventaire des mollusques d'eau douce en Ituri (Haut Zaïre). Conséquences sanitaire pour l'homme et le bétail. Rea. Hydrobiol. Trop., 2, 5, 3 pp 189 – 196, 1992.
[18] J. Lietar, Biologie et écologie des mollusques vecteurs de Bilharziose à Jodotville. Ann. Soc. Belg. Med. Trop., 36, pp 919-1036, 1956
[19] J. Wautier, Le contrôle des populations des mollusques hôtes intermédiaires des trématodes et l'environnement. Bull. Ecol., 5, 4, pp 39-350, 1974.
[20] B. Baluku, M. Bagalwa et K. Nkusi, Nouveau foyer de la Schistosomiase à Lwiro : Sud-Kivu, Est du Zaïre. Rev. Sci. Nat., 2, pp 19-27, 1994.
[21] V. R. Southgate et M. C.Agrawal, Human schistosomiasis in India? *Parasitology, Today,* 6**,** 5, pp 166–168, 1990.
[22] H. A.Pilsbry et J. Bequaert, The aquatic mollusks of the Belgian Congo, with a geographical and ecological account of Congo malacology. Bull. Ann. Mus. Nat Hist., 53, pp 69 – 602, 1927.
[23] H. H. Najarian, Biological studies on the snail, *Bulinus truncatus*, in Central Iraq. WHO, 25, pp 435 – 446, 1961.
[24] B. Baluku et M. Loreau, Etude comparative de la dynamique des populations de *Biomphalaria pfeifferi* (Gasteropoda, Planorbidae) dans deux cours d'eau du Zaïre oriental. Rev. Zool., Afr., 103, pp 311-325, 1989.
[25] OMS, Schistosomiase (Bilharziose). Organisation Mondiale de la Santé, Genève, Aide-mémoire, no 115, 2012.
[26] G. Mandahl-Barth, The freshwater mollusks of Uganda and adjacent territories. Ann. Mus. Roy. Congo Belge Zool., 32, pp 1-206, 1954.

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DISTRIBUTION SPATIO-TEMPORELLE DES MOLLUSQUES *Physa acuta*, HOTES POTENTIELS DE LA SCHISTOSOMOSE A *Schistosoma haematobium* DANS LA REGION DE KATANA

[SPATIO-TEMPORAL DISTRIBUTION OF THE SNAILS *Physa acuta*, POTENTIAL HOSTS of Schistosomiasis of *Schistosoma haematobium* IN KATANA AREA]

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ABSTRACT: *Schistosoma mansoni,* the blood fluke responsible for human intestinal schistosomiasis exists in Katana region and it's hosted by the snail *Biomphalaria Pfeifferi*. But *Schistosoma haematobium* responsible of urinary schistosomiasis has not been reported in that area. The appearance of its intermediate host *Physa acuta* in the region attracts our attention about future infestation. The objective of this study is to determine the distribution area of this species which appears in region. The snail collection was done in 25 sites comprising 14 streams and rivers, 3 groups of ponds, 7 springs and Lake Kivu.These sites are grouped in terms of altitude gradient and the frequency of people and domestic animals. The results show that altitude has an effect on the distribution of *Physa acuta* in the region. The snail was collected in streams and ponds compared to sites located at the Lake and in rivers. They were found in the site where the ecological conditions were favorable (water velocity, aquatic vegetation and also water quality). The absence of snails in some elevations is related to the ecological factors which reduce the survival of *Physa acuta*. The risk of local transmission of urinal schistosomiasis in Katana is predictable as its potential intermediate host *Physa acuta* is now present and largely distributed in the region.

KEYWORDS: Distribution, *Physa acuta*, *Schistosoma haematobium*, Katana, D. R. Congo.

RESUME: La schistosomiase intestinale à *Schistosoma mansoni* dont l'hôte intermédiaire est le mollusque *Biomphalaria pfeifferi* existe dans la région de Katana. Mais la schistosomiase à *Schistosoma haematobium* n'a jamais été signalée dans cette région. L'apparition de son hôte intermédiaire dans la région suscite des inquiétudes sur l'infestation ultérieure. Cette étude a été inité pour déterminer l'aire de distribution de cette espèce qui apparait dans la région.Il a été procédé à la récolte des mollusques dans 25 sites dont 14 ruisseaux et rivières, 3 groupes d'étangs piscicoles, 7 sources et le Lac Kivu. Ces sites sont choisis en fonction de l'altitude et le choix des sites a été dicté par la fréquentation de la population et les animaux d'élevage. Les résultats montrent que les mollusques *Physa acuta* sont inégalement repartis dans les écosystèmes de la région de Katana et en fonction de l'altitude. Les mollusques sont fréquemment récoltés dans les ruisseaux et les étangs par rapport aux autres sites. Ces mollusques se retrouvent dans les sites où les conditions écologiques leur sont favorables (vitesse du courant, végétation aquatique, mais aussi la qualité des eaux). L'absence des mollusques dans certaines tranches d'altitude est liée aux facteurs écologiques de l'espèce qui rend difficile la survie de *Physa acuta*. Le risque de transmission locale de la bilharziose urinaire est d'autant plus à envisager que les porteurs de *Schistosoma haematobium* dans les populations venant des régions infestées sont en mouvement dans la région de Katana.

MOTS-CLEFS: Distribution, *Physa acuta, Schistosoma haematobium*, Katana, R. D. Congo.

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1 INTRODUCTION

Les Schistosomes sont des endoparasites responsables d'importants dommages chez l'homme. Les maladies qu'ils transmettent sont classées en second après le paludisme, notamment dans les pays tropicaux où elles constituent un véritable problème de santé publique. Elles sont endémiques dans 76 pays avec 600 millions de personnes exposées et plus de 200 millions parasitées [1]. La mortalité due aux bilharzioses est estimée à 200 000 personnes environ par an [2], [3]. Il existe cinq espèces de schistosomes parasitant l'homme [4], [5], [6], [7]. Cependant seules trois d'espèces entre elles sont rencontrées en Afrique et spécialement en République Démocratique du Congo, à savoir *Schistosoma haematobium, Schistosoma intercalatum* et *Schistosoma mansoni.* Elles sont transmises à l'homme par des mollusques gastéropodes de la famille des Planorbidae très repandue dans les systèmes aquatiques.

Parmi ces trois espèces, *Schistosoma mansoni* est celle qui est la plus répandue dans la région de Katana [8], [9]. Dans la région de Katana, un seul type de schistosomiase existe ; la schistosomiase intestinale à *Schistosoma mansoni* dont l'hôte intermédiaire est le mollusque *Biomphalaria Pfeifferi* [10], [9]. Les hôtes intermédiaires d'autres parasitoses à *Schistosoma* existent dans la région notamment *Bulinus spp*, *Ferrisia burnipi* et actuellement le mollusque *Physa acuta*. Mais les cas d'infection à *Schistosoma haematobium* enregistré dans la région de Katana sont des cas probablement venus d'autres régions où cette parasitose est fréquente. En effet, les mouvements des populations humaines entre les régions infestées et non infestées [11], peut entrainer l'installation de cette maladie ; particulièrement le Sud- Kivu où les déplacements des populations dus aux guerres à répétition sont très fréquents.

Le mollusque *Physa acuta* est une espèce récoltée récemment dans les écosystèmes aquatiques de Katana (Rapport du laboratoire, inédit, 2009). Cette espèce n'existait pas avant dans ces écosystèmes [8], [12]. Dans la mesure où cette espèce, hôte intermédiaire de *Schistosoma haematobium,* Bilharz, 1852 est aussi à la base de la forte prévalence de la bilharziose urinaire dans d'autres régions, la compréhension de la dynamique de sa population pourrait contribuer dans les programmes de lutte contre cette parasitose. En effet, l'identification de la faune malacologique et la connaissance du comportement des espèces est une nécessité pour assurer le contrôle efficace des parasitoses concernées, aussi bien pour l'homme que pour l'animal [12].

Compte tenu des exigences écologiques des mollusques pour son installation dans un écosystème où l'espèce n'existait pas avant, cette étude se propose d'étudier la distribution spatio-temporelle de *Physa acuta* en fonction des sites, de l'altitude et des systèmes aquatiques de la région de Katana.

2 MATERIEL ET METHODE

2.1 PRÉSENTATION DE LA ZONE D'ÉTUDE

La région de Katana (Irhambi et Bugorhe) est située autour du Centre de Recherche en Sciences Naturelles (CRSN) de Lwiro sur la rive occidentale du lac Kivu (longitude entre 28°45' Est et 28°85'Est, latitude entre 02°15' Sud et 02°30'Sud, altitude entre 1465 niveau du Lac Kivu et 1800 mètres a la lisière du Parc National de Kahuzi Biega, superficie 141 km^2). Son climat est du type tropical humide, caractérisé par une importante pluviosité moyenne supérieure à 1500 millimètres par an et une température moyenne modérée variable entre 18 et 20° C [8].

On y distingue 2 saisons : une longue saison pluvieuse de Septembre à Mai et une courte saison sèche de juin à Août. Sa végétation est une savane cultivée qui remplace la forêt à *Albizia grandibracteata.* La récolte des échantillons des mollusques a été faite dans quatre types d'écosystèmes aquatiques à savoir les ruisseaux, les étangs, les rivières et le lac Kivu.

Cette région a été choisie car le Centre de Recherche en Sciences Naturelles y dispose d'infrastructures importantes (laboratoire de malacologie) et en raison de la présence du mollusque *Physa acuta* dans quelques écosystèmes aquatiques (rivières, ruisseaux et étangs); 25 sites ont été choisis dont: une rivière (la rivière Lwiro); 3 étangs (Lulonge, Maziba et Bika) ;13 ruisseaux (Birunga, Kalengo, Kayumanga, Nyabizenga, Busengura, Mushaba, Chashonzi, Cirhindiro, Kaleba, Kanyamalogo, Nyabikononga, Kamunyerere, Kashukabatware); 7 sources ont été choisies (Kisima Ciduha, Cihembe, Kamirihembe, Gaho, Tchoga, Nkene et Karhakumbwa) et le lac Kivu (3 sites ont été choisis à savoir Kakondo, Kaliba et Cibale suite à la fréquentation de la population durant notre étude). Ces sites ont été choisis en fonction de la fréquentation de la population ainsi que les animaux d'élevage.

Tableau 1. Sites de prelevement dans les deux groupements pendant la période d'etude.

Aire	Environnement	Nom du site	Nombre des mollusques
Bugorhe	Ruisseaux	Birunga	13
		Kaleba	0
		Kalengo	53
		Karhakumbwa	0
		Kashukabatware	0
		Kayumanga	0
		Mushaba	0
	Rivière	Lwiro	0
	Etangs	BIKA	3494
	Sources	Gaho	0
		Kamirihembe	0
		Kisima ciduha	0
Irhambi	Ruisseaux	Busengura	21
		Chashonzi	0
		Kanyamalogo	0
		Nyabikononngo	0
		Nyabizenga	119
		Ka munyerere	0
		Cirhinidiro	0
	Etangs	Maziba	6
		Lulonge	6
	Sources	Nkene	414
		Choga	157
		Cihembe	0
	Lac	Lac kivu	0
Total			4283

2.2 RÉCOLTE DES MOLLUSQUES DANS LES ÉCOSYSTÈMES AQUATIQUES ET IDENTIFICATION DES MOLLUSQUES

La récolte des mollusques a été pratiquée suivant la méthode Homme –temps standardisée [14]. Le temps de récolte a été fixé à 10 minutes par personne pour chaque gite d'étude et par mois. Pour chaque site, les mollusques sont recherchés au moyen d'une épuisette, à la fois sur la végétation aquatique, sur les différents supports possibles et sur le fond de l'eau. Ils sont ramassés au moyen d'une pince afin d'éviter tout risque de contamination. La densité au niveau d'un site est exprimée par le nombre de mollusques récoltés par une personne pendant 10 minutes. La présence de toutes les espèces de mollusques a été notée, mais seuls les *Physa acuta* sont présentés dans ce travail en raison de son implication dans la transmission de schistosome à *Schistosoma haematobium*. Ils ont fait l'objet d'études concernant leurs répartitions, densités et fluctuations saisonnières.

Tous les mollusques récoltés sont ramenés au laboratoire ; ils sont identifiés suivant la clé de détermination de [15],[16], groupés par système aquatique, puis dénombrés. Dans un deuxième temps, ces mollusques sont mis dans des piluliers avec un peu d'eau distillée et exposés individuellement à la lumière (du jour ou d'une lampe) pendant 30 minutes, pour déterminer la nature et le taux de leur infestation. L'identification des cercaires émises est faite au moyen de la clef de [17]. Les *Physa acuta* ont été mesurés afin d'étudier les corrélations entre leur taille et leur infestation.

2.3 ANALYSE BIOMÉTRIQUE DES MOLLUSQUES

Les *Physa acuta* ont été mesurés à l'aide d'un papier millimétré placé sous une vitre. Les mollusques ont été répartis en 3 classes : [18], [19].

Classe 1 (C_1) : de 0 à 5 mm
Classe 2 (C_2) : de 6 à 8 mm
Classe 3 (C_3) : de 8 à 10 mm

Les analyses des fréquences ont été calculées pour chaque classe de taille.

2.4 ANALYSE DES DONNÉES

Les sites de prélèvement des mollusques ont été classés en fonction de l'altitude. Ainsi, 5 tranches altitudinales ont été déterminées dans la région de Katana.

Tranche 1: 1460 m – 1560 m ; tranche 2: 1561 m - 1660 m ; tranche 3: 1661 m - 1760 m ; tranche 4: 1761 m - 1860 m et tranche 5: 1861 m - 1960 m.

Le dépouillement des mollusques a aussi été fait suivant le type des écosystèmes. Ces écosystèmes ont été classifiés en rivière, ruisseaux, sources, étangs et le lac kivu.

3 RESULTATS

3.1 RÉPARTITION DE MOLLUSQUE *PHYSA ACUTA* DANS LES SITES DE PRÉLÈVEMENT

La présence des mollusques dans ces sites est présentée dans le tableau 1.

Tableau 2. Présence des mollusques Physa acuta pendant l'année 2011 dans les différents écosystèmes aquatiques positifs prospectés.

N°	Ecosystèmes	Altitude (m)	Jan	Fe	Mar	Av	Mai	Juin	Juil	Aout	Sep	Oct.	Nov	Déc	Total
a)Les ruisseaux															
1	**Birunga**	1675	8	2	0	2	0	0	0	0	0	1	0	0	13
2	**Busengura**	1512	0	0	0	0	0	0	0	0	12	8	1	0	21
3	**Chashonzi**	1528	0	0	0	0	0	0	0	0	0	0	0	0	0
4	**Kaleba**	1723	0	0	0	0	0	0	0	0	0	0	0	0	0
5	**Kalengo**	1678	0	0	0	0	2	3	4	2	11	24	6	1	53
6	**Kanyamalogo**	1589	0	0	0	0	0	0	0	0	0	0	0	0	0
7	**Karhakumbwa**	1715	0	0	0	0	0	0	0	0	0	0	0	0	0
8	**Kashukabatware**	1685	0	0	0	0	0	0	0	0	0	0	0	0	0
9	**Kayumanga**	1630	0	0	0	0	0	0	0	0	0	0	0	0	0
10	**Mushaba**	1715	0	0	0	0	0	0	0	0	0	0	0	0	0
11	**Nyabikonongo**	1542	0	0	0	0	0	0	0	0	0	0	0	0	0
12	**Nyabizenga**	1547	0	0	0	0	0	0	0	56	7	4	25	27	119
13	**kamunyerere**	1592	0	0	0	0	0	0	0	0	0	0	0	0	0
14	**Cirhindiro**	1507	0	0	0	0	0	0	0	0	0	0	0	0	0
b) Rivière															
15	**Lwiro**	1641	0	0	0	0	0	0	0	0	0	0	0	0	0
c) Les étangs															
16	**Etangs BIKA**	1683	317	503	140	171	327	166	175	163	131	415	522	464	3494
17	**Lulonge**	1556	0	0	0	0	0	0	0	0	1	1	3	1	6
18	**Maziba**	1888	0	0	0	0	0	0	0	0	0	3	2	1	6
d) Les sources															
19	**Gaho**	1709	0	0	0	0	0	0	0	0	0	0	0	0	0
20	**Kamirihembe**	1628	0	0	0	0	0	0	0	0	0	0	0	0	0
21	**Kisima ciduha**	1728	0	0	0	0	0	0	0	0	0	0	0	0	0
22	**Nkene**	1479	1	7	18	9	2	16	2	100	80	121	41	17	414
23	**Choga**	1593	6	6	20	0	25	48	12	19	11	1	5	4	157
24	**Cihembe**	1482	0	0	0	0	0	0	0	0	0	0	0	0	0
e) Le lac															
25	**Lac Kivu**	1464	0	0	0	0	0	0	0	0	0	0	0	0	0
Total général			332	518	178	182	356	233	193	340	253	578	605	515	4282

3.2 RÉPARTITION DES MOLLUSQUES *PHYSA ACUTA* EN FONCTION DE L'ALTITUDE

L'altitude est un facteur important de la distribution des organismes dans la nature. En effet, les mollusques ont une préférence de distribution suivant l'altitude. Les sites prospectés dans cette étude tenaient compte de l'altitude. La répartition des sites prospectés et de sites positifs par tranche altitudinale est représentée dans la figure 1.

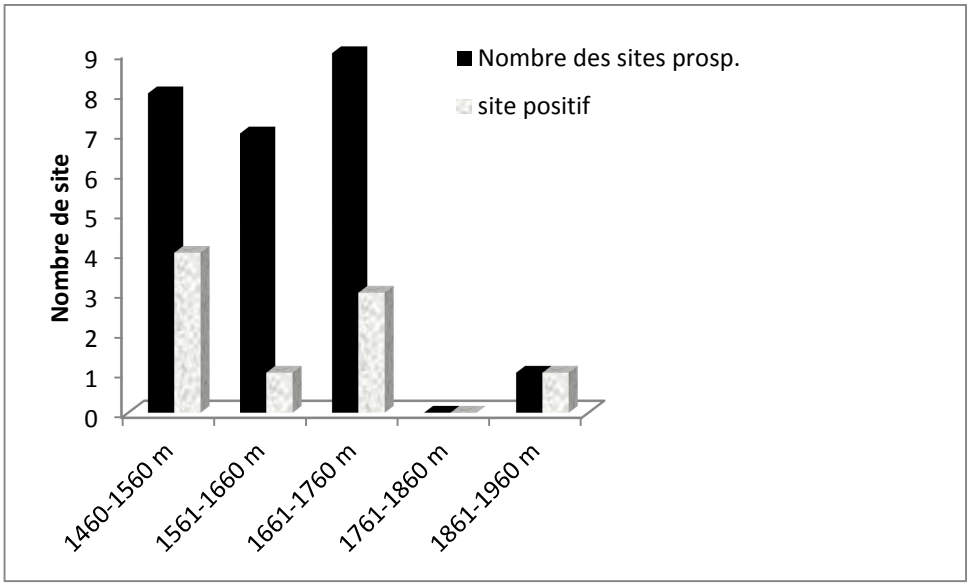


Figure 1. Occurrence de Physa acuta par tranche altitudinale dans la région de Katana.

On y constate que la tranche altitudinale proche du lac est la plus colonisée par cette espèce. La répartition des mollusques dans ces tranches altitudinales est présentée dans la figure 2. On remarque que la tranche altitudinale proche du lac (1460 m - 1560 m) est aussi la plus riche en nombre d'individus de l'espèce. Dans la tranche altitudinale située entre 1761 m – 1860 m les écosystèmes ne sont pas colonisés par cette espèce.

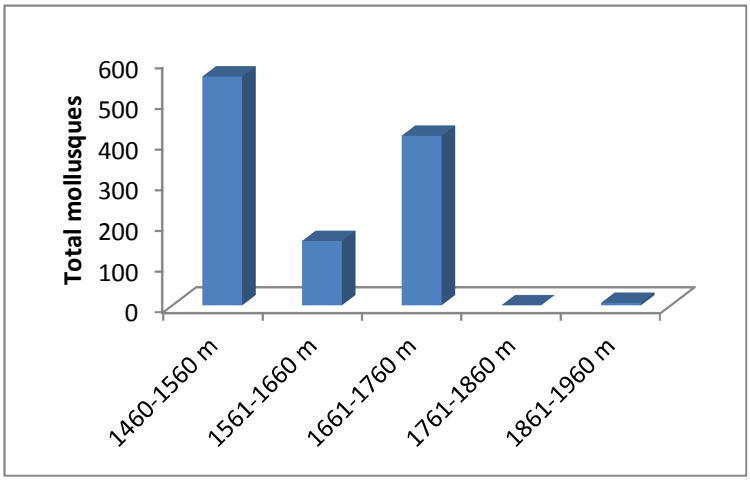


Figure 2. Abondance des mollusques suivant les tranches altitudinales

3.3 RÉPARTITION DU MOLLUSQUE *PHYSA ACUTA* EN FONCTION DES ÉCOSYSTÈMES AQUATIQUES

Cette répartition est donnée dans la figure 3. On y constate qu'elle varie d'un système aquatique à un autre avec un maximum des sites positifs dans les ruisseaux et le nul dans le lac Kivu.

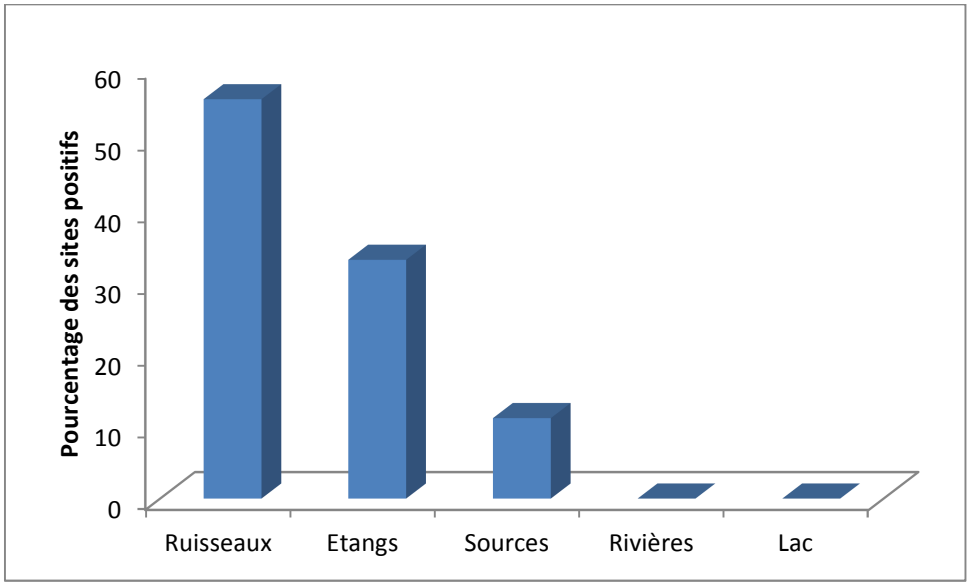


Figure 3. Répartition des mollusques Physa acuta dans les sites de récolte suivant les systèmes aquatiques

4 DISCUSSION

La répartition de mollusque *Physa acuta* dans les sites de prélèvement montre que dans certains sites prospectés, le mollusque *Physa acuta* est absent. Ces sites sont : Chashonzi, Kaleba, Kanyamalogo, Karhakumbwa, Kashukabatware, Kayumaga, Mushaba, Nyabikonongo, Kamunyerere, Cirhindiro, Lwiro, Gaho, Kamirihembe, Kisima ciduha, Cihembe et le Lac Kivu.

Il ressort du tableau 1 que, sur les 25 sites prospectés, le mollusque *Physa acuta* est présent seulement dans 9 sites (36%). Ceci prouve que cette espèce est inégalement répartie dans les écosystèmes aquatiques de la région de Katana. [20], dans son étude sur la distribution des mollusques dans l'Île de la Réunion (France) a trouvé la présence de ce même mollusque dans aussi 9 stations sur les 17 prospectées. Cette répartition de *Physa acuta* serait due d'une part, aux facteurs environnementaux des milieux prospectés (ex : Etangs BIKA, Choga, Nkene, Lulonge, Birunga, Kalengo, Nyabizenga, Busengura, Maziba) et d'autre part, aux exigences écologiques de ce mollusque qui sont satisfaisantes dans un cas et non satisfaisantes dans l'autre cas. Certains mollusques présentent une discontinuité temporelle dans la colonisation des habitats [21]. Cette situation est confirmée par nos résultats car, comme on peut le constater dans le tableau 1, certains habitats (ex : Choga, Etangs BIKA, Nkene) ont été colonisés par *Physa acuta* de Janvier à Décembre, alors que d'autres ne l'ont pas été qu'à partir de Mars (ex : Lulonge) ou Juin (ex : Maziba, Nyabizenga, Birunga, Busengura, Kalengo).

D'autre part, les mollusques sont capables d'estiver lorsque les conditions environnementales deviennent défavorables, par exemple quand les rivières s'assèchent ou quand elles subissent des changements importants dans leur composition chimique de l'eau, notamment en matières organiques, oxygène dissous, etc. [22] ,[16]. D'autres facteurs peuvent aussi affecter la distribution des mollusques *Physa acuta* dans les écosystèmes. Parmi ceux-ci, la vitesse du courant, la température, la lumière, et la présence des prédateurs ou des parasites jouent un rôle important [23], [15].

En effet, l'habitat des mollusques est très polymorphe, mais les eaux stagnantes ou à faible débit constituent leurs lieux de prédilection. Le facteur d'implantation et de colonisation d'un habitat tient généralement aux ressources alimentaires, sachant que la majorité des mollusques consomme des végétaux [24]. Les plus jeunes consomment principalement des algues microscopiques alors que les adultes se développent surtout sur des végétaux supérieurs. De plus, ceux-ci leur servent souvent de lieu de ponte. Les Gastéropodes possèdent une large tolérance aux facteurs physico-chimiques (température, illumination, pH, teneur en matières organiques). Le dessèchement des biotopes est le facteur principal de diminution, voire de disparition, des mollusques aquatiques, bien que certaines espèces aient la propriété de s'enfouir dans le sol pour survivre à la sécheresse (cinq à huit mois sans eau en région tropicale) [23], [25].

Du point de vue abondance des mollusques *Physa acuta* dans les sites de prelevement, cette situation serait due, probablement, à son écologie qui se rapporte à l'habitat, à la nutrition, à la reproduction, à la résistance aux facteurs du milieu et aux rapports avec les espèces concurrentes ou ennemies comme les soulignent d'autres auteurs [25], [26].

Les résultats sur la répartition des mollusques *Physa acuta* dans les sites de récolte suivant les systèmes aquatiques montre bien que suivant l'écologie de ce mollusque, certains sites prospectés ne sont pas favorables à leur survie notamment les facteurs physico-chimiques. En effet, la vitesse de courant dans les rivières serait probablement à la base du non colonisation des mollusques surtout que dans les rivières on observe des crues qui charrient toute la végétation où les mollusques peuvent pondre ou se fixer à la recherche de la nourriture. En ce qui concerne sont absence dans le Lac, ceci serait probablement dû à la qualité chimique des eaux [27]. L'analyse statistique t-student montre une différence significative entre les sites de prélèvement ($t= 1{,}318$; $p \leq 0{,}01$). Le changement des milieux aquatiques a été démontré comme étant la base de la prolifération de la faune malacologique [28], [29] en particulier *Physa acuta.*

L'apparition de *Physa acuta* dans cette zone serait probablement due aux activités agricoles dans les marais et l'installation des étangs piscicoles dans la région. L'aire de répartition exacte de cette espèce dans la région de Katana n'est pas connue jusqu'à présent. Mais dans d'autres régions de la République Démocratique du Congo, cette espèce est reconnue comme le principal hôte intermédiaire de *Schistosoma haematobium* [16], [5], [4]. Le risque de transmission locale de la bilharziose urinaire est d'autant plus à envisager que les porteurs de *Schistosoma haematobium* dans les populations venant des régions infestées sont en mouvements dans la région de Katana. Des études approfondies, tant malacologiques qu'épidémiologiques de cette espèce dans la région de Katana s'avère très indispensable.

5 CONCLUSION

D'un point de vue épidémiologique, on doit noter que *Physa acuta,* hôte intermédiaire de *Schistosoma haematobium,* a été récolté pour la première fois dans la région de Katana. Ce mollusque peut s'étendre à d'autres sites en raison de la présence des systèmes aquatiques et favoriser l'implantation de la schistosomiase urinaire si une surveillance épidémiologique et malacologique n'est pas mise en œuvre. I1 a été observé une variation des populations de mollusques dans les ruisseaux, étangs piscicoles et sources d'eau dans toute la région. Cette variation a été associée à la variation d'altitude et la variation des écosystèmes aquatiques. L'absence des mollusques dans certaines tranches altitudinales est liée aux facteurs écologique de l'espèce qui rend difficile la survie des *Physa acuta*.

REFERENCES

[1] L. Chitsulo, D. Engels, A. Montresor, L. Savioli, '' The global status of schistosomiasis and its control''. *Acta Tropica,* 77**,** pp 41-51, 2000.

[2] OMS, La Schistosomes (Bilharziose). *WHO/WSH/ZZ/DFS,* Genève, 2010.

[3] OMS, Schistosomiase (Bilharziose). *Organisation Mondiale de la Santé, Genève, Aide-mémoire*, no 115, 4p, 2012.

[4] OMS, Atlas de la schistosomiase. *Presse Universitaire de Bordeaux ed* ; Genève, pp 171-182, 1987.

[5] Wright. Geographical distribution of schistosomes and their intermediate hosts. In ANSARI (N) ed. *Epidemiology and control of schistosomiasis, Basel, S. Karger*, pp 32- 249, 1973

[6] J. L. Koeck, C. Modica, F. TUAL, E. Czarnecki, R. Fabre, C. Merle, F. Montfort, ''Découverte d'un foyer de Bilharziose intestinale en République de Djibouti''. *Med. Trop.,* 59, 1, pp 35-38, pp 1999.

[7] F. Njiokou, L.C. Yimtatsemo, T. Kuete, A. Same Ekobo, ''Dynamique des Schistosomoses intestinales au Cameroun: Evolution de la transmission dans le foyer mixte de Nkolmébanga'', Lékié. *Méd. Trop*, pp 351-354, 2004.

[8] M. Bagalwa, B. Baluku, ''Distribution des mollusques hôtes intermédiaires des schistosomoses humains à Katana, Sud – Kivu, Est du Zaïre''. *Méd Trop.* 57, pp 369 – 372, 1997.

[9] B. Baluku, M. Bagalwa, B. Bisimwa, ''Enquête parasitologique sur la schistosomose à *Schistosoma mansoni* à Katana, République Démocratique du Congo''. *Méd. Trop*. 60 : pp 163 – 16, 2000.

[10] B. Baluku., ''Contribution à l'étude des hôtes intermédiaires des bilharzioses. Ecologie des mollusques *Biomphalaria pfeifferi* dans deux cours d'eau du Zaïre Oriental''. *Thèse de Doctorat, ULB*, 487p, 1987.

[11] Y. Yapi, J.L. Rey, K.E. N'Goran, C. Bellec, P. Cunin, ''Enquête parasitologique sur les schistosomoses à Yamoussoukro (Côte d'Ivoire)''. *Médecine d'Afrique noire*, 35, 1, pp 59 – 65, 1988.

[12] M. BagalwaB. , Baluku, N. Mushayuma, 2009. ''Distribution des mollusques dans le Lac Kivu et leur importance médicale''. Numéro Special, CRSN- LWIRO, pp 14 – 21.

[13] G. Dreyfuss, D. Rondelaud, ''Les mollusques dans la transmission des helminthoses humaines et vétérinaires''. *Bull. Acad. Vét*. France, 164, 1, pp 13 – 20, 2011.

[14] L. Olivier, M. Scheiderman, ''A Method of estimation of the density of aquatic, snail population''. *Exp parasital*, 5, pp 109-117, 1956.

[15] Brown S. D., Fresh Water snails of Africa and their medical importance. Taylor and Francis, London, 487p, 1980.

[16] Brown S. D., Fresh snails of Africa and their medical importance. *Revised 2nd. Edition.Taylor and Francis*, London, 608p, 1994.

[17] Fain, Contribution à l'étude des formes larvaires des trématodes au Congo Belge et spécialement de la larve de *Schistosoma mansoni*. Mémoires, Institut royal colonial Belge, 22, 1(1952) 311p.

[18] M. N. Assogba, J. T. Dougnon, I. T. Alkoiret, Y. Akpo, M. Boukari, A. Youssao, ''Epidémiologie de la Fasciolose bovine au Bénin et essai de lutte biologique''. *Livestock Research for rural development*, 23, 12, 2011.

[19] C. Lévèque, ''Biologie de *Bulinus forskalii* (mollusque, Gastropode) de la région de Fort-Lamy (Tchad)''. *Cah. O.R.S.T.O.M., Sér. Hydrobiol*. Vol.II, N°2, pp 79 – 90, 1968.

[20] N. Barren, H. Isautier, B. Mandahl, ''Inventaire des mollusques d'eau douce de la Réunion : Conséquence sanitaire''. *Rev. Elev., Méd. Vét. Pays Trop.*, 35, 1, pp 35 – 41, 1982.

[22] E. A. Malek, ''Schistosomiasis. Snail-transmitted Parasitic Diseases''. Boca Raton, Florida: *Ed. CRC Press*, pp 179-307, 1982.

[23] N.V. Williams, ''Studies on aquatic pulmonate snails in Central Africa''. I. *Field observations in relation to water chemistry. Malacologia*; 10, pp 153-64, 1970.

[24] B. Baluku, G. Josens, M. Loreau, ''Le régime alimentaire de *Biomphalaria pfeifferi* (Gastropoda, Planorbidae) au Zaïre Oriental''. *Révue Zool., Afr,*. 101, pp 272-282, 1987.

[25] J.N. Poda, B. Sellin, L. Sawadogo, S. Sanago, ''Distribution spatiale des mollusques hôtes intermédiaires potentiels des schistosomes et de leurs biotopes au Burkina-Faso''. *Bulletin de liaison de l'organisation de coordination et coopération pour la lutte contre les grandes endémies*.14eme année, N°101, 32p, 1994

[26] J. N. Poda, L. L. Sawadogo, B. Sellin, S. Sanogo, ''Dynamique des populations de *Bulinus truncatus* rohlfsi clessin dans le barrage de Dyoro en Zone Soudanienne du Burkina faso''. *Agronomie Africaine VIII*, 1, pp *61 – 6,* 1996.

[27] L.C. Beadle, '' The mineral composition of Tropical African freshwaters in relation to ecology''. *The lnland Waters of Tropical Africa*. London: Longman, 1974.

[28] J. J. Symoens, M. Burgis, J. J. Gaudet, ''Ecologie et utilisation des eaux continentales africaines''. *Sec. Tech. PNUE, 212p. Universitaire de Bordeaux, Genève* .Vol 82, 6, pp 571-579, 1982.

[29] I. Takougang, P.B. Tchounwou, P. Barbazan, ''Impact des effluents d'un complexe agro-industriel sucrier sur la distribution des mollusques dulçaquicoles à M bandjock (Cameroun)''. *Cahiers de Santé*, 3, pp 178 – 182, 1993.

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Effect of Production Location and Addition of Guar Gum on the Quality of a Sudanese Wheat Cultivar for Bread Making

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ABSTRACT: This study was carried out to investigate the effect of environment and addition of guar gum on the bread making quality of a Sudanese wheat cultivar. Results showed that wheat production location has a significant ($P \leq 0.05$) impact on the biochemical properties of wheat grains. The level of wet gluten of North Sudan wheat (29.3%) was significantly higher ($P \leq 0.05$) compared to that of Central Sudan wheat (25.6%). Falling number of North Sudan wheat flour (355 sec.) was close to the ideal range (250-300 sec.) compared to extremely higher level (490 sec.) recorded for Central Sudan wheat flour. Addition of guar gum as an improver at 1% significantly ($P \leq 0.05$) enhanced the water absorption, dough development time and dough stability in the wheat flour of both locations, however, North Sudan wheat flour remains superior ($P \leq 0.05$) in term of the dough properties compared to Central Sudan wheat flour. Surprisingly, addition of guar gum at 0.5% concentration to North Sudan wheat flour significantly ($P \leq 0.05$) improved the loaf bread volume (4.45 cm^3) compared to control (4.33 cm^3), whereas increasing the guar gum level to 1% slightly decreased the bread volume (4.22 cm^3). Contradictory, increasing the concentration of guar gum from 0.5 to 1% significantly enhanced the loaf bread volume (from 3.98 to 4.23 cm^3) of Central Sudan wheat flour compared to its control (3.90 cm^3). Furthermore, the bread of North Sudan wheat flour with 0.5% guar gum was superior ($P \leq 0.05$) in sensory characteristics such as flavor, taste and texture compared to that of Central Sudan wheat flour.

KEYWORDS: Debera, Dough properties, Guar gum, Loaf bread, Sudanese wheat.

1 INTRODUCTION

With an annual production of about 620 million tonnes, bread wheat (*Triticum aestivum* L.) is one of the world's most important crops [1]. Wheat is unique among cereals, because it contains gluten which has the characteristic of being elastic when mixed with water and retains the gas developed during dough fermentation. The quality of wheat flour for bread-making is generally evaluated by the amount of protein and quality of gluten [2]. The wheat flour containing large amount of protein and high quality of gluten is used for normal bread, whereas that of lower amount of protein is mostly used for confectionary or cakes [3]. Wheat produced in different parts of the world differs greatly in their intrinsic protein qualities and quantities, the quantity is influenced mainly by environmental factors, but the quality of protein is mainly a heritable characteristic [1]. Baking quality is determined by the physical properties of dough, its oxidative properties, the flour water absorption, bread volume, and the color of the bread crumb and crust. The baking properties of a dough sample depend on

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the flour's ability to form dough that, after mixing and during fermentation, has appropriate physical properties. The strength thus contributed to the dough is an important part of the bread making quality of the flour [4]. For several thousand years, bread has been one of the major constituents of the human diet, making the baking of yeast-leavened and sourdough breads is one of the oldest biotechnological processes. In wheat bread making, flour, water, salt, yeast and/or other micro-organisms are mixed into visco-elastic dough, which is fermented and baked [5]. Wheat flour is the major ingredient and consists mainly of starch (ca. 70–75%), water (ca. 14%) and proteins (ca. 10–12%). In addition, non-starch polysaccharides (ca. 2–3%), in particular arabinoxylans (AX), and lipids (ca. 2%) are important minor flour constituents relevant for bread production and quality [5]. During all steps of bread making, complex chemical, biochemical and physical transformations occur, which affect and are affected by the various flour constituents. In addition, many substances are nowadays used to influence the structural and physicochemical characteristics of the flour constituents in order to optimize their functionality in bread making [5]. In Sudan, wheat is a strategic field crop, since it constitutes the main staple food for most of the urban and rural population. Wheat cultivation in Sudan expanded recently and occupying the largest area in Sudanese irrigated schemes, and it is the second most important cereal crop after sorghum in the country [6]. The season with acceptable heat limits ranged between 90 and 110 days [7]. Wheat production was confined to the Northern Sudan, along the Nile banks (17-22N). However, after 1940s due to increasing demand for wheat consumption and scarcity of land, the growing area extended southward to the warmer Central and Eastern Sudan [8]. One of the main constraints of wheat production in Sudan is heat stress, which adversely affects plant growth and grain formation [9]. The consumption of wheat bread in Sudan is increasing in both rural and urban areas as a consequence of changing taste, convenience and consumer subsidies. However, bread can only be made from imported high gluten wheat which is not suitable for cultivation in the tropical areas for climatic reasons [10]. Sudanese wheat are generally of poor bread making quality, which is attributed to the low protein and gluten quantity and quality, in addition to low alpha amylase activity [11]. Improvement of wheat flour quality is very essential for production of good quality bread, and thus most of the quality problems can be solved with the suitable cultivation condition and uses of natural improver. Guar gum has been increasingly used as natural wheat flour improver because it is safe, cheap, and has the ability to improve dough properties and bread quality. Therefore, the aim of the present study was to investigate the effect of cultivation location of Sudanese wheat cultivar (locally known as Debera), as well as the addition of guar gum on the rheological and loaf bread making quality.

2 MATERIALS AND METHODS

2.1 MATERIALS

Sudanese wheat cultivar (Debera) that was cultivated in two locations; North and Central Sudan was obtained from Seen Flour Mills, Khartoum North, Sudan. Guar gum was obtained from Weeta Flour Mills, Khartoum North, Sudan. Yeast was obtained from local market. All other chemicals are of analytical grade.

2.2 PREPARATION OF WHEAT FLOUR AND GUAR/WHEAT FLOUR BLENDS

The samples were cleaned and the physical characters such as, 1000 kernel weight, hectoliter weight were determined, then wheat grains were milled in Seen Flour Mill to white flour (74% extraction rate), and prepared for chemical analysis and bread making. The guar was blended with flour at three different levels: (0.5%, 1% and 1.5%).

2.3 CHEMICAL COMPOSITION

Moisture, ash, crude protein, crude fibre and fat contents were determined for wheat flour, guar and guar-wheat flour blends according to the AOAC method [12].

2.4 TOTAL MINERALS CONTENT

Minerals were determined from the samples by the dry ashing method that described by Chapman and Pratt [13]. About 2.0 g of samples was acid-digested with diacid mixture (HNO_3 /$HClO_4$, 5:1, v / v) in a digestion chamber. The digested samples were dissolved in double-distilled water and filtered (Whatman No. 42). The filtrate was made to 50 mL with double-distilled water and was used for determination of total minerals. Calcium and Magnesium were determined by a titration method [13]. Phosphorus was determined spectrophotometrically by using molybdovanadate method. Potassium and Sodium were determined according to the AOAC method [12] using EEL flame photometer.

2.5 GLUTEN QUANTITY AND QUALITY

Gluten quantity and quality of wheat flours with and without improvers were carried out according to the revised standard ICC method No. 155 and 158 [14] by using Glutomatic 2200 system (Perten Instruments AB, Huddinge, Sweden). Ten grams of the sample were mixed into dough with 5 ml distilled water in a test chamber with bottom sieve. The dough was then washed with 2% solution of sodium chloride. The gluten ball obtained was centrifuged at maximum speed by centrifuge (Type 2015) and quickly weighed. The percentage of wet gluten remaining on the sieve after centrifugation is defined as the gluten index. The total wet gluten was dried in heater (Glutork, 2020) to give the dry gluten. The weight of gluten was multiplied by ten to give the percentage of wet or dry gluten.

2.6 FALLING NUMBER

Alpha – amylase activity of wheat flours with and without improvers was determined according to Perten [15] as described previously [11].

2.7 SEDIMENTATION VALUE

Sedimentation value of wheat flours with and without improvers was carried out according to the official standard methods [16] that described previously [11].

2.8 FARINOGRAPH AND EXTENSOGRAPH CHARACTERISTICS

Brabender farinograph method was carried on wheat flours with and without improvers according to AACC method [16]. Titration curve was used for the assessment of the water absorption for each flour sample. A sample of 300 gram (14% moisture) was weighed and transferred into a clean mixer. The farinograph was switched on at 63 rpm for 1 min, then the distilled water was added from especial burette (the correct water absorption can be calculated from the deviation, 20 units deviation correspond to 0.5% water, if the consistency, is higher than 500 F. U. more water is needed and vice – versa). When the consistency is constant, the instrument was switched off and the water drawn from the burette indicates water absorption of the flour in percentage. The measuring mixer was thoroughly cleaned. A sample of 300 g was weighed, and then introduced into the mixer; the farinograph was switched on such as before. The water quantity, which is determined by the titration curve, was fed at once. When an appreciable drop on the curve was noticed, the instrument was run further 12 min before shutting off.

Extensograph method was used according to ICC method [17]. The extensograph and farinograph were set and operated at 30°C. The dough for extensograph was prepared as for the farinograph, but the amount of water used for mixing was 2% less due to the addition of 2% salt and the dough was mixed for 5 min only. Two pieces of dough (150 g each) were weighed, molded on the balling unit, rolled with dough roller into cylindrical test pieces, fixed in the dough holder, and stored in the rest cabinet for 45 min. The dough piece was placed on the balance arm of extensograph and stretched by stretching hook until it broke. During the period of stretching the behavior of the dough was recorded on a curve via extensograph. This test was performed at 45, 90, and 135 min intervals.

2.9 PREPARATION OF BREAD SAMPLES

Wheat flour and guar-wheat flour blends were baked according to Badi *et al*. [18]. About 250 g flour, water (according to farinograph water absorption), salt (1%), yeast (2%), sugar (2%) and oil (2%) were mixed to form a dough in mono-universal laboratory dough mixer for 5 min at medium speed. The dough was allowed to rest for 10 min at room temperature, then three pieces of 120 g dough were weighed, made into round ball and allowed to rest for another 15 min, then moulded, put into pan and placed in the fermentation cabinet for final proof for 1 h. Baking was done in an oven at 220°C with saturation of steam for 10-15 min. After the loaves were cooled, they were weighed (g) then the volumes measured in ml using volumeter by millet seed displacement method [19] and their specific volumes (v/w) were calculated. The loaves were sliced with an electrical knife, and then each loaf with its slice was photographed.

2.10 SENSORY EVALUATION

The loaves were sliced with an electric knife and prepared for sensory evaluation, at same day, by the ranking test according to the procedure described by Land and Shepherd [20]. Ten semi-trained assessors were provided coded samples

and asked to evaluate the general appearance, flavour, taste, texture and overall acceptability of bread slices. Sum of ranks were then statistically ($P \leq 0.05$) interpreted according to the same ranking test described earlier.

2.11 STATISTICAL ANALYSIS

Data generated, except for sensory evaluations, was analyzed using Statistical Package for Social Sciences (SPSS). Mean (SD) were tested using one factor analysis of variance (ANOVA), and then separated using Duncan's Multiple Range Test (DMRT) according to Mead and Gurnow [21].

3 RESULTS AND DISCUSSION

3.1 PHYSICAL CHARACTERISTICS OF WHEAT GRAINS AND NUTRITIONAL COMPOSITION OF WHEAT FLOUR

The results on effect of cultivation location on the physical characteristics of wheat grains and the nutritional quality of wheat flour are presented in Table 1. Thousand kernels weight of Debera cultivar from North and Central Sudan was 34.8 and 31.2g, respectively. This result is within the range reported by Ahmed [22] and Mutwali [23] who found that the weight of 1000 kernels of different Sudanese cultivars ranged between 28 and 44 g, and 28.7 to 48.5, respectively. However, Makawi *et al*. [24] found that the weight of 1000 kernels of Sudanese cultivars Elnelain, Nepta and Argeen ranged between 31.70 to 34.80 g. Moreover, Zeleny [25] found that the thousand kernels weight for hard red spring and hard red winter wheat ranged from 20 to 32g, whereas soft white and durum wheat ranged from 30 to 40 g. Analysis of variance showed significant differences ($P \leq 0.05$) in the kernel weight between the cultivar in the two locations. The cultivar of North Sudan has higher kernels weight compared to that of Central Sudan. This is reasonable since the environmental and growing conditions (soil, climate, water and nutrient levels) in the North Sudan are favorable for wheat cultivation compared to that of Central Sudan. Furthermore, the hectoliter weight of Debera cultivar from North and Central Sudan was 83.0 and 78.0 kg/hectoliter, respectively (Table 1). This result agreed with those of Mutwali [23] who stated that the hectoliter weight of 20 Sudanese wheat cultivars ranged between 76.6 and 85.25 kg/hectoliter. Williams *et al*. [26] reported that higher correlations occur between hectoliter weight (test weight) and flour yield. This is because hectoliter weight is related to grain density, rather than weight, and the denser kernels tend to contain more endosperm (flour). Statistical analysis of the results showed significant differences ($P \leq 0.05$) in the hectoliter weight among debera cultivar in the two locations. Hectoliter weight of North Sudan cultivar is significantly ($P \leq 0.05$) higher than that of the same cultivar when cultivated in Central Sudan. This result indicated that the differences in the environmental condition between the two locations significantly ($P \leq 0.05$) affect the physical characteristics of wheat grains.

On the other hand, the chemical composition of the wheat cultivar (Debera) from the Northern and Central Sudan is also differ and are presented in Table 1. The moisture content of wheat is important for both farmer and miller. The moisture content of tempered wheat flour (74% extraction) of Debera from North Sudan was 13.3% while that of Central Sudan was 12.3%. These results are similar to those of Mutwali [23] who reported a range of 10.21 to 13.13 for several Sudanese wheat cultivars grown in three different locations. Statistical analysis of the results showed significant differences ($P \leq 0.05$) between the cultivar of the two locations, this may be attributed to the temperature variation between the two locations that is the Central Sudan is warmer than North Sudan. Differences in moisture content is expected even for wheat coming from a single field which can vary widely in moisture due to factors such as differences in soil fertility or stage of ripening of the grain. The ash content of the white wheat flour (74% extraction) is shown in Table 1. Ash content of Debera from North and Central Sudan was 0.54% and 0.55%, respectively. These results were well agreed with the data reported by Mutwali [23] who found that the ash content of 20 Sudanese wheat cultivars was ranged between 0.47 to 0.85%. Statistical analysis of the results showed significant differences ($P \leq 0.05$) in the ash content of wheat flours (74% extraction rate) for the two locations. These results indicated that the production site of wheat had significant effect on the flour ash content. This could be attributed to differences in soil conditions, temperature, water and fertilizers between the two cultivation sites. Grain protein is of primary importance in determining the bread making quality of wheat. Variations in both protein content and composition significantly modify the flour quality for bread making. The protein content of white wheat flour (74%) of Debera cultivar from North and Central Sudan was 11.8% and 10.1%, respectively (Table 1). The results lies within the range obtained by Mutwali [23] who reported that the protein content of white flours of 20 different Sudanese cultivars grown in three different locations ranged between 9.59% to 14.06%. Analysis of variance showed significant differences ($P \leq 0.05$) in the protein content among the white flours of Debera cultivars from North and Central Sudan, which indicated that cultivation site, had influenced the flour protein content. This variation may be due to the variation in growing condition such as amount of nitrogen and drying temperature in Central Sudan, which can partly denature grain protein and cause loss in protein [23]. Protein content and quality are of vital importance in flour milling. They are the characteristics that make wheat

unique and are the main factors on which wheat is traded, where higher protein wheats commanding a higher price. As shown in Table 1. fat content of white wheat flour of Debera from North Sudan (1.07 %) was significantly ($P \leq 0.05$) higher than that of Debera from Central Sudan (1.04%). These values were in agreement with those of Mutwali [23] who reported that the fat content of white flour of 20 Sudanese cultivars ranged between 0.91 and 1.74%. Similar findings were also reported by Ahmed [22] who stated that fat content of Sudanese wheat cultivars ranged between 0.85 and 1.73% for white wheat flour. Fiber content of the white wheat flour of Debera cultivar from North was 1.08%, whereas that of Debera from Central Sudan was 1.07% (Table 1). Analysis of variance showed insignificant differences ($P \geq 0.05$) in the fiber content of white wheat flour of the Debera cultivar grown in the two locations. These results are higher than those of Ahmed [22] who reported that the fiber content of Sudanese wheat cultivars ranged between 0.30 and 0.48% for white flour. Mohamed [27] showed that the fiber content of the white flour of four Sudanese cultivars Debera, Elneelain, Condor and Sasaraib ranged between 0.40 and 0.48%. The carbohydrates content (Table 1) of Debera from North was 71.84%, while carbohydrates content of Debera from Central Sudan was 74.94%. The results obtained were agreed with Mohamed [27] who reported that carbohydrates content of four Sudanese wheat cultivars ranged between 72.2 and 80.1%. Analysis of variance showed significant differences ($P \leq 0.05$) among the white wheat flour of the Debera cultivar grown in two different locations. Results in Table 1 also showed the macro elements content of Debera cultivar from North and Central Sudan. It is clear that the extraction (74%) affected positively in minerals content, in addition to the significant difference between the mineral content of Debera cultivar from North and Central Sudan. This result is in a good agreement with those of Mohamed [27] who reported that different locations of wheat cultivar have an effect on elements of sample. Kulp *et al*. [28] reported that, milling wheat into flour reduces the levels of many nutrients from their original levels in the wheat. It is well known that environmental conditions and genetic factors are very important, factors that influence variation in mineral element concentration in wheat flours.

Table 1. Physical characteristics of wheat grains, and nutritional composition of the flour (74% extraction) of Debera cultivar grown at different locations.

Parameter	Debera cultivar location	
	North Sudan	Central Sudan
Hectoliter weight (kg/hectoliter)	83.0±0.79[a]	78.0±0.26[b]
1000-kernels weight (g)	34.79±0.58[a]	31.20±0.30[b]
Moisture content (%)	13.3±0.10[a]	12.3±0.06[b]
Protein content (%) [Nx5.7]	10.8±0.06[a]	10.1±0.06[b]
Ash content (%)	0.54±0.01[a]	0.55±0.01[a]
Fat content (%)	1.07±0.02[a]	1.04±0.01[b]
Fiber content (%)	1.08±0.01[a]	1.07±0.01[b]
Carbohydrate content (%)	71.54±0.01[b]	74.94±0.01[a]
Phosphorus (mg/100 g)	0.39±0.01[a]	0.31±0.06[b]
Potassium (mg/100 g)	5.12±0.12[a]	4.50±0.30[b]
Sodium (mg/100 g)	10.30±0.10[a]	9.63±0.06[b]
Calcium (mg/100 g)	6.81±0.06[a]	5.32±0.06[b]
Magnesium (mg/100 g)	0.31±0.02[a]	0.29±0.01[a]

*Mean values having different superscript letter in the same raw differ significantly ($P \leq 0.05$).

3.2 QUALITY PARAMETERS OF WHEAT FLOUR AND WHEAT FLOUR-GAUR BLENDS

The quality parameters (gluten quality and quantity, falling number and sedimentation values) of wheat flour and blends were shown in Table 2. Wet gluten content of control for Debera cultivar flour from North Sudan is 29.3%, whereas that of control for Debera cultivar flour from Central Sudan is 25.6%. These results are partially agreed with those of Mohamed [27] and Mutwali [23] who found that the wet gluten of Sudanese cultivars ranged between 26.2 to 31.9% and 28.6 to 46.9, respectively. Analysis of variance showed significant differences ($P \leq 0.05$) in the wet gluten content of white wheat flour of the Debera cultivar grown in two different locations. In which the gluten content of Debera cultivar from North Sudan is significantly ($P \leq 0.05$) higher than that from central Sudan. The low wet gluten in Central Sudan flour may be attributed to the warm weather in Central Sudan, which affects the moisture content of the grain, and this plays a vital factor in lowering the gluten quality and quantity. Addition of guar gum powder to the wheat flour caused a significant reduction ($P \leq 0.05$) in wet gluten content. Results showed wet gluten values of 28.4, 26.6 and 24.0% for Debera cultivar from north Sudan supplemented with 0.5, 1 and 1.5% of guar gum powder, respectively, and 24.9, 23.4 and 20.2 % for Debera cultivar from

central Sudan at 0.5, 1 and 1.5% of guar gum, respectively. There is a significant ($P \leq 0.05$) reduction in the wet gluten content with increasing the percentage of guar gum powder in the blends. On the other hand, dry gluten content of control for Debera cultivar flour from North is 9.7%, while that of control for the same cultivar from Central Sudan is 8.5%. Partially similar results were obtained by Mutwali [23] who reported that the dry gluten content of Sudanese wheat cultivars grown in three different regions are ranged between 8.96 and 16.76 %. However, the results of dry gluten content in this study is lower than those of Makawi *et al*. [11] who reported a range of 10.3 to 11.6 for dry gluten content in some Sudanese wheat cultivars. Analysis of variance showed significant differences ($P \leq 0.05$) in dry gluten content of wheat flour of the Debera cultivar grown in two different locations. Addition of guar gum powder was negatively ($P \leq 0.05$) affected the dry gluten content. This result showed dry gluten values 9.5, 8.6 and 8.0% for Debera cultivar from North at 0.5, 1 and 1.5% of guar gum powder, respectively, and 8.3, 7.8 and 6.7% for Debera cultivar from Central Sudan at 0.5, 1.0 and 1.5% guar gum, respectively. The control of Debera cultivar flour from North showed 73.2 gluten index, whereas the result 70.2 gluten index obtained for Debera cultivar from Central Sudan (Table 2). This value agreed with those of Perten [15] who stated that the optimum range of gluten index for bread making is between 60 and 90. Also the results agreed with those of Mutwali [23] who reported a range of 36.4 to 92.8% for gluten index of 20 Sudanese wheat cultivars from three different locations. Addition of guar gum powder to wheat flour caused a significant increase ($P \leq 0.05$) in gluten index. Guar gum positively ($P \leq 0.05$) affected the gluten index due to it is ability to make a network of gluten more strong. Perten [15] stated that gluten index is an important indicator for gluten quality. Usually, there is a positive relationship between glutenin quantity and the gluten index percentage. But, there is a negative correlation with the gliadin quantity. Consequently, flour quality is influenced by the nature of the gluten and its various components. The result in Table 2 shows significant differences ($P \leq 0.05$) among the blends in their sedimentation value. Debera flour from North showed 19.0 ml sedimentation value, while the that from Central Sudan gave 17.7 ml sedimentation value. This result was agreed with Elagib [29] who found that sedimentation values for Sudanese wheat cultivars ranged from 13.6 to 19.07 ml. While, Mutwali [23] reported a range of 19.0 to 40.3 ml for the sedimentation value of 20 Sudanese wheat cultivars grown at three different locations. Addition of guar gum at 0.5, 1.0 and 1.5% to Debera cultivar flour from North showed sedimentation values of 18.7, 19.8 and 21.0 ml respectively, whereas it gave sedimentation values of 18.3, 19.7 and 20.0 ml, respectively for wheat flour from Central Sudan. Analysis of variance revealed that addition of guar gum significantly ($P \leq 0.05$) increased the sedimentation values of the wheat flours of both sites. The sedimentation test was based on the fact that gluten imbibes water and swells greatly when treated with dilute lactic acid under standard conditions. The amount of water imbibes and volume occupied by a weight of flour depends on the quality of gluten. Strong gluten swells the most and occupies the bigger volume [30]. Falling number of the flour for Debera cultivar from North Sudan was 355 sec, whereas that of the cultivar from Central Sudan gave a result as 490 sec (low alpha-amylase activity). Analysis of variance showed significant differences ($P \leq 0.05$) in the falling number values of white wheat flour of the Debera cultivar grown in two different locations. Variation in falling number values might be due to the seasonality and storage conditions of wheat grains (moisture and temperature). The results of falling number in this study is lower the range obtained by Makawi *et al*. [11] who reported falling number of some Sudanese wheat flours between 471-833sec. Extremely higher falling numbers in the range of 508.0 to 974.7 sec were also reported by Mutwali [23] for 20 Sudanese wheat cultivars. This higher falling number may be attributed to dry harvest season which consequently affect the activity of alpha-amylase. Addition of guar gum powder at 0.5, 1.0 and 1.5 to Debera flour from North and Central Sudan negatively ($P \leq 0.05$) affected the α-amylase activity and gave falling numbers of 380, 398, 422, 502, 535 and 556 sec, respectively. This may be due to the lowering activity of alpha-amylase enzyme by guar gum.

Table 2. Gluten quantity and quality, falling number and sedimentation value of flours and flour-guar blends.

Debera cultivar (Location)	Guar gum level (%)	Gluten quantity and quality			Falling number (sec)	Sedimentation value (cm^3)
		Wet gluten (%)	Dry gluten (%)	Gluten index (%)		
North Sudan	0.0	29.3±0.00^{a}	9.7±0.00^{a}	73.2±0.00^{e}	355±1.53^{h}	19.0±0.00^{bcd}
	0.5	28.4±0.21^{b}	9.5±0.07^{b}	78.2±0.21^{c}	380±0.58^{g}	18.7±0.58^{cde}
	1.0	26.6±0.14^{c}	8.6±0.07^{c}	80.7±0.42^{b}	398±2.08^{f}	19.8±0.58^{bc}
	1.5	24.0±0.14^{f}	8.0±0.70^{e}	84.7±0.35^{a}	422±1.73^{e}	21.0±0.00^{a}
Central Sudan	0.0	25.6±0.21^{d}	8.5±0.00^{d}	70.2±0.00^{f}	490±1.53^{d}	17.7±0.58^{e}
	0.5	24.9±0.35^{e}	8.3±0.14^{d}	73.2±0.14^{e}	502±1.00^{c}	18.3±0.58^{de}
	1.0	23.4±0.35^{g}	7.8±0.14^{e}	76.3±0.42^{d}	535±4.51^{b}	19.7±0.58^{bc}
	1.5	20.2±0.42^{h}	6.7±0.14^{f}	80.1±0.57^{b}	556±6.66^{a}	20.0±0.00^{b}

*Mean values having different superscript letter in the same column differ significantly ($P \leq 0.05$).

3.3 FARINOGRAPH CHARACTERISTICS

The farinograph characteristics of Debera cultivar from North and Central Sudan and the blends were shown in Table 3. The water absorption of bread flour of Debera cultivar from North and Central Sudan was 61.2 and 60.3 farinograph unit, respectively. These results were within the range 57 to 62% obtained by Mutwali [23] for Sudanese wheat cultivars grown in three different locations. Similar observation of water absorption was recently reported for Iranian wheat that used for the preparation of leavened flat bread locally known as Barbari [31]. Water absorption of the Debera cultivar flour of North Sudan was higher than that of Central Sudan. This indicated that the production site had affected the water absorption of Debera wheat flour. For North Sudan cultivar, addition of guar gum powder in the ratios 0.5, 1.0 and 1.5% was shown to increase the water absorption of the blends to 61.9, 63.1 and 65.0, respectively. For Central Sudan cultivar, addition of guar gum powder in ratios 0.5, 1.0 and 1.5% was also shown to increase the water absorption of the blend to 60.8, 62.2 and 64.1%, respectively. These results are in agreement with the fact that addition of different gums increased the water absorption of wheat flour [32]. The water absorption of wheat flour dough is governed in practice, by the protein content and quality and by the extent to which the starch is damaged mechanically [33]. Generally high farinograph water absorption of flour is considered an indication of good baking performance. The reason could be that high protein content causes good baking performance and high water absorption [34], [35]. The development time of control Debera flour from North Sudan was 4.3 min, which is higher than development time of control Debera flour from Central Sudan, which was 3.5 min. These results agreed with the findings of Mutwali [23] who reported that dough development time of Sudanese wheat cultivar in the range of 1.68-5.16 min. It seems that North Sudan cultivar has good bread making quality compared to that of Central Sudan, because long development time is good indicator of the quality of the flour for bread making [36]. Addition of guar gum powder in ratios of 0.5, 1.0 and 1.5% concomitantly decreased the development time of wheat flour of the two locations. These results agreed with Rao *et al*. [32] who reported that addition of guar gum decreased the dough development time. Dough stability of Debera cultivar from North and Central Sudan was 4.9 and 5.4 min, respectively. These results agreed with the findings of Mutwali [23] who reported that dough stability of Sudanese wheat cultivar in the range of 2.0-6.2 min. The weak flour gives dough with low elasticity and stability, while the strong flour gives elastic dough with high stability. But the additives can improve these properties. The dough stability time with 0.5, 1.0 and 1.5% guar gum were 5.4, 5.7, and 4.8 min, respectively, compared with control Debera flour from North Sudan, which is 4.9 min. In case of flour from Central Sudan cultivar, dough stability was 5.7, 6.3 and 5.1 min for ratios 0.5, 1.0 and 1.5% guar gum, respectively. Ellis and Apling [37] reported that, addition of guar gum improved dough stability. The dough stability time of wheat flour was increased by addition of guar gum powder at 0.5 and 1.0%, while the ratio 1.5% decreased the dough stability time of wheat flour. This negative result may be due to the fact that increment of ratio of guar gum powder makes the dough very viscose and thus affect the dough strength.

Table 3. Farinograph characteristics of Debera flour containing different levels of guar gum as improver.

Debera cultivar location	Guar gum level (%)	Water absorption corrected to14%	Water absorption corrected to 500 FU	Dough Stability (min)	Dough development time (min)
North Sudan	0.0	59.2	61.2	4.9	4.3
	0.5	59.9	61.9	5.4	3.7
	1.0	60.8	63.1	5.7	2.9
	1.5	62.7	65.0	4.8	2.4
Central Sudan	0.0	59.0	60.3	5.4	3.5
	0.5	59.6	60.8	5.7	2.5
	1.0	61.1	62.2	6.3	2.2
	1.5	63.0	64.1	5.1	2.0

FU: Farinograph unit

3.4 EXTENSOGRAPH CHARACTERISTICS

The extensograph measures the stretching properties of wheat flour dough for determining the flour quality and for checking flour treatment with additives like ascorbic acid, proteinase or emulsifiers. The extensograph characteristics of wheat flour and blends are shown in Table 4. Debera flour with guar gum exhibited an increase in the energy and resistance at 45, 90 and 135 min, compared to the control flour. This effect is in agreement with study of Rao *et al*. [32] who reported an increase in resistance to extension by addition of guar gum to wheat flour. From the present results, using guar gum powder in ratios of 0.5, 1.0 and 1.5% showed higher ($P \leq 0.05$) values of energy at 45, 90 and 135 min of Debera flour from

North Sudan than the values of Debera flour from Central Sudan. The ratio 1.5% of guar gum showed significant decrease ($P \leq 0.05$) in energy results compared with other ratios of guar gum. There were significant differences among locations, indicating that site of production had affected the flour extension properties. Similar observation has recently been reported for several Sudanese wheat cultivars grown in three different locations [23]. The results also showed that as the fermentation time increased the resistance values of the flour blends and the control increased. Whereas addition of guar gum powder to wheat flour showed slight decrease in extensibility at 45, 90 and135 min compared with control wheat flour. These results agreed with those of Rao *et al*. [32] who reported a decrease in extensibility with addition of surfactant gels to wheat flour. This negative effect may be due to the dilution of gluten content specially gliadin, which is responsible for extensibility. It is well known that the increase in protein content is associated with an increase in mixing time, mixograph peak resistance, and resistance to extension, extensibility and loaf volume. Ellis and Apling [37] mentioned that, the guar gum can improve the energy of weak dough and increase the resistance to extension.

Table 4. Extensograph characteristics of Debera flour containing different levels of guar gum as improver.

Cultivar location	Guar gum level (%)	Energy $(cm)^2$			Resistance (cm)			Extensibility (mm)			R/E		
		45 min	60 min	135 min	45 min	60 min	135 min	45 min	60 min	135 min	45 min	60 min	135 min
North	0.0	59	61	58	224	260	283	146	138	127	2.0	2.5	2.7
	0.5	75	81	86	276	348	320	148	136	149	2.3	3.2	2.8
	1.0	73	75	85	314	436	468	134	112	116	3.7	4.3	4.7
	1.0	72	79	73	342	408	427	126	122	110	3.1	3.7	4.3
Central	0.0	61	65	62	277	408	494	131	112	95	2.6	3.0	3.4
	0.5	60	70	68	286	357	394	126	120	112	3.1	3.5	4.0
	1.0	70	71	74	318	358	406	132	120	118	3.4	3.7	4.2
	1.5	63	56	64	318	369	448	121	103	104	2.9	3.8	4.0

*Each value is the mean of triplicate samples.

3.5 BREAD MAKING QUALITY

The main factor, which places wheat in the front position among the world crops, is its bread-making quality. So, wheat food products are an essential part of balanced diet, because they provide good nutritional value for their caloric values. Wheat is used for several purposes, but the traditional staple food is bread, which is produced in many forms by different processes. The effect of addition at ratios 0.5, 1.0 and 1.5% of guar gum powder on the baking characteristics of Debera flour from North Sudan and Debera flour from Central Sudan is shown in Tables 5, and Figures 1 and 2. Control loaf bread volume of Debera flour from North is 465 cc, addition of guar gum gave a significant difference ($P \leq 0.05$) in bread volume. The loaf bread of 0.5% guar gum gave the highest value; even more than control it gave 480.0 sec, while the ratios 1.0 and 1.5% guar gum gave the result of 450.0 and 435.0 cc, respectively. Whereas the control loaf bread volume of Debera flour from Central Sudan is 408 cc, the ratio 1.0% guar gum gave the highest value, it was 462 cc, while the ratios 0.5 and 1.5% guar gum gave the lowest values, which were 422.0 and 418.0 cc, respectively. Specific volume of control bread of Debera flour from North was 4.33 cc/g. The highest value of specific volume gave at ratio 0.5% guar gum as 4.45 cc/g, whereas the ratios 1.0 and 1.5% gave results 4.22 and 4.12 cc/g, respectively. While the specific volume of control loaf bread of Debera flour from Central Sudan was 3.90 cc/g, addition of guar gum affected positively at ratios 0.5 and 1.0% gave results of 3.98 and 4.23 cc/g, respectively. While guar gum at ratio 1.5% negatively affected the loaf specific volume and the result was 3.82 cc/g. These results are supported by those obtained by Elagib [29] who reported similar loaf volumes of some Sudanese wheat cultivars. From the present results, it is clear that the specific volume of the loaf bread was affected by the addition of improvers and by wheat quality as indicated by the amount of protein content, gluten quantity and quality and sedimentation value. Cauvain and Chamberlain [38] stated that, loaf volume increase is attributed to improved gas retention and to extending the period of dough expansion during the baking stage. Perten [15] stated that, quality factors such as loaf volume and water absorption are related to gluten quality and quantity. Higher gluten quantity values generally give a greater bread volume. Basically, strong flours must be used for making good bread.

Table 5. Physical characteristics of loaf breads made from debera wheat cultivars and with guar gum as improver.

Cultivar Location	Guar gum (%)	Loaf Weight (g)	Loaf Volume (cm^3)	Loaf Specific volume (cm^3/g)
North Sudan	0.0	107.3 ± 0.12^{bc}	465 ± 5.00^{ab}	4.33 ± 0.05^{ab}
	0.5	107.9 ± 0.59^{ab}	480 ± 5.00^{b}	4.45 ± 0.02^{a}
	1.0	106.6 ± 2.00^{bc}	450 ± 18.03^{abc}	4.22 ± 0.12^{bcd}
	1.5	109.2 ± 0.26^{a}	435 ± 31.22^{bcd}	4.12 ± 0.10^{cde}
Central Sudan	0.0	104.6 ± 0.70^{de}	$408.\pm17.56^{d}$	3.90 ± 0.17^{e}
	0.5	105.8 ± 0.78^{cd}	422 ± 10.41^{cd}	3.98 ± 0.11^{e}
	1.0	109.1 ± 0.53^{a}	462 ± 2.89^{ab}	4.23 ± 0.05^{bc}
	1.5	103.9 ± 0.40^{e}	418 ± 20.21^{d}	3.82 ± 0.18^{de}

*Mean values having different superscript letter in each column differ significantly at ($P \leq 0.05$).



Fig. 1. Loaf bread prepared from North Sudan Debera cultivar flour with guar gum as improver at concentration of (A) 0.0%, (B) 0.5%, (C) 1.0%, and (D) 1.5%.



Fig. 2. Loaf bread prepared from Central Sudan Debera cultivar flour with guar gum as improver at concentration of (A-G) 0.0%, (B-G) 0.5%, (C-G) 1.0%, and (D-G) 1.5%

3.6 SENSORY EVALUATION

Table 6. shows the effect of guar gum powder on the organoleptic quality (general appearance, flavor, taste, texture and overall preference) of bread made of Debera flour from North Sudan and Central Sudan. The Evaluation of general appearance of bread made from Debera flour from North, ranged between 23 to 38, and the ratio 0.5% guar gum gave the best result. Whereas the general appearance of bread prepared from Debera flour from central Sudan ranged between 18 to 41. The ratio 1% guar gum gave the better bread. The flavour and taste affected as the same, and it is clear in this study addition of guar gum not bad, except in high level 1.5%. Compared with control flour, addition of guar gum improved the bread made from Debera flour, especially at ratio 0.5% that gave a better result for bread prepared from north Sudan cultivar and the ratio 1% gave the best value for bread prepared from Central Sudan cultivar. This positive effect in a good agreement with Cawley [39] who stated that bread with guar had a soft texture, better softness and improved shelf life. From these results it is clear that the Panelists prefer the bread prepared from Debera flour of North Sudan with ratio of 0.5% guar gum. When the ratio of added guar gum elevated to 1% the bread made from Debera cultivar of Central Sudan is preferred compared to that of North Sudan with the same amount of guar gum.

Table 6. Sensory evaluation (%) of loaf bread made from the debera wheat cultivar flours with guar gum as improver.

Cultivar Location	Guar gum (%)	General Appearance	Flavor	Taste	Texture	Performance
North Sudan	0.0	38^{c}	15^{a}	26^{b}	26^{b}	23^{b}
	0.5	23^{b}	15^{a}	18^{a}	18^{a}	17^{a}
	1.0	32^{b}	23^{b}	22^{b}	27^{b}	25^{b}
	1.5	36^{b}	40^{c}	38^{c}	30^{b}	47^{c}
Central Sudan	0.0	32^{b}	27^{b}	23^{b}	35^{b}	36^{b}
	0.5	21^{b}	21^{b}	22^{b}	24^{b}	21^{b}
	1.0	18^{b}	27^{b}	24^{b}	16^{a}	15^{a}
	1.5	41^{c}	37^{b}	39^{b}	28^{c}	36^{b}

*Means values having different superscript letter in the same column differ significantly ($P \leq 0.05$).

4 CONCLUSIONS

The study revealed that the wheat variety Debera is capable of producing high quality loaf bread if natural improver such as guar gum is applied. The quality of the wheat produced in the Northern Sudan is better than that produced in the Central Sudan due to differences in the climatic factors, length of the season, soil and temperature especially as the low temperature is suitable for improving the chemical characteristics and the nutritive value of the wheat and affecting the rheological characteristics of the dough. The guar gum flour has approved its effectiveness as improver for bread making from even low quality wheat, and this is due to its remarkable effect in strengthening the gluten network. The mixing ratio or 0.5% is the appropriate for good bread making for Debera variety cultivated in North Sudan, whereas 1% is the appropriate ratio of bread making from Debera variety cultivated in Central Sudan.

REFERENCES

[1] J. Bordes, G. Branlard, F. X. Oury, G. Charmet and F. Balfourier, "Agronomic characteristics, grain quality and flour rheology of 372 bread wheats in a worldwide core collection," *Journal of Cereal Science*, vol. 48, no. 3, pp. 569–579, 2008

[2] B. S. Khatkar, A. E. Bell and J. D. Schofield, "The Dynamic Rheological Properties of Glutens and Gluten Sub-Fractions from Wheats of Good and Poor Bread Making Quality," *Journal of Cereal Science*, vol. 22, no. 1, pp. 29-44, 1995.

[3] P. A. Caballero, M. Gomez and C. M. Rosell, "Improvement of dough rheology, bread quality and bread shelf-life by enzymes combination," *Journal of Food Engineering*, vol. 81, no. 1, pp. 42–53, 2007.

[4] M. Menkovska, D. Knezevic and M. Ivanoski, "Protein Allelic Composition, Dough Rheology, and Baking Characteristics of Flour Mill Streams from Wheat Cultivars with Known and Varied Baking Qualities," *Cereal Chemistry*, vol. 79, no. 5, 720–725, 2002.

[5] H. Goesaert, K. Brijs, W. S. Veraverbeke, C. M. Courtin, K. Gebruers and J. A. Delcour, "Wheat flour constituents: how they impact bread quality, and how to impact their functionality," *Trends in Food Science and Technology*, vol. 16, no. 1, pp. 12–30, 2005.

[6] Ishag, H. M., *Genotype differences in heat stress in wheat in Gezira Scheme*. In: DA Saunders and GP Hettel eds, Wheat in Heat- Stressed Environment, Irrigated, Dry Areas & Rice-Wheat Farming Systems, Mexico, D.F.: CIMMYT, pp. 170-174 1994.

[7] H. M. Ishage and O. A. Ageeb, "The physiology of grain yield in wheat in an irrigated land," *Tropical Environment*, vol. 27, pp. 71-77, 1991.

[8] Ageeb, O. A. A., *Agronomic aspects of wheat production in Sudan*. In: DA Saunders and GP Hettel eds, Wheat in heat – stressed environment, Irrigated, Dry Areas & Rice – Wheat Farming System, Mexico, D. F.: CIMMYT, pp. 67-74, 1994.

[9] Elahmadi, A. B., Development of wheat germplasm tolerant to heat stress in Sudan. In: DA Saunders and GP Hettel eds, Wheat in heat – stressed environment, Irrigated, Dry Areas and Rice – Wheat Farming System, Mexico, D. F.: CIMMYT, pp. 48-54, 1994.

[10] M. O. Edema, L. O. Sanni and A. I. Sanni, "Evaluation of maize-soybean flour blends for sour maize bread production in Nigeria," *African Journal of Biotechnology*, vol. 4, no. 9, pp. 911-918, 2005.

[11] A. B. Makawi, H. A. Hassan, M. I. Mahmood, M. M. Eltayeb, and I. A. Mohamed Ahmed, "Optimizing the Bread Formulation of Sudanese Wheat cultivars," *International Journal of Innovation and Applied Studies*, vol. 5, no. 4, pp. 316-326, 2014.

[12] AOAC, *Official methods of analysis of AOAC international,* 17 Ed. Association of the Official Analytical Chemists (AOAC)

[13] Chapman, H.D., and Pratt, F.P., *Determination of minerals by titration method*. In: Methods of Analysis for soils, plants and water (2nd edn.), California University, Agriculture Division, USA, pp. 169 – 170, 1982.

[14] ICC, ICC Standard No. 155. Determination of wet gluten quantity and quality (Gluten Index ac. To Perten) of whole wheat meal and wheat flour (*Triticum aestivum*). Verlas Moritz Schafer: Detmold, West Germany, 1994.

[15] Perten, H., *Manual of falling number 1500 as a measurement of alpha-amylase activity*, (ISO-standard No. 3093, 1974), ICC standard No 10711 (1995), and AACC method 56-81B (1992), Hudding, Sweden, 1996.

[16] AACC, *Approved methods of American Association of Cereal Chemists* (Method 38-12), 10th Edn. American Association of Cereal Chemists, St. Paul, MN, USA, 2000.

[17] ICC, *International Association for Cereal Chemistry*, (No. 114/1) Vienna, Austria, 2001.

[18] S. M. Badi, H. A. Elfaki and H. Perten, "Evaluation of Sudanese wheat varieties (harvested 1975)," *Sudan Journal of Food Science and Technology*, vol. 10, no. 1, pp. 5-11, 1978.

[19] Pyler, E. J., *Baking science and technology*. Siebel publishing company, Chicago, USA, vol. 2, 1973.

[20] Land, D. G. and Shepherd, R., *Scaling and ranking methods*. In: Piggott JR, eds, Sensory Analysis of Foods, pp. 155-85. Elsevier Applied Science, New York, USA, 1988.
[21] Mead, B., and Gurnow, R.W., *Statistical Methods in Agricultural Experimental Biology*. In: Chapman and Hall eds, New York, USA, 1983.
[22] Ahmed, S. E., *Proximate composition and flour quality of wheat cultivars grown in the Sudan* (M.Sc. Thesis), University of Khartoum press, 1995.
[23] Mutwali, N. I. A. K., *Quality of wheat cultivars grown in different locations of Sudan for bread making* (PhD thesis), University of Khartoum press, 2011.
[24] A. B. Makawi, M. I. Mahmood, H. A. R. Hassan and I. A. Mohamed Ahmed, "Grains Quality Characteristics of Local Wheat (Triticum aestivum) Cultivars Grown at Khartoum State, Sudan," *International Journal of Life Sciences*, vol. 7, no. 1, pp. 12-16, 2013.
[25] Zeleny, L., *Criteria of wheat quality*, Page 26. In: Y. Pomeranz ed, Wheat Chemistry and Technology, St. Paul, MN: American Association of Cereal Chemists, pp. 26, 1971.
[26] Williams, P., El –Haramein, F. J., Nakkoul, H. and Rihawi, S., *Crop quality evaluation methods and guidelines*, In: International Center for Agricultural Research in Dry Areas Technical Manual, ICARDA, Syria, pp. 1-31, 1986.
[27] Mohamed, E. A., *Evaluation of four local wheat cultivars with special emphasis on protein fractions* (M.Sc. Thesis), University of Khartoum press, 2000.
[28] K. Kulp, P. M. Banum, P.C. Williams and W.T. Yamazaki, "Natural levels of nutrients in commercially milled wheat flour. I. Description of sample and proximate analysis," *Journal of Cereal Chemistry*, vol. 57, no. 2, pp. 54-58, 1980.
[29] Elagib, E. A. A., *A study of the proteins and baking quality of three Sudanese wheat cultivars* (PhD Thesis), University of Khartoum press, 2002.
[30] J. Williams, "Brief notes on wheat and flour evaluation," *Journal of Food Science and Technology*, vol. 2, no. 1, pp. 38-42, 1970.
[31] M. Ghanbari and J. Farmani, "Influence of Hydrocolloids on Dough Properties and Quality of Barbari: An Iranian Leavened Flat Bread," *Journal of Agricultural Science and Technology*, vol. 15, no. 3, pp. 545-555, 2013.
[32] G. V. Rao, D. Indrani and S. R. Sharpalakar, "Guar gum as an additives for improving the bread making quality of wheat flours," *Journal of Food Science and Technology*, vol. 22, no. 1, pp. 101-107, 1985.
[33] W. Bushuk and I.Hlynka, "Water as aconstituent of flour, dough, and bread," *Baker's Digest*, vol. 38, no. 2, pp. 43-47, 1964.
[34] A. H. Bloksma, "Flour composition, dough rheology, and baking quality," *Cereal Science Today*, vol. 17, no. 3, pp. 380-386, 1972.
[35] P. Meredith, "Dependence of water absorption of wheat flour on protein content and degree of starch granule damage," *Newzealand Journal of Science*, vol. 9, no. 3, pp. 324-230, 1966.
[36] A. H. Bloksma, "Dough structure, Dough Reology, and Baking Quality," *Cereal Foods World*, vol. 35, no. 2, pp. 237-243, 1990.
[37] P. R. Ellis and P. R. Apling, "The development and acceptability of guar-bran bread," *Development in Food Science*, vol. 58, no. 8, pp. 1121-1226, 1982.
[38] S. P. Cauvain and N. Chamberlain, "The bread improving effect of fungal alpha amylase," *Journal of Cereal Science*, vol. 8, no. 3, pp. 239-248, 1988.
[39] R. V. Cawley, "The role of wheat flour pentosans in baking," *Journal of the Science for Food and Agriculture*, vol. 15, no. 8, pp. 834-841, 1984.

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Analysis of gene expression profile for gender in human blood samples

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ABSTRACT: Human peripheral blood is a useful material for biomedical research, since it can be used to investigate responses to treatment and predict diseases. However, various biological and technological factors produce a large degree of variation in blood of gene expression profiles. Our study was based on gene expression profiling analysis on peripheral blood of 45 healthy volunteers, 21 females and 24 men. The blood cells were concentrated, and the total RNA was isolated for the analysis of gene expression using the Affymetrix Gene Chip technology. The results were obtained by a fluorescent scanner, and the numerical data was analyzed using Bioconductor. Samples were clearly divided by gender through the unsupervised clustering analysis. 40 identified genes, differentiating samples by gender were analyzed according to their biological function and chromosomal location. Most of them are located on the X and Y chromosomes. These results provide new insights into the genetic makeup which distinguishes both sexes probably associated with diseases and sex determination.

KEYWORDS: transcriptome, expression, gender, RNA, peripheral blood.

1 BACKGROUND

Peripheral blood is an important source of RNA for gene expression profiling studies (GEPs), because it can be used: to determine the toxicological or disease-related events that have occurred in inaccessible target tissues, to explore the inter-individual GEP associated with donor sex, age, treatments and health conditions., and to describe the influence of technical procedures in GEPs, such as: the conditions of blood sample storage and protocols for RNA extraction and amplification **[1], [2], [3], [4], [5].**

Important differences between males and females exist at every biological level, from the organism as a whole, to organs and organ systems, to individual cells. At the cell level, a major difference is that female cells have two X chromosomes, whereas male cells have one X and one Y chromosome. These biological differences are complex, and may confer variation between gender related to the risk to suffer diseases, like the infection with Hepatitis virus B and C, mental illness and cancer. Furthermore, gender influences in the response to drugs and therapies **[6].**

According to the information published by Cutolo, *et al*. in 1995 and Verthelyi, D. in 2001 **[7], [8]** "Gender is a major determinant of variation in physiology, morphology, and disease susceptibility in humans".

Taking into account the previous information, we set the goal of exploring at a genomic scale the gene expression profile inter-sex. Based on previous research **[1], [9]** we hypothesize that "The expression in peripheral blood of genes associated to sex is mainly determined by genes linked to sex chromosomes, and in smaller degree by genes linked to autosomes, most of them related to diseases conditions such as: infertility, blood diseases and cancer". The importance of this descriptive study resides in providing new information about the inter-sex gene expression profile, in order to help explaining the causes of illnesses and promoting the development of new drugs and therapies.

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2 MATERIALS AND METHODS

2.1 BLOOD SAMPLES DESCRIPTION

2.5 mL of peripheral blood were obtained from 45 apparently healthy Cuban volunteers from 26 to 59 years old (mean±SD=45.42±8, 08). See demographic summary of sample in **Table 1.**

Table 1: Demography summary of samples

	Female	Male
Total # subjects	21	24
Age (mean/sd)	43.95/9.57	47/6.45
Body Mass Index BMI (mean/sd)	27.08/4.81	26.52/3.31
Spanish descendant (% whites)	47.6	62.5
Africans and Spanish mixed (% mulattoes)	23.8	25
African descendant (% blacks)	28.5	12.5

For the efficient blood preservation, the PaxGene collection tubes were used (PreAnalytiX GmbH. Switzerland). Blood was stored at -20^{o}C until use. Subsequently, the RNA was purified using PaxGene purification kit (PreAnalytiX GmbH. Switzerland), following the manufacturer's recommendations.

2.2 THE RNA QUALITY CONTROL

The RNA quality control (quantity, purity and integrity) was made using NanoDrop; 1000 Spectrophotometer (Thermo scientific, USA) and the Bioanalyzer Agilent 2100, by the use of the Eukaryote RNA 6000 Nano Chip (Agilent technologies, California, USA). All purified RNA exhibited high quality, with an RNA integrity number higher than 7.

To explore the gender-specific differences in mRNA level expression, we compared gene expression patterns between males and females using a whole-genome HG-U133 Plus 2.0 gene chip with more than 46 000 transcripts (Affymetrix Genechip® System, USA).

2.3 DATA ANALYSIS

Microarrays data analysis preprocessing was performed using the bioconductor packages, limma, SAM, affy and simpleaffy **[10].** (Affymetrix data was normalized using the RMA module. A standard Pearson correlation method was used to perform unsupervised hierarchical clustering **[11].** The Limma module of Biocoductor was used to fit a linear model for each probe and P-values were corrected using Benjamini and Hochberg's method to control the false discovery rate **[12].** Class prediction analysis was conducted using the class prediction tools available in the BRB-ArrayTools v3.8 software **[13].** For Gene ontology and disease annotation were used the Database for Annotation, Visualization and Integrated Discovery (DAVID) v6.7 Bioinformatics Resources 6.7, NIAID/NIH, and The human Malady compendium (MalaCard Version 1.05.183 02, Mar 2014), respectively.

3 RESULTS

Gene expression data, from the 45 Affymetrix gene chip were normalized and all was included in the analysis. An unsupervised hierarchical clustering algorithm was run on the data to ascertain if they are separated into groups based on their gene expression profiles. **Fig. 1a** shows different cluster, demonstrating the predominance of two blocks, which contain the greatest number of individuals separated in females (F) and males (M). Sex-differences in gene expressions were characterized by a genome-wide scale using peripheral blood sample collection, allowing for the detection of expression differences with high statistical power. As noted, when the levels of the expression of 46,000 transcripts are taken into account to perform unsupervised cluster with the 45 individuals, two male (2081 and 2036) and three female individuals (2086, 2049 y 2048) are separated from the rest. This might respond to some common factors that affect the expression levels of transcripts in blood, such as temperature, hormones, drugs, the chemicals and other factors that were no controlled in our study. Furthermore, the **Figure 1b** shows a supervised cluster made with the 40 genes that perfectly distinguishes females from males, suggesting it a gene-expression signature for gender.

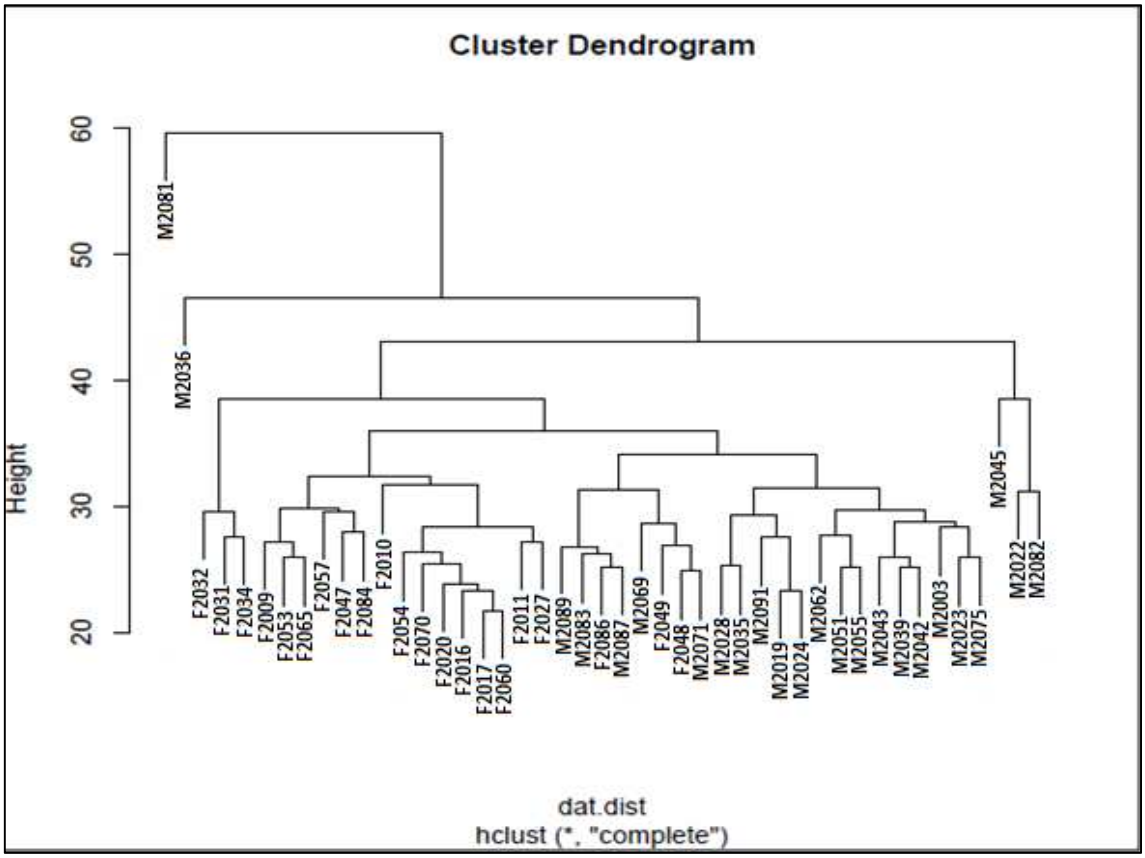


Fig. 1a- Dendrogram of unsupervised hierarchical clustering of Samples, using Pearson's Correlation coefficient as the distance metric. The samples are divided mainly by sex.

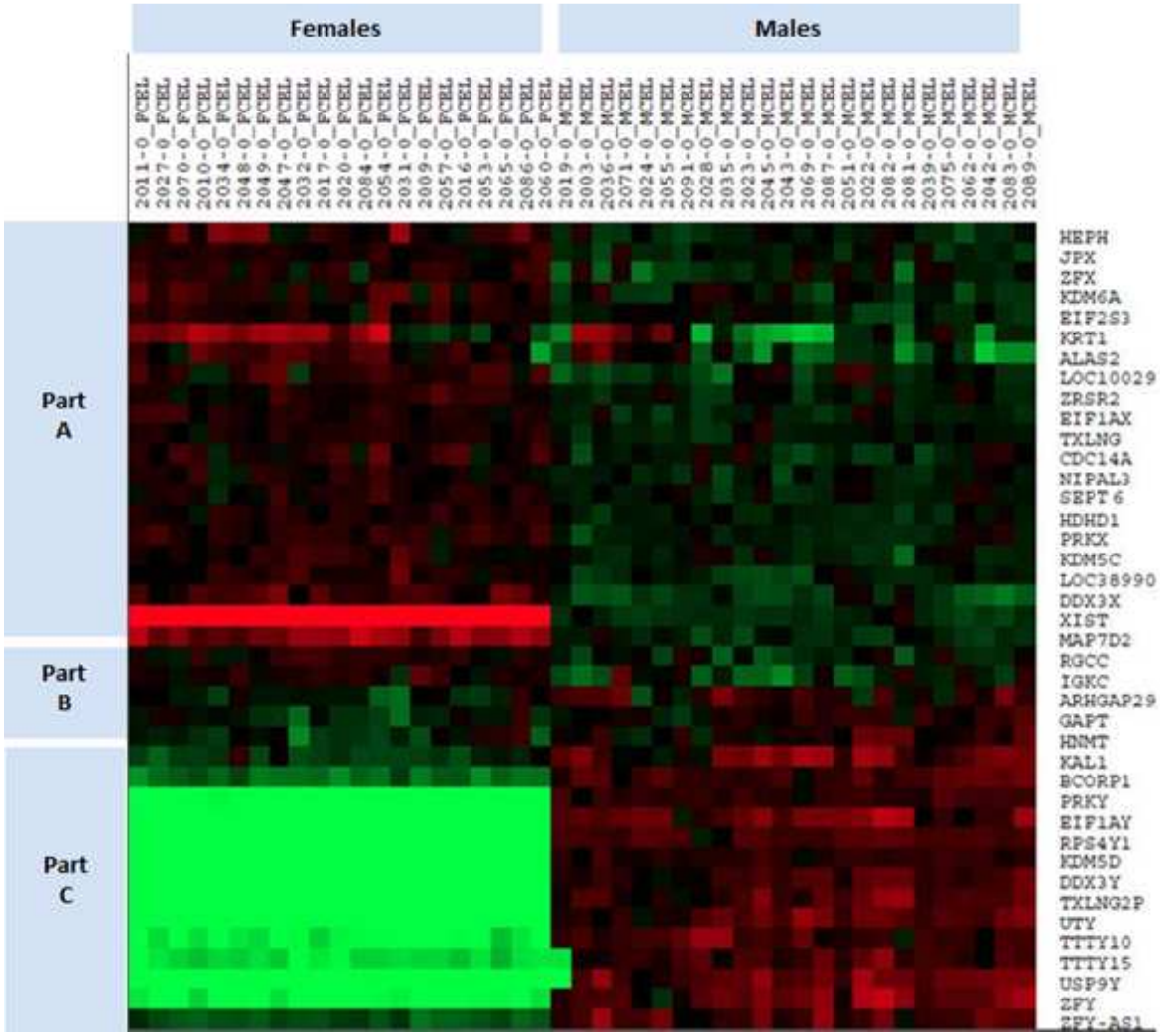


Fig. 1b: Hierarchical supervised cluster of differentially expressed genes associated to sex. Females are represented from the column name 2011 to 2060, and males are represented from the column 2019 to 2089.

40 sex-biased genes were identified with a Fold Change (FC) > 1.4. Among the studied genes, 57.5% showed higher expression in females and 42.5% in males. According to the 17 overexpressed transcripts in males, 76.47% (13 genes) were located on the Y chromosome. On the other hand, of the 23 transcripts overexpressed in females, 73.91% (17 genes) were located on the X-chromosome **(Fig. 2)**. We also identified nine autosomal transcripts with an expression profile different among sexes: KRT1, LOC100291323, RGCC, NIPAL3, GAPT, CDC14A, HNMT, ARHGAP29, and IGKC.

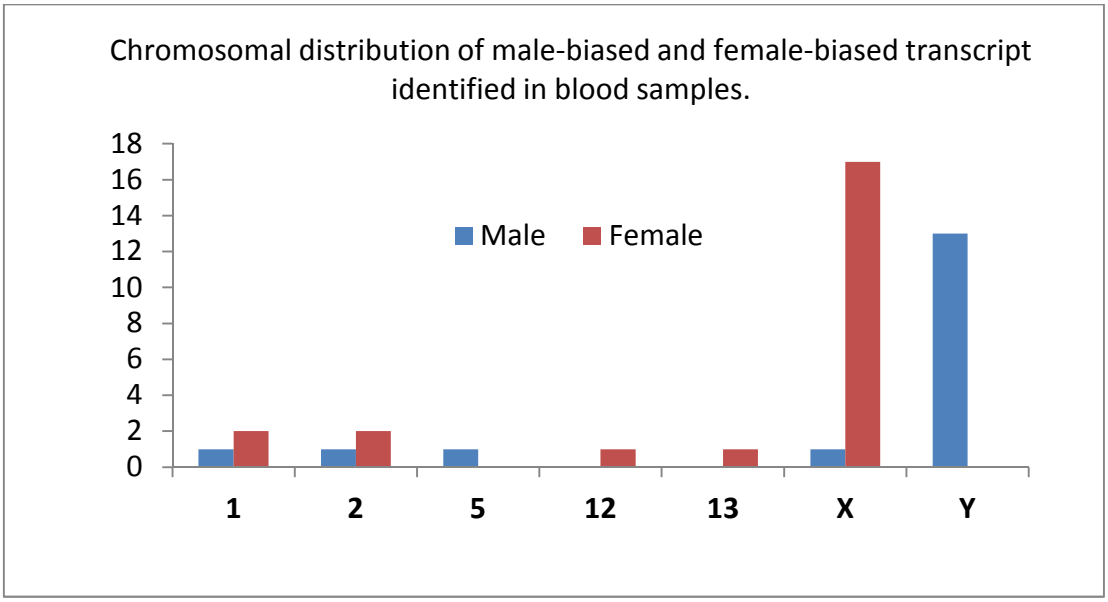


Fig. 2: Chromosomal distribution of overexpressed genes identified in blood samples with male and female-biased.

These differentially expressed genes could represent sex biomarkers. Part A of the cluster, from genes HEPH to MAP7D2 **(Fig. 1b)** represents 45% of the 40 genes with differential expression between gender (all of them are overexpressed in females compared to males). These genes are mainly located on the X chromosome, except for the genes KRT1, CDC14A and NIPAL3 which are located on the autosomes (chromosomes 12 and 1, respectively). Part B of the cluster (from genes RGCC to HNMT) is represented by 22% of all genes. These genes are located on autosomes (chromosomes 1, 2, 5 and 13), and are overexpressed or down-regulated in females in relation to males. Furthermore, the part C of the cluster (from genes KAL1 to ZFY-AS1) is represented by 32% of all the genes, which are mainly located on the Y chromosome and are overexpressed in males in relation to females.

Chromosomal bias was observed with female-biased genes enriched on chrX and male-biased genes enriched on chrY. Analysis of a public information resulted in approximately 77% overlap with our findings **[1], [5], [6], [9], [14], [15], [16].**

Table 2 shows genes with changes in expression greater than 2-fold, and **Table 3** shows genes with changes in expression greater than 1-fold.

Table 2: Genes with a FC>2 of differential expression between sexes.

	Gene symbol	NM	Gene name	Fold change	adj.P.Val	Chr
1	XIST	NR_001564.2	X (inactive)-specific transcript (non-protein coding)	5114,03	7,15e-55	X
2	MAP7D2	NM_152780.3	MAP7 domain containing 2	6,38	2,18e-18	X
3	DDX3X	NM_024005.1	DEAD (Asp-Glu-Ala-Asp) box polypeptide 3, X-linked	3,27	5,86e-10	X
4	ALAS2	NM_000032.4	Aminolevulinate, delta-, synthase 2	2,5	3,77e-2	X
6	HEPH	NM_014799.2	Hephaestin	2,16	6,56e-5	X
5	KAL1	NM_000216.2	Kallmann syndrome 1 sequence	-4,16	5,85e-09	X
7	RPS4Y1	NM_001008.3	Ribosomal protein S4, y-linked 1	-2685,75	1,4e-52	Y
8	KDM5D	NM_004653.4	Lysine (k)-specific dease 5D	-3068	2,68e-52	Y
9	DDX3Y	NM_004660.3	Dead(asp-glu-ala-asp) box	-947,99	2,36e-46	Y
10	TXLNG2P	NM_001005852.2	Taxilin gamma 2, pseudogene	-617,72	1,18e-42	Y
11	EIF1AY	NM_004681.2	Eukaryotic translation initiation factor 1A, y-linked	-793,33	3,74e-40	Y
12	PRKY	NM_002760.3	Protein kinase, y-linked	-44,52	5,86e-37	Y
13	UTY	NM_182659.1	Ubiquitously transcribed tetratricopeptide repeat gene, Y-linked	-144,4	1,73e-36	Y
14	TTTY10	Non-protein coding	Testis-specific transcript, Y-linked 10	-33,02	8,26e-30	Y
15	ZFY	NM_003411.3	Zinc finger protein, y-linked	-50,68	1,64e-27	Y
16	USP9Y	NM_004654.3	Ubiquitin specific peptidase 9, Y-linked	-353,97	2,65e-23	Y
17	TTTY15	Non-protein coding	Testis-specific transcript,Y-linked 15	-19,81	2,25e-20	Y
18	BCORP1	NM_001173413.1	BCL6 co-repressor-like 2	-6,47	6,45e-21	Y
19	ZFY-AS1	Non-Protein Coding	Zinc finger protein, Y-linked	-5,02	3,77e-15	Y
20	KRT1	NM_006121.3	Keratin 1	3,86	3,66e-2	12

Table 3: Genes with a FC>1 of differential expression between sexes.

	Gene Symbols	NM	Gene Name	Fold change	adj.P.Val	Chr
1	PRKX	NM_005044.4	Protein kinase, X-linked	1,831	1,89e-06	X
2	HDHD1	NM_012080.4	Haloacid dehalogenase-like hydrolase domain containing 1A	1,623	4,60e-06	X
3	EIF1AX	NM_001412.3	Eukaryotic translation initiation factor 1A, X-linked	1,687	2,31e-05	X
4	LOC389906	Hypothetical protein	Similar to Serine/threonine-protein kinase PRKX (Protein kinase PKX1)	1,844	4,18e-05	X
5	JPX	Non-protein coding	JPX transcript, XIST activator (non-protein coding)	1,580	4,94e-4	X
6	KDM6A	NM_021140.2	Lysine (K)-specific demethylase 6A	1,956	6,57e-4	X
7	TXLNG	NM_018360.2	Taxilin gamma	1,453	1,12e-3	X
8	EIF2S3	NM_001415.3	Eukaryotic translation initiation factor 2, subunit 3 gamma, 52kDa	1,622	1,17e-3	X
9	ZRSR2	NM_005089.3	Zinc finger (CCCH type), RNA-binding motif and serine/arginine rich 2	1,550	3,19e-3	X
10	KDM5C	NM_004187.3	Lysine (K)-specific demethylase 5C	1,617	4,77e-3	X
11	ZFX	NM_003410.3	Zinc finger protein, X-linked	1,793	1,65e-2	X
12	Septin6	NM_145802	Septin 6	1,409	4,32e-2	X
13	LOC100291323	Hypothetical protein	Similar to immunoglobulin kappa constant; similar to Ig kappa chain	1,963	4,74e-3	2
14	RGCC	NM_014059.2	Regulator of cell cycle	1,699	7,56e-3	13
15	NIPAL3	NM_020448	NIPA-like domain containing 3	1,473	1,21e-2	1
16	GAPT	NM_152687.2	GRB2-Binding Adaptor Protein, Transmembrane	-1,652	2,70e-2	5
17	CDC14A	NM_003672	CDC14 cell division cycle 14 homolog A (S. cerevisiae)	1,645	3,66e-2	1
18	ARHGAP29	NM_004815.3	Rho GTPase activating protein 29	-1,839	3,67e-2	1
19	IGKC	Hs.306357.0	Immunoglobulin kappa constant	1,868	3,77e-2	2
20	HNMT	NM_001024074.2	Histamine N-methyltransferase	-1,802	4,32e-2	2

Genes that discriminate between female and male are involved in 22 biological functions, which could contribute to the establishment of sex dimorphism. Some of them have been validated as biomarkers of sex determination, disease development and drug response (**Table 4**).

Table 4: Gene Ontology analysis of 40 transcripts with differential expression between sexes.

	Biological function	Genes
1	Long non coding RNA (Regulatory function in the genome)	XIST, TTTY10, TTTY15, ZFY-AS1, JPX
2	Histones Demethylase (Epigenetic modification)	UTY, KDM5D, KDM6A, KDM5C
3	ATP-dependent RNA helicase (RNA metabolism)	DDX3Y, PRKY, PRKX, DDX3X
4	Transcriptional activators	ZFY, ZFY-AS1, ZFX
5	Eukaryotic translation initiation factor	EIF1AY, EIF1AX, EIF2S3
6	Cytokinesis (Cell cycle regulation)	SEP6, CDC14A, RGCC
7	Negatively regulates B-cell proliferation	GAPT, LOC3899, NIPAL3
8	Immune response	LOC100291323, RPS4Y1, IGKC
9	Phosphatase	CDC14A, HDHD1
10	GTPase Activity	ARHGAP29
11	Metal ion binding	ZRSR2
12	Posttranslational modification, protein turnover	ALAS2
13	Peptidase	USP9Y
14	Iron metabolism	HEPH
15	Histidine metabolism	HNMT
16	Cellular morphogenesis	PRKX
17	Kinases regulation	KRT1
18	Protein biosynthesis	RPS4Y1
19	X chromosome inactivation	XIST
20	Cell migration during embryogenesis	KAL1
21	Transcription regulation	TXLNG
22	Unknown function	BCORP1, MAP7D2, TXLNG2P

With the aim of linking the differentially expressed genes among sexes with illnesses, we searched for the available information and found that these genes are related to nine conditions, being cancer the most common disease representing 17 genes associated to it (**Table 5**). These associations are based on differences between healthy and unhealthy people with regard to genetic polymorphism and gene expression.

Table 5: Genes associated with sexes represent potential disease biomarkers and future drug targets.

		Genes	References
1	Cancer	RGCC, CDC14A, Septin6, GAPT, KDM5D, DDX3X, ZFX, JPX, XIST, UTY, DDX3Y, EIF1AY, PRKY, ZFY, TTTY15, TTTY10, RPS4Y1, BCORP1.	[17], [18], [19], [20]
2	Infertility	KAL1, ZFY, USP9Y**,** ZFY-AS1, DDX3Y, EIF1AY, KDM5D.	[21], [22], [23]
3	Psychiatric and neurodegenerative disorders	EPH, KDM6A, EIF2S3, KDM5C, MAP7D2, TXLNG, BCORP1, TXLNG2P, NIPAL3.	[24], [25]
4	Heart Failure	USP9Y, DDX3Y, EIF1AY, RPS4Y1.	[26], [27]
5	Blood diseases	ALAS2, ZRSR2, XIST, HEPH.	[28]
6	Viral diseases	DDX3X, EIF2S3.	[21]
8	Kidney disease	PRK.	[29]
9	Hyperkeratosis, dermatitis and asthma susceptibility	KRT1, HNMT.	[30], [31], [32]
10	Ichthyosis	HDHD1.	[33]

The most represented disease among the 40 sex-linked genes obtained in this study, is cancer. There is a majority representation of genes associated with cancer in sex chromosomes and autosomes, showing the molecular complexity and the high genetic component of the disease with the highest worldwide incidence (**Fig. 3**).

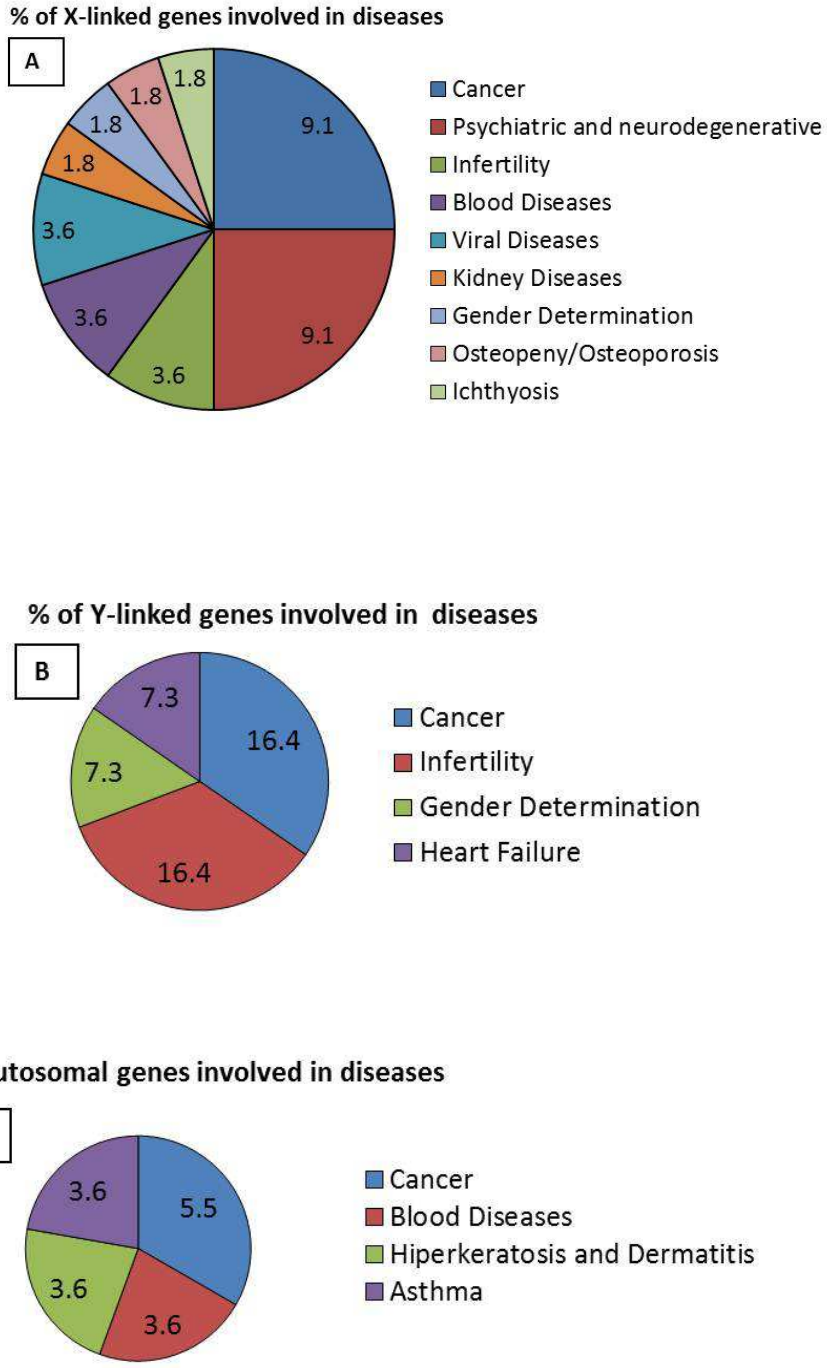


Fig. 3: Sexual chromosomes and diseases representation of the 40 genes with differential expression between sexes. A: represent the % of X-linked genes associated to diseases, with a predominance of genes involved in cancer, neurodegenerative and psychiatric diseases. B: represent the % of Y-linked genes associated to diseases, with a predominance of genes involved in cancer and infertility. C: represent the % of genes in autosomes associated to diseases, with a predominance of genes involved in cancer.

Age also has a strong influence on gene expression [**34**]. To examine whether the effects of age on gene expression, we separately analyzed the data for two age groups (< 45 years N=22; 11 female and 11 men) and >45 years (N=23; 10 female and 23 men). In these two age groups, we identified a set of 73 genes significant by SAM (data not shown). When this list of

genes was used for age classification of samples, the 1-Nearest Neighbor classifier algorithm was the best method, but the sensitivity and specificity was lower than 60%, suggesting that other effects not related with age and not controlled in our experiment may be stronger.

4 DISCUSSION

Of the total genes with significant differences between the sexes, 45% (18 genes) are located on the X chromosome, 32.5% (13 genes) are located on the Y chromosome and 22.5% (9 genes) on autosomes (**Fig. 2 and Tables 2 and 3**). Genes linked to the X chromosome are the most represented in the analysis of differential expression among sexes. Moreover, unlike the previous genes, all genes located on the Y chromosome have a FC>2 of differential expression rate. As is well known, the genes located on the Y chromosome have a distinctive role in sex determination. Some of the most overexpressed genes on the Y chromosome are RPS4Y1, KDM5D, and DDX3Y, which are involved in various biological functions as: eukaryotic translation initiation, epigenetic modification, cell growth, spermatogenesis, RNA metabolism and protein biosynthesis **[35], [36], [37].**

Furthermore, among the overexpressed genes located on X chromosome with the highest Fold Change is the XIST, which is a spliced and polyadenylated "long non-coding RNAs" (lncRNA) typically expressed in all female somatic cells and involved in the initiation of XCI (X chromosome inactivation) in the female cells **[38].** The expression and function of XIST is controlled by other lncRNAs such as JPX (X inactive specific transcript activator), which is described in **Table 3**. A recent work demonstrated the loss of XIST results on X chromosome reactivation and can produce hematopoietic cancers in mice **[20],** showing, in this sense, a direct link between the X chromosome and cancer.

In our transcriptome analysis, the most represented transcripts with expression differences among sexes are non-coding RNA (**Table 4**). The data suggests a possible role of large non-coding RNAs in the epigenetic modification of sex-linked gene expression. It has been suggested by other authors, that gene expression on sex chromosomes can influence the autosomic genes expression, which in turn impact on sex dimorphism observed in human **[39].** This fact could help to explain the inter-sex differences on the autosomic gene expression, being the epigenetics regulation one of the mechanisms involved in the different gene expression profile between sexes. LncRNAs (long non-coding RNAs) have emerged as key molecular players in the regulation of gene expression in different biological processes. Their involvement in epigenetic processes includes the recruitment of histone-modifying enzymes and DNA methyltransferases, leading to the establishment of chromatin conformation patterns that ultimately result in the fine control of genes **[40].**

Among the overexpressed transcripts in males, we found four genes DDX3Y, EIF1AY, PRKY and ZFY which has a functionally overexpressed and interchangeable counterpart on the X-chromosome (genes found on human X and Y chromosomes, in regions that do not recombine during male meiosis. An analysis of nucleotide sequence suggests that these X-Y gene pairs encode similar but non-identical proteins) **[41].** Interestingly in females, the genes DDX3X, EIF1AX, PRKX and ZFX escapes to X inactivation, which would suggest its overexpression in any tissue in females vs. males, due to resultant higher genetic load in females **(Tables 1 and 2) [41].**

It is noteworthy that the KAL 1 gene, which is located on the X chromosome and, according to Franco et al in 1991 [**42], [43**] partially escapes to X inactivation, has a lower fold change in females than in males (**Table 1**). But, with the development of new genomic technologies such as microarrays (gene chip) and Hiseq, it has been observed that Kal 1 gene is not found in the list of 114 genes that escape to X-inactivation **[41].** So, the differential expression between female and male may be due to different factors that have an effect on gene expression, such as cellular and hormonal environmental and epigenetic events associated with sexes.

Sex hormones are usually considered the main architects of sex dimorphisms; recent studies have demonstrated that sex chromosomes can also induce sex differences in somatic gene expression in the absence of hormonal differences **[40].** We observed sex differences in the autosomal gene expression which might be related to sex dimorphism. Recent reports on sex differences induced by epigenetic events not hormone-induced, may help to explain the inter sex difference on autosomal genes **[16].**

Diseases with high prevalence in females and males have been reported; in females for example are the autoimmunity diseases, Alzheimer's disease, and mental illness such as depression and anxiety. In males are cancer, hematologic malignancies, infections, Parkinson disease, autism, alcohol dependence and antisocial personality disorder.

Furthermore, another differences between gender are the clinical symptom presentation (age of disease presentation and evolution) and the response to drugs and therapies **[44], [45], [46].** In this regard, we emphasize that in the female group, there is a prevalence of 9.1% of genes with differential expression inter-sex, which are related to the condition of

psychiatric and neurodegenerative diseases **(Fig. 3).** This result is consistent with the information available about the prevalence of diseases in females in relation to males **[47].**

On the other hand, there is predominance (16.4%) of differential expression of genes related to cancer on the male group, being observed in our results correspondence with the existing information about the association of diseases and sex.

The results show a group of five genes with extreme differential expression between sexes (XIST, RPS4Y1, KDM5D, DDX3Y, and EIF1AY). These genes can be studied and validated as molecular sex biomarker for application in areas such as health and sport. These genes are also involved in the human reproduction, defining the individual fertility, and also they are involved on sex determination during embryonic life and possibly during adult life **[48].**

In this whole blood transcriptome, about 0.1% of genes from the genome changed their expression differentially upon sexes. This is a very low percentage of genes to justify sex dimorphism and all its influence on health and drug response. In addition, other factors may profoundly contribute to sex differences, including: 1) Genetic Factors: genetic polymorphism, and mutations. 2) Epigenetic events: posttranscriptional, posttranslational and environmental and life style factors. 3) Sex hormones: estrogens level s differences. 4) Sex dimorphism: psychological and behavioral differentiation and brain structure and neurochemical **[46], [47], [48], [49], [50]**.

Blood cells, as well as, other tissues show differences in gene expression between sexes. For example, it has been known for decades that the mammalian liver is a sexually dimorphic organ, exhibiting major sex differences in the profile of steroid and drug metabolism **[50], [51], [52].** In humans; it has been observed that there is, in female, a predominant expression of CYP3A4, which is the most important P450 catalyst of drug metabolism in human liver **[52]**. The sexually dimorphic expression of P450s and other liver-expressed genes is regulated by the temporal pattern of plasma growth hormone (GH) released by the pituitary gland, which shows significant sex differences **[52].** The sex-associated differences in the anatomy, physiology and pathophysiology of the human cornea have been also reported. Researchers have identified significant sex-related differences in the diameter, curvature, thickness, and sensitivity and wetting time of the cornea, the mitotic rate of corneal epithelial cells, the density of corneal endothelial cells, and the survival rate of corneal grafts **[53], [54], [55].**

Just like transcriptomic studies examining gene expression profile at the mRNA level, studies comparing the proteome and serum metabolite concentrations of males and females, also found remarkable sex differences. Thus, sex dimorphism most commonly examined at the gene expression levels appear to be present also at the metabolomic and proteomic level **[56]**.

5 CONCLUSIONS

In peripheral blood, the expression of genes associated to sex is mainly determined by genes linked to sex chromosomes (77%), and in smaller degree by genes linked to autosomes (23%). Most of them are related to disease conditions and could contribute to explain the anatomical, behavioral and chemical environmental differences between male and female**.**

All genes located on the Y chromosome have a >2 Fold Change and they are related with infertility and cancer. Genes, located on the X chromosome and autosomes, are related with cancer, psychiatric and neurodegenerative diseases.

This study offer new molecular insights into gender-specific differences providing new genes that could be evaluated as biomarkers of sex and diseases. Our results agree with previous researches showing that female transcriptome is different from the male transcriptome, in which most of differentially expressed genes are located on sex chromosomes**.**

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REFERENCES

[1] S.J. Kim, D.J. Dix, K.E. Thompson, R.N. Murrell, J.E. Schmid, J.E. Gallagher, J.C. Rockett, " Effects of Storage, RNA Extraction, Gene chip Type, and Donor Sex on Gene Expression Profiling of Human Whole Blood", *Clinical Chemistry*, vol. 53, no. 6, pp.1038–1045, 2007.

[2] B. Wolf, A. Schwarzer, A.L. Cote´, T.H. Hampton, T. Schwaab, E. Huarte, C.R. Tomlinson, J. Gui, J.L. Fisher, C.E. Fadul, J.W. Hamilton, M.S. Ernstoff, "Gene Expression Profile of Peripheral Blood Lymphocytes from Renal Cell Carcinoma Patients Treated with IL-2, Interferon-a and Dendritic Cell Vaccine", *PLoS ONE*, vol 7, No. 12, e50221, 2012.

[3] R. Canali, L. Natarelli, G. Leoni, E. Azzini, R. Comitato, O. Sancak, L. Barella, F. Virgili, "Vitamin C supplementation modulates gene expression in peripheral blood mononuclear cells specifically upon an inflammatory stimulus: a pilot study in healthy subjects", *Genes Nutr*, vol. 9, no. 3, 2014.

[4] T. R. Louis-Ferdinand, "The Use of Blood Cell Gene Expression Profiles as a Surrogate for Target Organ Toxicity", *European International Journal of Science and Technology*, vol. 2, no. 4, pp. 2304-9693, 2013.

[5] P. De Boever, B. Wens, A.C. Forcheh, H. Reynders, V. Nelen, J. Kleinjans, N.V. Larebeke, G. Verbeke, D. Valkenborg, G. Schoeters, "Characterization of the peripheral blood transcriptome in a repeated measures design using a panel of healthy individuals", *Genomics*, vol 103, no. 1, pp. 31–39, 2014.

[6] A.R. Whitney, M.A. Diehn, S.J. Popper, A.A. Alizadeh, J.C. Boldrick, D.A. Relman, P.O. Brown, "Individuality and variation in gene expression patterns in human blood", *PNAS*, vol. 100, no. 4, pp. 1896–1901, 2003.

[7] M. Cutolo, A. Sulli, B. Seriolo, S. Accardo, A.T. Masi, "Estrogens, the immune response and autoimmunity", *Clin Exp Rheumatol*, vol. 13, pp. 217–26, 1995.

[8] D. Verthelyi, "Sex hormones as immunomodulators in health and disease", *Int. Immunopharmacol*, vol. 1, pp. 983–993, 2001.

[9] R. Jansen, S. Batista, A.I. Brooks, J.A. Tischfield, G. Willemsen, G. van Grootheest, J.J. Hottenga, Y. Milaneschi, H. Mbarek, V. Madar, W. Peyrot, J.M. Vink, C.L. Verweij, E.J.C. de Geus, J.H. Smit, F.A. Wright, P.F. Sullivan, D.I. Boomsma and B.W.J.H. Penninx, "Sex differences in the human peripheral blood transcriptome", *BMC Genomics*, vol. 15, 2014.

[10] R.C. Gentleman, V.J. Carey, D.M. Bates, B. Bolstad, M. Dettling, S. Dudoit, B. Ellis, L. Gautier, Y. Ge, J. Gentry, K. Hornik, T. Hothorn, W. Huber, S. Iacus, R. Irizarry, F. Leisch, C. Li, M. Maechler, A.J. Rossini, G. Sawitzki, C. Smith, G. Smyth, L. Tierney, J.Y.H. Yang, J. Zhang, "Bioconductor: open software development for computational biology and bioinformatics", *Genome Biology*, vol. 5, no. 10, 2004.

[11] M.B. Eisen, P.T. Spellman, P.O. Brown, D. Botstein, "Cluster analysis and display of genome-wide expression patterns", *Proc. Natl Acad. Sci*. USA, Vol. 95, pp. 14863–14868, 1998.

[12] G.K. Smyth, "Limma: linear models for microarray data. In Bioinformatics and Computational Biology Solutions using R and Bioconductor". Edited by: Gentleman R, Carey V, Dudoit SR, Irizarry WH. New York: Springer. pp. 397-420. 2005.

[13] R. Simon, A. Lam, M.C. Li, M. Ngan, S. Menenzes, Y. Zhao, "Analysis of gene expression data using BRB-ArrayTools", *Cancer informatics*, vol. 3, pp. 11-17, 2007.

[14] J.J. Eady, G.M. Wortley, Y.M. Wormstone, J.C. Hughes, S.B. Astley, R.J. Foxall, J.F. Doleman, and R.M. Elliott. "Variation in gene expression profiles of peripheral blood mononuclear cells from healthy volunteers", *Physiol Genomics*, vol. 22, pp. 402–411, 2005.

[15] Z. Jangravi, M. Alikhani, B. Arefnezhad, M. Sharifi Tabar, S. Taleahmad, R. Karamzadeh, M. Jadaliha, S.A. Mousavi, D.A. Rastegar, P. Parsamatin, H. Vakilian, S. Mirshahvaladi, M. Sabbaghian, A.M. Meybodi, M. Mirzaei, M. Shahhoseini, M. Ebrahimi, A. Piryaei, A.A. Moosavi-Movahedi, P.A. Haynes, A.K. Goodchild, M.H. Nasr-Esfahani, E. Jabbari, H. Baharvand, M.A.S. Gilani, H. Gourabi, and G.H. Salekdeh, "A Fresh Look at the Male-specific Region of the Human Y Chromosome". *J. Proteome Res*, vol.12, no.1, pp. 6−22, 2013.

[16] Q. Xu, S. Ni, F. Wu, F. Liu, X. Ye, B. Mougin, X. Meng, X. Du, "Investigation of Variation in Gene Expression Profiling of Human Blood by Extended Principle Component Analysis", *PLoS ONE*, vol. 6, no. 10, e26905, 2011.

[17] A.K. Wong, Y. Chen, L. Lian, P.C. Ha, K. Petersen, K. Laity, A. Carillo, M. Emerson, K. Heichman, J. Gupte, S.V. Tavtigian, D.H Teng, "Genomic structure, chromosomal location, and mutation analysis of the human CDC14A gene", *Genomics*, vol. 59, no. 2, pp. 248-51, 1999.

[18] Y.F. Lau, J. Zhang, "Expression analysis of thirty one Y chromosome genes in human prostate cancer", *Mol Carcinog*, vol. 27, no. 4, pp. 308-21. 2000.

[19] G. Pierron, F. Tirode, C. Lucchesi, S. Reynaud, S. Ballet, S. Cohen-Gogo, V. Perrin, J.M. Coindre, O. Delattre, "A new subtype of bone sarcoma defined by BCOR-CCNB3 gene fusion", *Nat Genet*, vol. 44, no. 4, pp. 461-466, 2012.

[20] E. Yildirim, J.E. Kirby, D.E. Brown, F.E. Mercier, R.I Sadreyev, D.T. Scadden, J.T. Lee, "Xist RNA is a potent suppressor of hematologic cancer in mice", *Cell*, vol. 152, no. 4, pp. 727-42, 2013.

[21] B. Rinkevich, "The DDX3 subfamily of the DEAD box helicases: divergent roles as unveiled by studying different organisms and in vitro assays", *Current Medicinal Chemistry*, vol. 14, no. 23, pp. 2517-2525, 2007.

[22] V.S. Vineeth and S.S. Malini, "A Journey on Y Chromosomal Genes and Male Infertility", *Int J Hum Genet*, vol. 11, no. 4, pp. 203-215, 2011.

[23] N. Pitteloud, R. Quinton, S. Pearce, T. Raivio, J. Acierno et al, "Digenic mutations account for variable phenotypes in idiopathic hypogonadotropic hypogonadism", *J Clin Invest*, vol. 117, no. 2, pp. 457–63, 2007.

[24] M.P. Vawter, S. Evans, P. Choudary, H. Tomita, J. Meador-Woodruff, M. Molnar, J. Li, J.F. Lopez, R. Myers, D. Cox, S.J. Watson, H. Akil, E.G. Jones, W.E. Bunney, "Gender-specific gene expression in post-mortem human brain: localization to sex chromosomes", *Neuropsychopharmacology*, vol. 29, no. 2. pp. 373-84, 2004.

[25] Y. Niida, A. Yachie, "MAP7D2 is a brain expressing X-linked maternal imprinted gene in humans". *Nat Proceedings*. http://hdl.handle.net/10101/npre.2011.6684.1.

[26] J. Isensee, H. Witt, R. Pregla, R. Hetzer, V. Regitz-Zagrosek, N.P. Ruiz, "Sexly dimorphic gene expression in the heart of mice and men", *J Mol Med*, vol. 86, pp. 61–74, 2008.

[27] B. Heidecker, G. Lamirault, E.K. Kasper, I.S. Wittstein, H.C. Champion, E. Breton, S.D. Russell, J. Hall, M.M. Kittleson, K.L. Baughman, J.M. Hare, "The gene expression profile of patients with new-onset heart failure reveals important gender-specific differences", *European Heart Journal*, vol. 31. pp. 1188–1196, 2010.

[28] T.A Griffiths, A.G Mauk, R.T. MacGillivray, "Recombinant expression and functional characterization of human hephaestin: a multicopper oxidase with ferroxidase activity", *Biochemistry*, vol. 44, no. 45, pp. 14725-31, 2005.

[29] M. Meier, J.K. Park, D. Overheu, T. Kirsch, C. Lindschau, F. Gueler, M. Leitges, J. Menne, H. Haller, "Deletion of protein kinase C-beta isoform in vivo reduces renal hypertrophy but not albuminuria in the streptozotocin-induced diabetic mouse model", *Diabetes*, vol. 56, no. 2, pp. 346-54, 2007.

[30] N.V. Whittock, G.H. Ashton, W.A. Griffiths, et al, "New mutations in keratin 1 that cause bullous congenital ichthyosiformerythroderma and keratin 2e that cause ichthyosisbullosa of Siemens", *Br. J. Dermatol*, vol. 145, no. 2, pp. 330–335, 2001.

[31] L. Balaci, M.C. Spada, N. Olla, G. Sole, L. Loddo, F. Anedda, S. Naitza, M.A. Zuncheddu, A. Maschio, D. Altea, M. Uda, S. Pilia, others, "IRAK-M is involved in the pathogenesis of early-onset persistent asthma". *Am. J. Hum. Genet*, vol. 80, pp. 1103-1114, 2007.

[32] H.S Lee, S.H. Kim, K.W. Kim, J.Y. Baek, H.S. Park, K.E. Lee, J.Y. Hong, M.N. Kim, W.I. Heo, M.H. Sohn, K.E. Kim, "Involvement of Human Histamine N-Methyltransferase Gene Polymorphisms in Susceptibility to Atopic Dermatitis in Korean Children", Allergy *Asthma Immunol Res*, Vol. 4, no. 1, pp. 31-36, 2012.

[33] A. Preumont, R. Rzem, D. Vertommen, E.V. Schaftingen, "The HDHD1 gene, often deleted in X-linked ichthyosis, encodes a pseudouridine-5'-phosphatase". *Biochemical Journal*, vol. 431, no. 2, pp. 237-244, 2010.

[34] D. Glass, A. Viñuela, M.N. Davies, A. Ramasamy, L. Parts, D. Knowles, A.A. Brown , Å.K. Hedman, K.S. Small, A. Buil, E. Grundberg, A.C. Nica, F.O. Nestle, M. Ryten, the UK Brain Expression consortium, the MuTHER consortium, R. Durbin, M.I. McCarthy, P. Deloukas, E.T. Dermitzakis, M.E. Weale, V. Bataille and T.D. Spector, "Gene expression changes with age in skin, adipose tissue, blood and brain", *Genome Biology*, vol. 14, no. 7, R75. 2013.

[35] J. Secombe, R.N. Eisenman, "the function and regulation of the JARID1 family of histone H3 lysine 4 demethylases: the Myc connection", *Cell Cycle*, vol. 6, no. 11, pp. 1324-8, 2007.

[36] A. Nottke, M.P. Colaiácovo and Y. Shi, "Developmental roles of the histone lysine demethylases", *Development*, vol. 136, pp. 879-889, 2009.

[37] H.J. Ditton J. Zimmer, C. Kamp, E. Rajpert-De Meyt, P.H. Vogt, "The AZFa gene DBY (DDX3Y) is widely transcribed but the protein is limited to the male germ cells by translation control", *Hum. Mol. Genet*, vol. 13, pp. 2333-2341, 2004.

[38] L.L. Hall, M. Byron, K. Sakai, L. Carrel, H.F. Willard, and J.B. Lawrence, "An ectopic human XIST gene can induce chromosome inactivation in post differentiation human HT-1080 cells", *PNAS*, vol. 99, no. 13. pp. 8677–8682, 2002.

[39] F.C. Beckedorff, M.S. C. Amaral, Deocesano-Pereira, S. Verjovski-Almeida, "Long non-coding RNAs and their implications in cancer epigenetics", *Biosci Rep*, vol. 33, no. 4, e00061, 2013.

[40] P.J. Wijchers, R.J. Festenstein, "Epigenetic regulation of autosomal gene expression by sex chromosomes", *Trends Genet*, vol. 27, no. 4, pp. 132-40, 2011.

[41] Y. Zhang, A. Castillo, M. Jiang, Y. Zhu, L. Hu, A.O. Urrutia, X. Kong, L.D. Hurst, "Genes that escape X-inactivation in humans have high intraspecific variability in expression, are associated with mental impairment but are not slow evolving", *Mol Biol Evol*, vol. 30, no. 12, 2013.

[42] B. Franco, S. Guioli, A. Pragliola, B. Incerti, B. Bardoni, R. Tonlorenzi, R. Carrozzo, E. Maestrini, M. Pieretti, P. Taillon-Miller, "A gene deleted in Kallmann's syndrome shares homology with neural cell adhesion and axonal path-finding molecules", *Nature*, vol. 353, no. 6344, pp. 529 –536, 1991.

[43] C. Dodé, J. Levilliers, J.M. Dupont, A. De Paepe, N. Le Dû, N. Soussi-Yanicostas, R.S. Coimbra, S. Delmaghani, S. Compain-Nouaille, F. Baverel, C. Pêcheux, D. Le Tessier, C. Cruaud, M. Delpech, F. Speleman, S. Vermeulen, A. Amalfitano, Y. Bachelot, P. Bouchard, S. Cabrol, J.C. Carel, H. Delemarre-van de Waal, B. Goulet-Salmon, M.L. Kottler, O. Richard, F.

Sanchez-Franco, R. Saura, J. Young, C. Petit, J.P. Hardelin, "Loss-of-function mutations in FGFR1 cause autosomal dominant Kallmann syndrome", *Nature Genet*, vol. 33, pp. 463-465.

[44] C.A. Haaxma, B.R. Bloem, G.F. Borm, W.J.G. Oyen, K.L. Leenders, S. Eshuis, J. Booij, D.E. Dluzen, M.W.I.M. Horstink, "Gender differences in Parkinson's disease". *J Neurol Neurosurg Psychiatry*, vol. 78, pp. 819–824, 2007.

[45] C.L. Carter, E.M. Resnick, M. Mallampalli, A. Kalbarczyk, "Sex and Gender Differences in Alzheimer's disease: Recommendations for Future Research", *Journal of females's health*, vol 21, no. 10, 2012.

[46] M.T. Dorak, E. Karpuzoglu, Gender differences in cancer susceptibility: an inadequately addressed issue, *Frontiers in Genetic*, vol. 3, no. 268, pp. 1-11, 2012.

[47] M.B. Cook, S.M. Dawsey, N.D. Freedman, P.D. Inskip, S.M. Wichner, S.M. Quraishi, et al, Sex disparities in cancer incidence by period and age, *Cancer Epidemiol Biomarkers Prev*, vol 18, no. 4, pp. 1174–1182, 2009.

[48] S. Cvitic, M.S. Longtine, H. Hackl, K. Wagner, M.D. Nelson, G. Desoye, U. Hiden, "Placental Sexome Differs between Trophoblast Epithelium and Villous Vessel Endothelium", *PLoS ONE*, vol. 8, no. 10, e79233, 2013.

[49] A. Gabory, L. Attig, C. Junien, "Sex dimorphism in environmental epigenetic programming", *Mol. Cell. Endocrinol*, vol. 304: pp. 8–18, 2009.

[50] F.E. Yates, A.L. Herbst, J. Urquhart, "Sex difference in rate of ring A reduction of δ4-3-keto-steroids in vitro by rat liver", *Endocrinology*, vol. 63, pp. 887-902, 1958.

[51] H.D. Colby, "Regulation of hepatic drug and steroid metabolism by androgens and estrogens", *Adv. Sex Horm*, vol. 4, pp. 27-71, 1980.

[52] D.J. Waxman & M.G. Holloway, "Sex Differences in the Expression of Hepatic Drug Metabolizing Enzymes", *Molecular Pharmacology*, vol. 76, no. 2, 2009.

[53] T. Snellingen, G.N. Rao, J.K. Shrestha, F. Huq, H. Cheng, "Quantitative and morphological characteristics of the human corneal endothelium in relation to age, gender, and ethnicity in cataract populations of South Asia", *Cornea*, vol. 20, pp. 55-8, 2001.

[54] T. Goto, S.D. Klyce, X. Zheng, N. Maeda, T. Kuroda, C. Ide. "Gender- and age-related differences in corneal topography", *Cornea*, vol. 20, pp. 270-276, 2001.

[55] M. Jonsson, K. Markström, "A. Behndig, Slit-scan tomography evaluation of the anterior chamber and corneal configurations at different ages", *Acta Ophthalmol Scand*, vol. 84, pp. 116-120, 2006.

[56] A.P. Arnold, A.J. Lusis, "Understanding the sexome: measuring and reporting sex differences in gene systems", *Endocrinology*, vol. 153, pp. 2551–2555, 2012.

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Accuracy of Handheld GPS compairing with Total Station in Land Use Survey: A Case Study in RUET Campus

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ABSTRACT: Global Positioning System (GPS) has become as an important tool in land use study. Using GPS, it is possible to conduct survey with less manpower and less time. In this study, land use analysis was carried out using handheld GPS and Total Station. Campus of Rajshahi University of Engineering & Technology (RUET) was selected as the study area for this study. Garmin GPS was used to locate ground position and track logs of different objects within the study area. Handheld GPS could receive and track satellite signals between 0 to 3 meters of positional accuracy. The aim of the study was to compare the land use survey results conducted by both GPS and Total Station. Primary input for mapping the whole study area was GPS readings which were collected during the field survey. GPS readings were processed using some software i.e. Map source, Google Earth, Google Sketch up, Auto CAD, Photoshop and developed land use map. This paper is an attempt to evaluate the performance of handheld GPS in land use survey. Precision of handheld GPS is low. Accordingly, the results of the GPS survey indicates about 12% errors compared with the results of Total Station survey. However, handheld GPS is recommendable to conduct preliminary survey and where there is scarcity of manpower and time.

KEYWORDS: Land use Survey, Handheld GPS, Total Station, Google Earth, AutoCAD, RUET.

1 INTRODUCTION

The Global Positioning System (GPS) is an all-weather, space based navigation system. A GPS receiver can fix its latitude and longitude by calculating its distance from three or more Earth-orbiting satellites, whose positions in space and time are known. If four or more satellites are within the receiver's "horizon," the receiver can calculate its elevation, direction of travel and even its velocity. Errors inherent in the system dilute the repeatable horizontal accuracy of the computed position to a level of 20 to 100 meters. Actual position of an object is somewhere within a circle which has a radius measuring from 20 to 100 meters.

Conventional terrestrial survey method, such as Total Station, is used in land surveying with great efficiency, reduces field survey and permits to accelerate data acquisition with highest accuracy. Total Station (TS) combine an Electronic Distance Measurement (EDM), an electronic digital theodolite, and a computer in one unit. The device automatically measure horizontal and vertical angles, as well as distances, and transmit the results in real time to a built-in computer. The horizontal and vertical angles and slope distance can be displayed, and then upon keyboard commands, horizontal and vertical distance components can be instantaneously computed from these data and displayed. If the instrument is oriented in direction and the coordinates of the occupied station are input to the system, the coordinates of any point sighted can be immediately obtained. This data can also be stored within the instrument, thereby eliminating manual recording.

The aim of this study is to compare the results of handheld GPS survey with that of a survey conducted with TS. The paper will address the performance and accuracy comparisons between handheld GPS and total station on land use data. The campus of Rajshahi University of Engineering & Technology (RUET) was selected as the study area to test the performances and accuracy of handheld GPS and TS on land use data.

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2 METHODOLOGY

For the implementation of any work, planning is essential and a step by step procedure of work should be followed from beginning to end of the work. In this case study we have planned to proceed in a systematic way.

At the beginning of the study, the whole campus area of RUET was surveyed using TS. A detail master plan was developed from the TS data and total land area, water body, greenery, open space and infrastructures are analyzed and mapped. Though the TS survey is more time consuming and laborious, the land use analysis and necessary survey results from this TS survey are considered as error free. This land use map is utilized to compare with GPS survey results. Afterwards, the same field parameters within the study area were surveyed using handheld GPS. Two models of GARMIN handheld GPS were used during the field survey. GPS used to identify the geographical location and positions of different building structures, water bodies, open spaces etc. Later, GPS data were processed to prepare the master plan of RUET. Finally the results of the GPS survey were compared with TS survey result to assess the performance and accuracy of handheld GPS.

Although GPS survey has so many advantages compared to conventional terrestrial survey methods, GPS has some limitations. For examples, in cases of failing to track sufficient GPS satellites due to the overhead obstructions, GPS can't work properly. In these events, inaccessible places are marked using some way points.

3 RECONNAISSANCE SURVEY

Proper field reconnaissance is a prerequisite for land use survey. The previous master plan of RUET, done by Total Station method, was used to select the control points of the GPS survey. This map provides required information like: location of boundary walls, roads, water bodies, buildings, agricultural lands and other open spaces. General information about topography of area helped to design the realistic observation schedule. The reconnaissance survey also helped to figure out about the inaccessible points within the RUET campus such as infrastructures, road network, low lands, ditches and agricultural lands. Moreover, densely accumulated tall trees in RUET campus were the main obstructions to direct open sky contact. Due to inadequate direct sky contact signal error occurs and the GPS device cannot work properly. In this unavoidable situation we have to proceed by trial and error method. So the inaccessible places were avoided by choosing way point method. In that case the way points were fixed up in the accessible points. Further we re-adjusted the position in Google earth to reduce the error level.

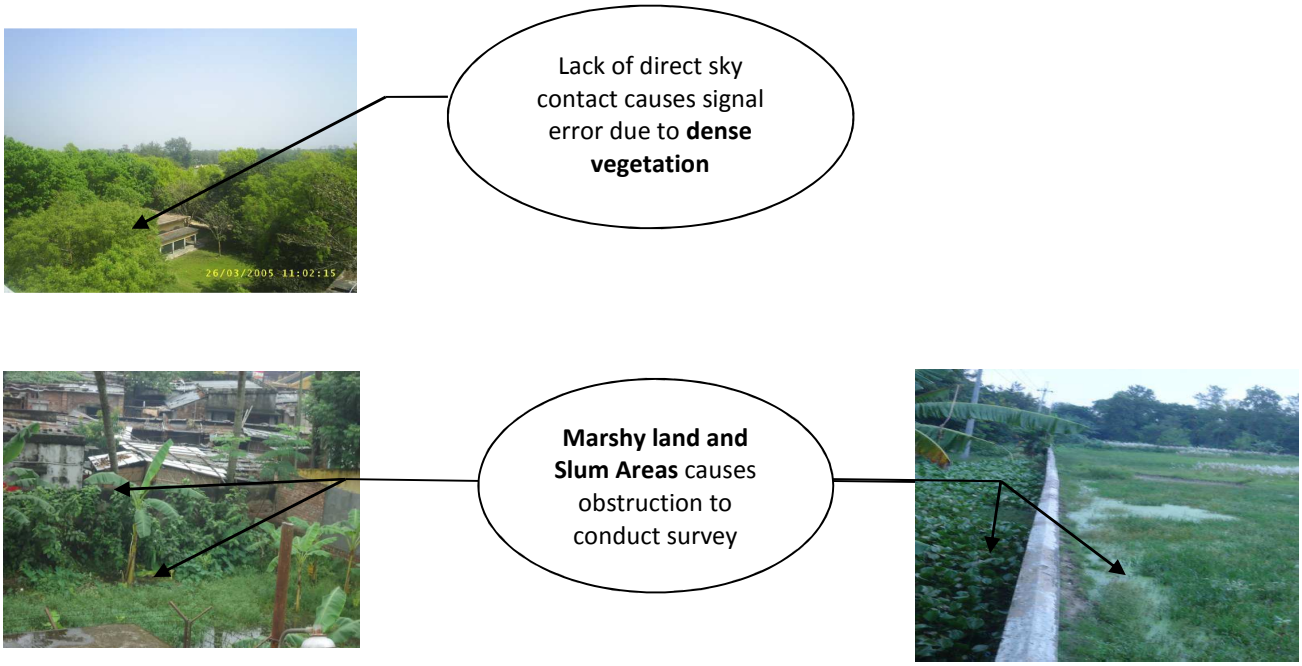
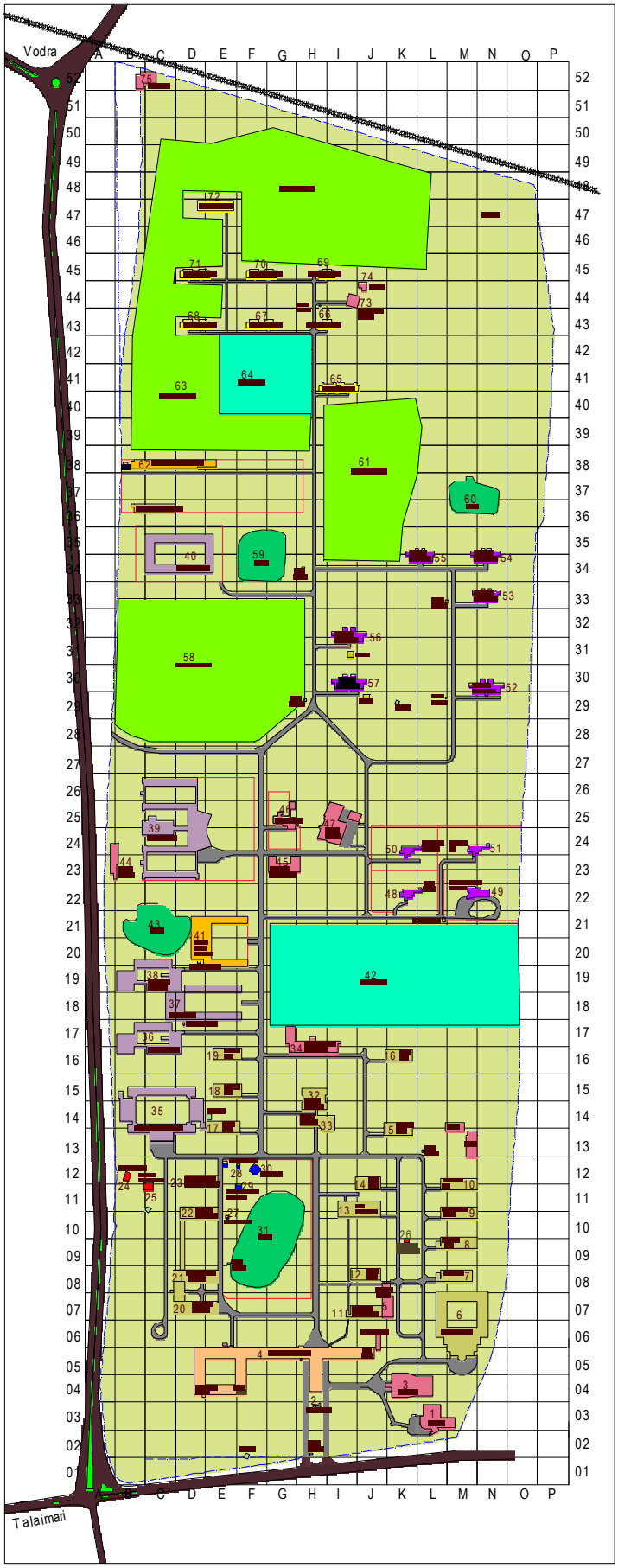


Fig.1. Problematic places during field survey

Fig.1 shows the inaccessible places of RUET campus.

MASTER PLAN OF RUET



0 200 400ft

No.	Description	Grid* No.
01	Cafeteria	L 03
02	Shahid Minar	H 03
03	Auditorium	K 04
04	Administrative Building	G 05
05	Central Store	J 07
06	Computer Science & Engineering (CSE) Dept.	M 07
07	Electrical & Electronics Engineering (EEE) Dept.	M 08
08	Machine Lab	M 09
09	Measurement Lab	M 10
10	Electronics Lab	M 11
11	Mechanical Engineering (ME) Dept. & Metrology Lab	J 07
12	Fluid Mechanics Lab (ME)	J 08
13	Heat Engine Lab	I 11
14	Boiler Shop	J 11
15	Machine Shop	K 14
16	Fitting Shop	K 16
17	Wood Shop	E 13
18	Foundry Shop	E 15
19	Welding Shop	E 16
20	Civil Engineering (CE) Department & S.M. Lab	D 07
21	Soil Mechanics Lab	D 08
22	Fluid & Survey Lab (CE)	D 10
23	Transportation and Public Health Lab	D 12
24	Electrical Store	B 12
25	Electrical Substation 1	C 11
26	Electrical Substation 2	K 09
27	Water Pump 1	E 10
28	Water Pump 2	F 12
29	Water Treatment Plant	F 11
30	Water Tank	F 12
31	Pond 1	F 10
32	Central Library 1	H 15
33	Central Library 2	H 14
34	Central Common Room (CCR)	H 16
35	S. P. Ziaur Rahman Hall	C 14
36	S. A. Hamid Hall	C 17
37	Tin Shed Hall	C 18
38	S. Shahidul Islam Hall	C 19
39	S. L. Selim Hall	C 24
40	D. S. Hasina Hall	D 34
41	Agrony School	D 20
42	Play Ground 1	J 19
43	Pond 2	C 21
44	Ansar's Quarters	B 23
45	Canteen & Glossary Shop	G 23
46	Medical Center	G 25
47	Central Mosque	I 25
48	Guest House	K 22
49	Vice Chancellor's Quarters	N 22
50	Professor's Quarters	K 24
51	Teacher's Club	N 24
52	Teacher's Quarters A1	N 30
53	Teacher's Quarters C3	N 33
54	Teacher's Quarters C2	N 34
55	Teacher's Quarters C1	L 34
56	Teacher's Quarters B1	I 31
57	Teacher's Quarters B2	I 30
58	Agricultural Land 1	D 31
59	Pond 3	F 34
60	Pond 4	M 37
61	Agricultural Land 2	J 38
62	Agroni School & College	B 38
63	Agricultural Land 3	D 41
64	Play Ground 2	F 41
65	Staff Quarters D1	I 41
66	Staff Quarters D2	H 43
67	Staff Quarters D3	F 43
68	Staff Quarters D4	D 43
69	Staff Quarters E1	H 45
70	Staff Quarters E2	F 45
71	Staff Quarters E3	D 45
72	Staff Quarters F1	E 47
73	Staff Quarters Mosque	I 44
74	Squatter	J 44
75	Gas Station	C 52

**Grid Size = 100ft x 100ft*

LAND USE ANALYSIS

Colour	Category	Area (sq.ft)
	Admin. Building (Office, Post Office, Bank etc.)	44,286
	Academic Building (Class Room, Lab & Library)	1,27,501
	Student's Hall	1,28,409
	Teacher's Quarters	29,823
	Staff Quarters	22,130
	Other Buildings (Audiotorium, Cafeteria, Mosque, CCR, Medical Center, Store, Garage, Ansar Quarter)	64,814
	Agricultural Land	10,66,428
	Water Body	1,33,769
	Play Ground	3,93,653
	Road	2,74,017
	Agroni School & College	1,51,109
	Water Tank, Pump & Treatment Plant	1,529
	Electrical Store & Substation	1,514
	Open Space 9438277.5337	41,59,126
	Total Land Area of RUET Campus	65,98,101

Fig. 2. Master Plan of RUET Developed by Total Statio

Fig.2 shows the master plan of RUET developed from TS survey.

4 GPS SURVEY

4.1 CALIBRATION OF HANDHELD GPS

Before conducting the field survey, the GPS machine is calibrated. Conventional chain, tapes and GPS were used to verify differences in linear measurements. As well, area measurements were also done both manually and GPS. Then the two measurements were compared and error calculated.

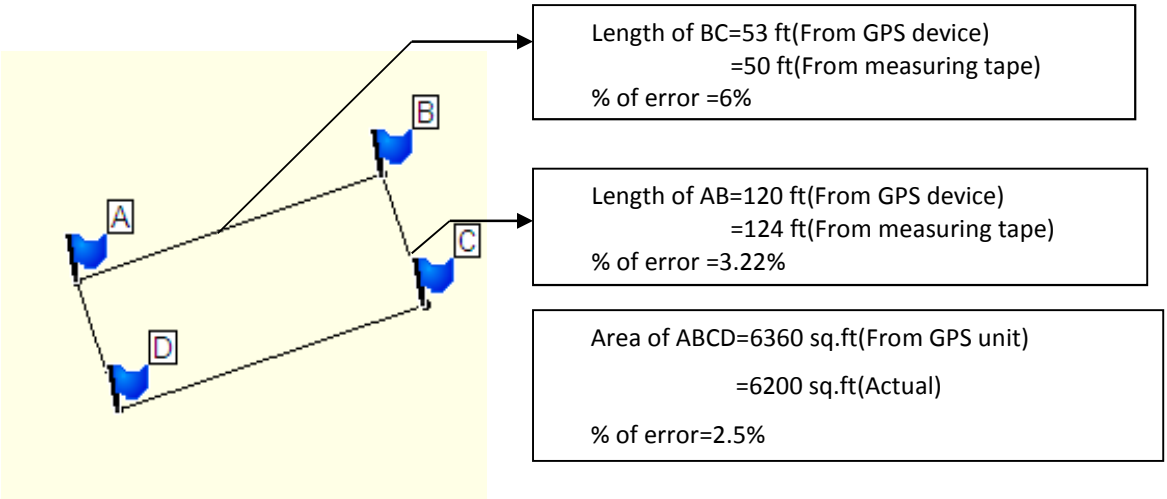


Fig.3. Calibration of GPS device

Fig.3 shows calibration of GPS device.

Error levels of handheld GPS are then computed and presented in Table 1.

Table 1: Estimation of Error in Handheld GPS Measurement

Linear Measurement (ft)				Area Measurement (sq. ft)		
No.	**GPS Length**	**Actual Length**	**Error (%)**	**GPS Area**	**Actual Area**	**Error (%)**
01	55	57.00	3.63%	2553	2346.00	8.10%
02	85	79.59	6.36%	2648	2514.24	5.05%
03	90	87.00	3.33%	3286	3213.40	2.20%
04	100	98.00	2.00%	4567	4375.40	4.19%
05	100	105.00	5.00%	5225	5229.00	0.07%
06	100	94.16	5.84%	6289	6174.20	1.82%
07	125	121.47	2.82%	6543	6296.20	3.77%
08	200	194.74	2.63%	7359	7337.72	0.29%
09	220	216.66	1.52%	8225	7741.18	5.88%
10	250	246.84	1.26%	10215	10199.70	0.15%
Average Error			**3.24%**	**Average Error**		**3.15%**

From the above data, it is found that the GPS device traces less measurement for large distance and large measurement for small distance. From the calibration result the error level for linear measurement lies between 1% to 6.5% and for area measurement the error level lies between 0.15% to 8.1%. Finally we have reached to a decision that the error level of GPS device lies between o.50 % to 8 % and the average error is about 4%.

4.2 FIELD SURVEY WITH GPS

After calibration of GPS devices, field surveying was conducted using two GPS devices. One GPS device was particularly kept for fixing permanent objects by choosing way points and another GPS was used for counting area by track logs. Waypoints are sets of coordinates that identify a point in physical space. For terrestrial navigation these coordinates can include longitude and latitude. The GPS track log is an electronic breadcrumb trial that shows the path that the travelers have traveled. The GPS track log points are often captured in latitude and longitude using WGS 84 datum. Some portion of boundary wall, all physical structures and infrastructures are fixed by waypoints. Ponds, open space, road network, play grounds and low lands are surveyed by track logs.

4.3 DEVELOPMENT OF MAPS AND LAND USE ANALYSIS

Basically the land use pattern consists of varied shapes of polygons. It is better to define the concepts of parent-polygon and children-polygon. For example, a polygon Y is divided into two polygons Y1 and Y2. Then, relative to Y1 and Y2, polygon Y is called the parent-polygon of Y1 and Y2 polygons and, Y1 and Y2 are called the children-polygons of polygon Y. Accordingly the land use pattern can be classified into two groups: (1) one parent-polygon is divided into several children-polygons, and there is no border merging relationship between parent-polygon and children-polygons; (2) one parent-polygon is divided into several children-polygons, and there is border merging relationship between parent-polygon and children-polygons (Lin, 2003).

The fundamental principles upon which the surveying is being carried out are working from whole to part. So the location and position of boundary wall of RUET were fixed first. Then the whole campus was sub-divided into several smaller zones. Each smaller zone was then surveyed maintaining the survey schedule. Subsequently GPS data were posted to the GARMIN software known as 'Map Source'. Using Map Source and Google Earth, each and every position was traced separately. In some events, GPS survey was repeated where there were some errors.

- GPS data was the input for Map Source. With the help of Map Source software, track logs draw the ground coverage of different objects in the study area. From the track logs, the total land area of RUET and area of all other physical structures, agricultural lands, play grounds and open space were mapped and computed.
- Map Source data were then transferred in Google Earth and the positions of different objects were compared with the Google Earth's aerial image. To reduce the variation of field data comparing with Google Earth image, field survey was repeated for some cases. The revised data was modified in Google earth and the position (North-East) of different objects were readjusted.
- The whole aerial image of RUET was divided into several parts and enlarged to redraw the survey elements in AutoCAD.
- Enlarged satellite image of whole RUET campus were knitted together in Adobe Photoshop and kept in CAD to draw the map of whole RUET campus.
- Finally, Google Sketch-Up was used to develop the 3D image of the built up area of RUET with some animation. Figure 7 provides 3D image of RUET campus.
- From AutoCAD, all necessary land use calculation was performed. The results from this calculation were the basis of comparison with TS survey. Table 2 presents the summary of this comparison and error level.

Table 2: Summary of Land Area by GPS Survey & Estimation of Error

Category	Description	Land Area (in Acre) by GPS	Land Area (in Acre) by Total Station	Error (%)
Administrative Buildings	Office, Bank & Post Office	1.09	1.02	7.06
Academic Building	Class Rooms & Labs	3.49	3.31	5.58
Residential Buildings	Students Halls	2.73	2.78	1.65
	Teacher's Quarters	0.79	0.65	22.76
	Staff Quarters	0.53	0.51	5.29
Related Facilities	Cafeteria, Canteen & Auditorium	0.57	0.56	1.78
Tin Shed Buildings	Tin Shed Hall & Garage	0.68	0.66	9.65
Water Supply Facilities	Water Tank, Pump House & Treatment Plant	0.04	0.04	15.66
Others Buildings	CCR, Mosque, Medical Centre, Guardrooms & Electric Sub-Stations	1.32	1.03	28.44
Water Body	Ponds & Ditches	2.49	3.02	17.27
Agricultural Land	All Agricultural Lands	41.06	38.08	12.2
Playground	Cricket, Football, Basketball & Tennis Field	6.87	6.65	10.67
Open Space	All Open Fields	84.09	105.90	20
Road	All Roads	6.20	6.27	1.11
Total Land Area of RUET (in Acre)		152.00	151.77	11.37

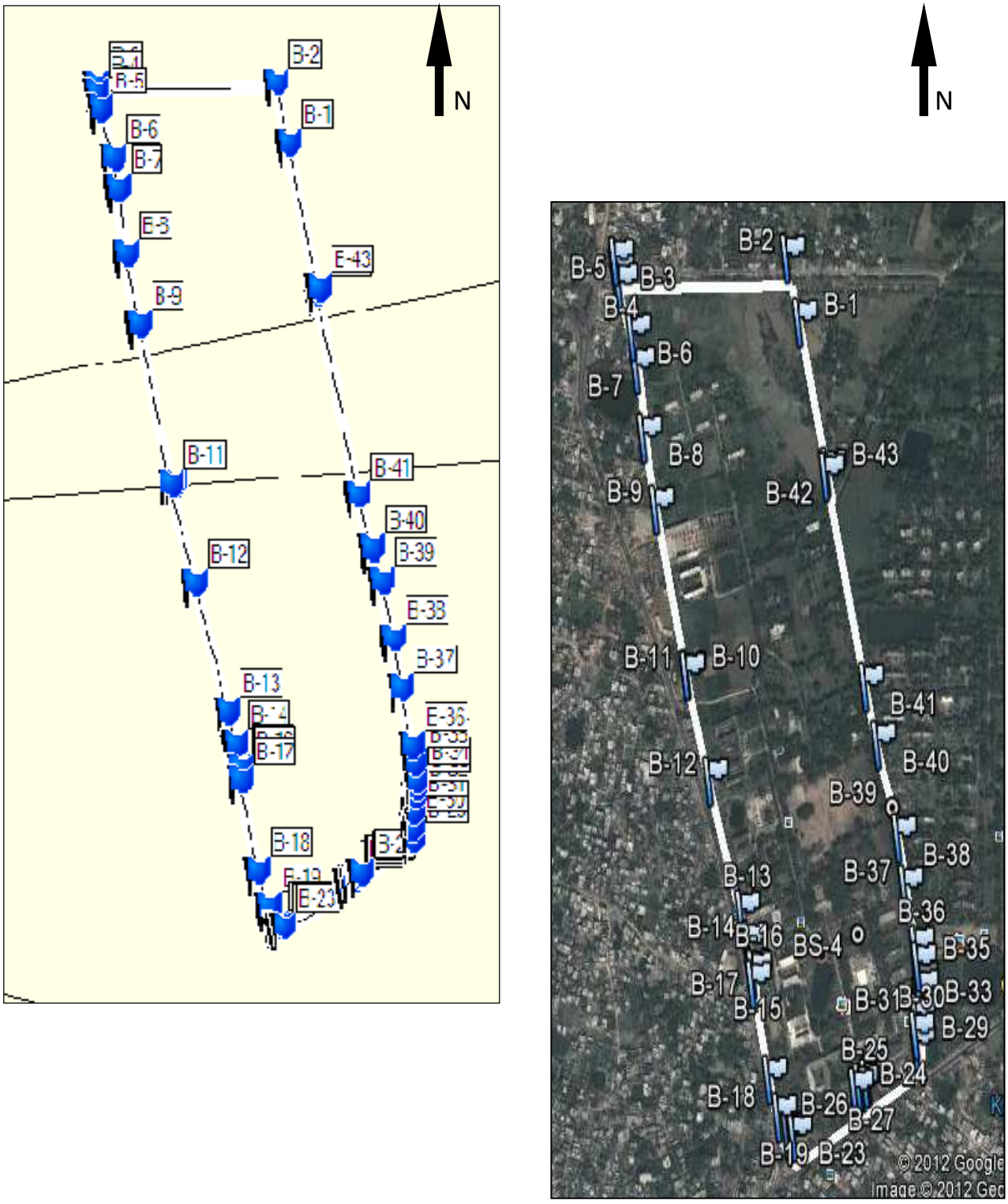


Fig.4. Waypoints of boundary of RUET campus in Map-Source and Google-Earth

Fig.4 shows boundary position of RUET campus



Fig.5. Waypoints of buildings of RUET

Fig.5 shows the spatial position of buildings of RUET in Google-Earth

5 LAND USE MAPPING

The final map of RUET Campus is prepared in Auto CAD which is plotted on grid. The grids are numbered according to latitude and longitude. From the grid zone, the position of different object can easily find out.

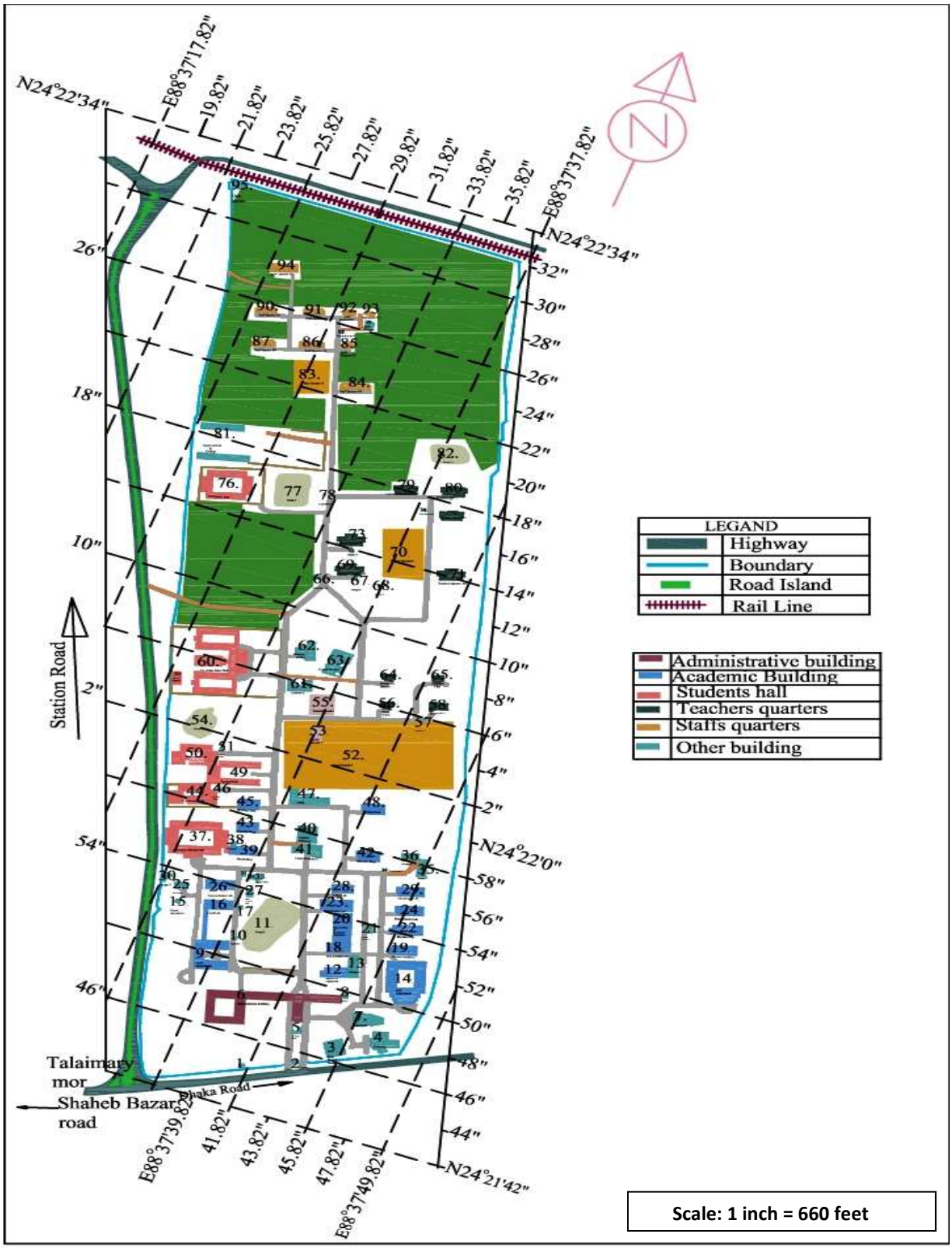


Fig.6. Land use Map of RUET

Fig.6 shows the Geographical position & location of RUET campus

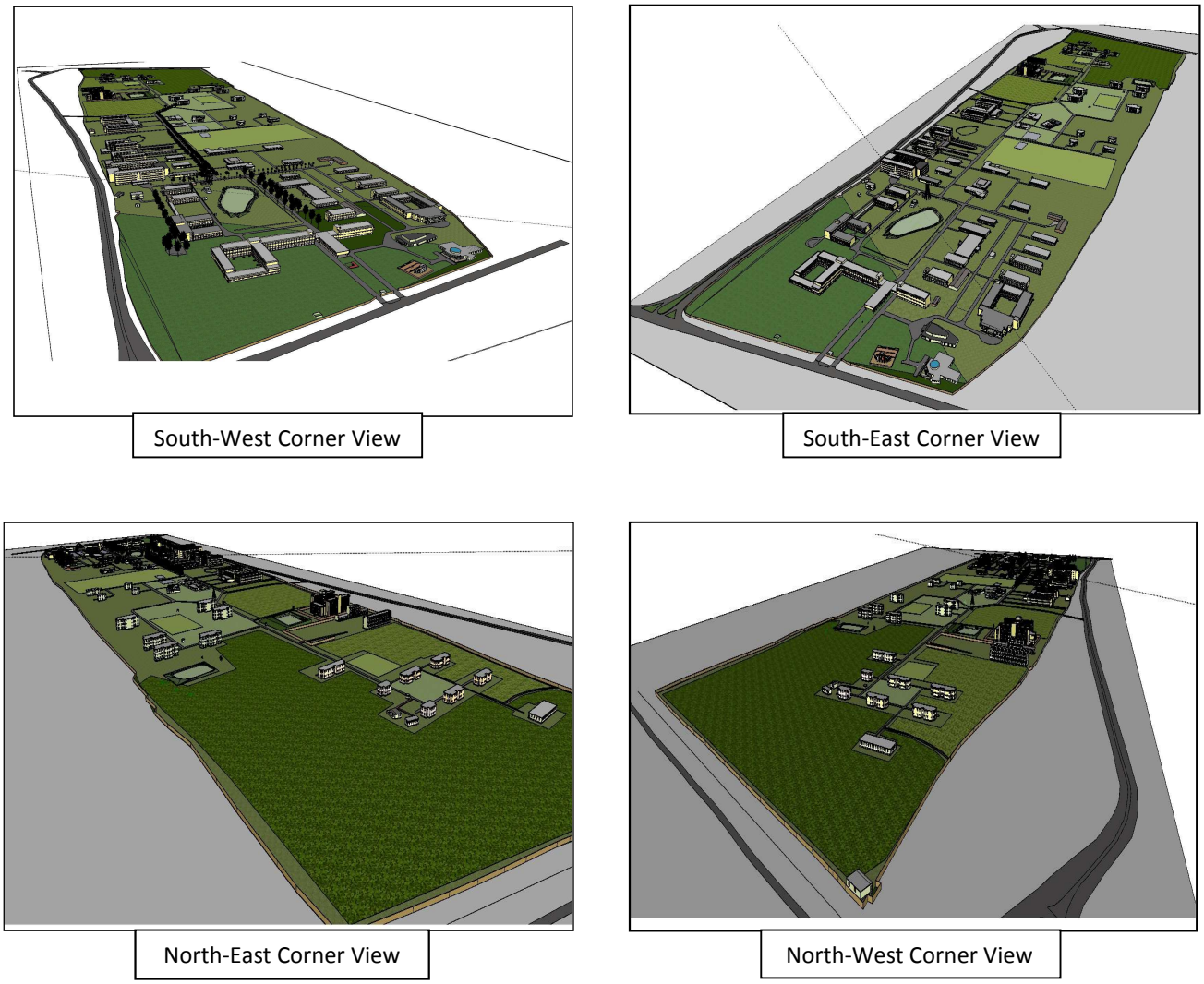


Fig.7. 3D View of RUET Campus using Google Sketch-Up

Fig.7 shows the 3D view developed in Google Sketch-Up

6 CONCLUSION

In the early era, the surveying was conducted by various conventional methods which require more manpower, more time and with less accuracy. GPS replaced conventional surveying method that often employ theodolite, level or total station because this technology that has been extended in various fields that measure geographical coordinates, velocity and time with astonishing speed and accuracy. Its effects in research field become also important.

The accuracy of handheld GPS is not high. So it is not recommendable to use handheld GPS in any precise survey, rather it can be used in preliminary survey. Specially, if there are scarcity of manpower and time, handheld GPS can sketch out the study site quickly. Comparing the survey results conducted in RUET campus it was found that the there are ample difference between TS and hand GPS. The average error level is about 11.37%. Due to the low accuracy of handheld GPS and due to signal blockages, hand GPS produces erroneous results.

REFERENCES

[1] Lin, L.S., "Integrating of GPS RTK and Total Station for Land Surveying of Urban Region", *The 1st Taipei International Conference on Digital Earth*, Chinese Cultural University, Taiwan, No. C1-12, pp. 1-10, 2003.

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Assessment of Chalan *beel* Ecosystem Diversity through Remote Sensing and Geographical Information Systems

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ABSTRACT: Chalan *beel,* the largest natural depression in Bangladesh is under threat due to population pressure, over exploitation, change of water courses, pollution and siltation. Therefore, a study was conducted to assess the habitat and biodiversity status in dry and wet seasons through MODIS AQUA 250 m images and Geographical Information Systems supported by field data from July 2010 to June 2012. The MODIS data of 2002 and 2008 were collected and analyzed to perceive the water availability, extend of water area and variety of fishes found round the year. The False Colour Composite images of blue, near infra-red and mid infra-red bands and Normalized Difference Vegetation Index of 2002 and 2008 were prepared to perform the land use and land cover changes. The data interpretation showed the trend of water receding tendency from wet to dry season in 2002 and 2008 images respectively. The occurrence of moderate and high vegetation was comparatively higher in 2002 images than in 2008. Moreover, very small water area was observed in March and April in both year images due to over use of surface and underground water for irrigation that is the threat to the natural resources in the region. Hence, steps need to be taken by the Government and stakeholders to stop fishing via dewatering and maintain the minimum water level in the Chalan *beel* for safe guard the aquatic biodiversity.

KEYWORDS: MODIS AQUA image, biodiversity, natural depression, land use change, irrigation.

1 INTRODUCTION

Fisheries sector plays a vital role in the agro-based economy of Bangladesh through its contribution to employment, income generation, foreign exchange earnings and providing food and nutrition security to the country. The sector presently contributes 4.43% of gross domestic product (GDP) and about 2.73% of total export earnings. The production of fish was 3.06 million MT in 2012 [4].

The inland water bodies have been supporting rich and diversified aquatic biodiversity and thus are important to the people Bangladesh for their food security and livelihood [7]. However, due to sharp decline the natural fish production and consumption over the last years and reached protein deficiency.

For centuries, a fragile cycle of flooding, fish migration between rivers and floodplains, spawning and grazing has been maintained in the wetlands of the country. The country's vast river networks, ponds, ditches and canals have been serving for the natural cycle of fish migration and wetlands regeneration. Floodplains inundated during monsoons are nutrient rich and play a significant role as nurseries for the larvae and juvenile of fish species [3], [9], [16]. Large areas of permanent, semi-permanent or seasonal wetlands are found in floodplains of lowland rivers with tranquil hydrology. The magnitude of flood and flooded areas greatly influences the population dynamics of fish species [2].

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The *Beels* are one of the important sources of fish supply in Bangladesh. Natural depressions comprise about 2.49% of total aquatic resources which supplied 30.06 million MT in 2011--12. Collectively, floodplain and wetlands occupy an area of 28.33 million ha constituting 61.91% of total inland water resources and provided more than 7, 68,830 tons production of inland capture fisheries. It also offered tremendous scope for both capture and culture fisheries potential by adopting enhancement technique [5].

The Chalan *beel* is the largest and most important watershed in Northern part of Bangladesh. It comprises a series of depressions interconnected by various channels to form a continuous vast water body in the rainy season (July-November) when it covers an area of about 400 km^2. During the dry winter and summer, the water area decreases down to 52-78 km^2 and looks like a cluster of *beels* of different sizes [14] and offers an excellent alluvial crop land in the post monsoon season. Presently the Chalan *beel* like many other *beels* are at the risk of partial or total degradation due to manifold reasons like agricultural encroachment including pesticide usage, siltation along with other anthropogenic activities. However, it is very difficult to say how much degradation has been occurred for sure and how these problems can be solved. The present study is aimed to provide an overview on the present status of ecosystem diversity through Remote Sensing (RS) images and Geographical Information Systems (GIS) tools to investigate the real scenario of water area and depth in different seasons for the aquatic organisms. It is also aimed to identify the scope and opportunities to develop fisheries management strategies with a focus on biodiversity conservation. Hence, the present study would be a significant development to the planners and policy makers to take initiatives to save the natural resources through proper recommendations and suggestions.

2 MATERIALS AND METHODS

2.1 THE STUDY AREA

The Chalan *beel* is situated between 24.35^o and 24.70^o North latitude and 89.10^o and 89.35^o East longitudes. Historically Chalan *beel* was spread over the districts of Rajshahi, Pabna, Sirajgang, Natore, Naogoan and Bogra (Figure 1). At present, the *beel* has been compressed in the districts of Pabna, Sirajgonj and Natore due to crisscross roads, embankments and other infrastructural expansion. Therefore, the research was conducted in three representative cluster sites under the above districts. For data collection, ten upazilas such as Singra, Gurudaspur and Boraigram of Natore district, Chatmohar, Bhangura and Faridpur of Pabna and Shahjadpur, Ullapara, Tarash and Raygonj of Sirajganj district were selected.

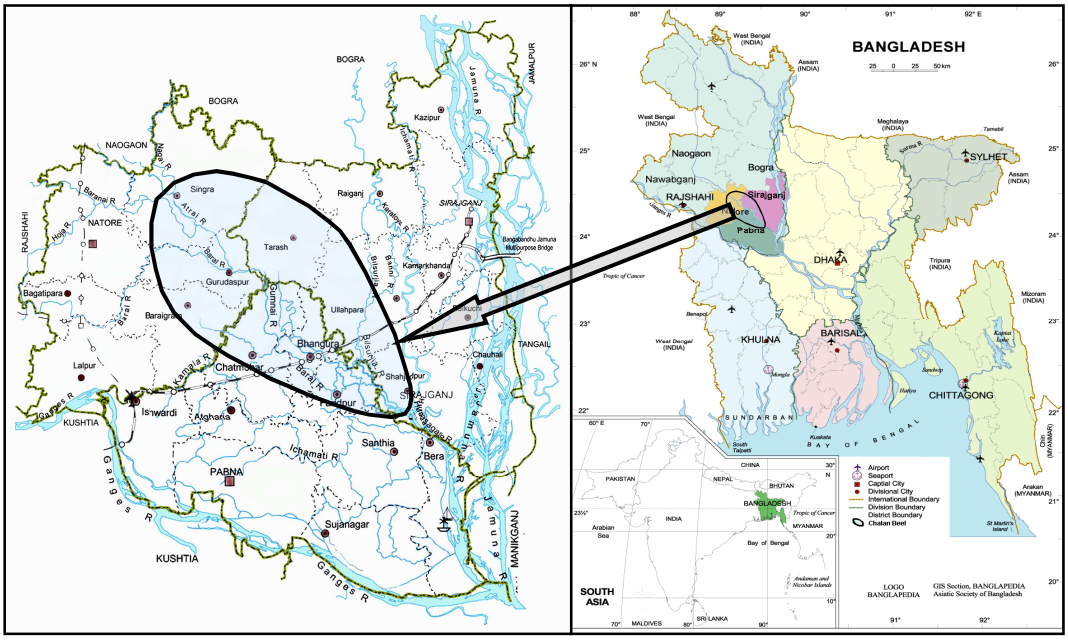


Fig. 1. "Chalan beel"

Figure 1 shows the study site "Chalan *beel*" in the map of Bangladesh

2.2 DATA SOURCES

The MODIS AQUA images were collected from the University of Stirling, Scotland, UK. (Table 1). The images of different dates of dry and wet seasons were collected and analyzed to see the land use changes if any of the ecosystems in the *beels* which caused the biodiversity degradation in the *beel*. The methodology of the study was based on Remote Sensing (RS) image interpretation which is supported by the secondary data collected from a range of sources like field visit, literature review, internet search and consultation with the relevant reports.

Table 1. MODIS AQUA image information used in the study

Name of Image data	Months and year	MODIS Product	Resolution	Season	Temporal Granularity
MYD13Q1	June-November 2002	Vegetation Indices	250 m	Wet season	16 Day
MYD13Q1	January-May 2002	Vegetation Indices	250 m	Dry season	16 Day
MYD13Q1	June-November 2002	Vegetation Indices	250 m	Wet season	16 Day
MYD13Q1	January-May 2008	Vegetation Indices	250 m	Dry season	16 Day

2.3 IMAGE ANALYSIS TECHNIQUE

MODIS AQUA data range from the bands Red, NIR, MIR and Blue were used in this study. The spatial resolution of image was 250 m x 250 m which used in the study. Image enhancement False colour composite (FCC) for visual interpretation, NDVI (Normalized Dense Vegetation Index) preparation, unsupervised image classification, etc. were also done.

2.4 IMAGE ENHANCEMENTS

The images were subjected to preliminary digital enhancements in order to enable their visual interpretation. The FCC images provided a clear visual discrimination of vegetation, water and water-bare land boundaries [6], [15]. The image processing methodology is presented in Figure 2. An associated contrast stretch of 5% was applied to have better visual discrimination among the features.

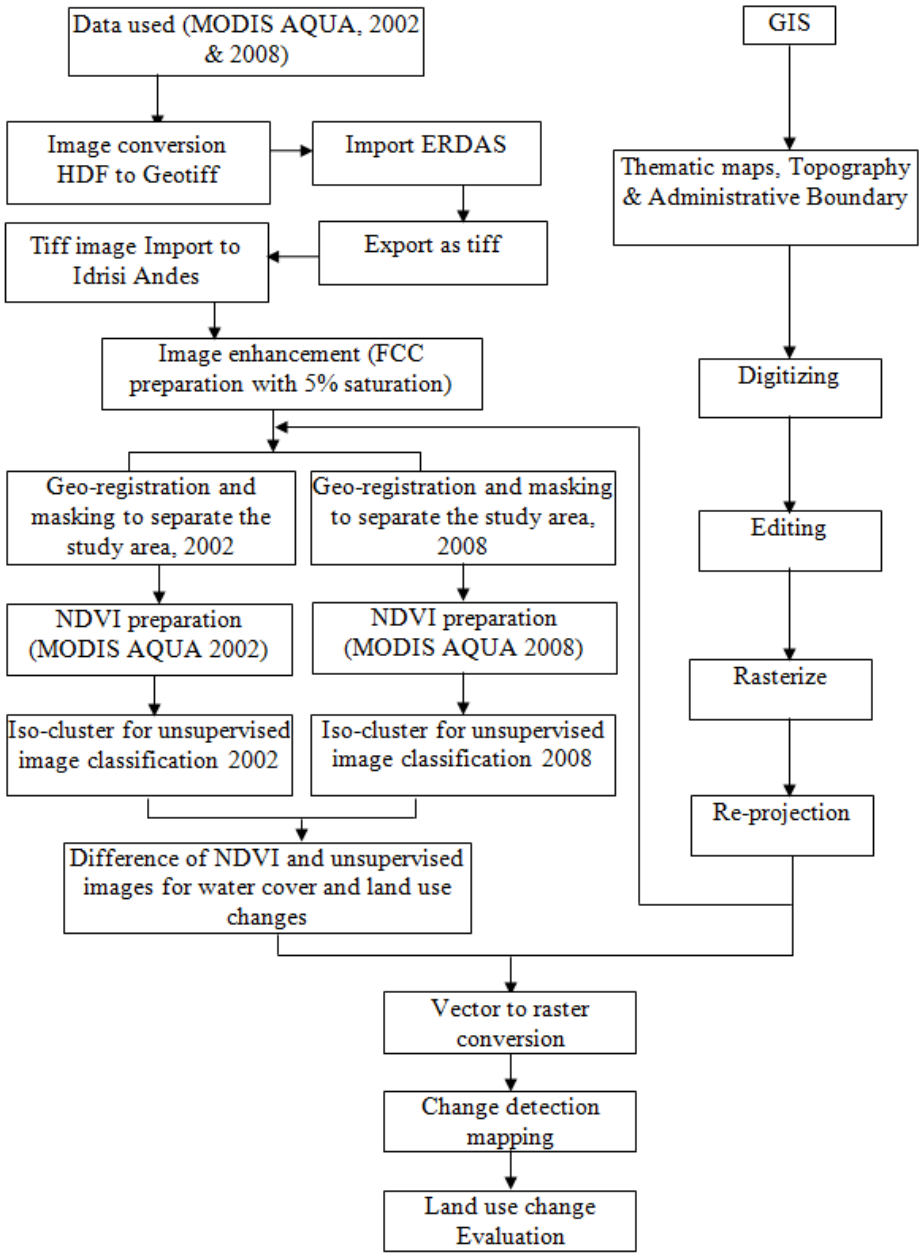


Figure 2 shows the schematic diagram of the major steps of RS and GIS methodology adopted in the study

2.5 NORMALIZED DIFFERENCE VEGETATION INDEX

The Normalized Difference Vegetation Index (NDVI) [13] was applied to calculate the state of vegetation on the land surface for each image from the RED and MIR bands of the satellite data using equation 1. The NDVI expresses the vegetated ground and the vegetation condition and is closely related to the leaf area index (LAI). The land use changes between the years were studied by NDVI images. The dense vegetation showed up very strongly in the imagery and the areas with little or no vegetation were also clearly identified. It also identified the water and the bare lands clearly. The NDVI took values between -1 to +1 where the value of 0.5 indicating dense vegetation and value <0 indicating no vegetation. Produced NDVI maps were reclassified into six land use categories depending on the digital number (DN) as deep water, shallow water, bare land, very low vegetation, moderate vegetation and high vegetation etc.

$$NDVI = \frac{MIR - Red}{MIR + Red} \quad \text{---------- (1)}$$

Where, MIR is the digital number in the mid infrared band and RED is the digital number in the red band in MODIS AQUA images.

2.6 UNSUPERVISED IMAGE CLASSIFICATION

The logic by which unsupervised classification works is known as cluster analysis and this was done by IDRISI Andes through ISOCLUSTER module. This module groups the features together with similar reflectance patterns. The unsupervised classification was done using the image bands of infrared, mid infrared and near infrared, and which provided the number of spectral classes in the raw data. This was conducted in several steps. First of all, the ISOCLUSTER module was used with the option of user selecting number of classes for the final image. The module then classified the image into discrete categories. This process was conducted using 15 fine clusters. Following the cluster, a 3 x 3 mode FILTER was applied out to eliminate minor clusters less than 9 pixels. The clusters were then identified and further reclassified into five land use and land cover classes based on the colour composite images and field visit data.

2.7 STATISTICAL ANALYSIS

Land use type data was evolved through ISOCLUSTER and NDVI analysis. Land and water were compared by two-way ANOVA considering years and seasons as fixed factors. The percentage data were arc-sine transformed. If the means were significantly different, then the differences among the treatments were tested with Duncan's Multiple Range Test (DMRT). All statistical tests were carried out at 5% significance level using SPSS (version 12.0).

3 RESULTS

3.1 FALSE COLOUR COMPOSITE ANALYSIS

The FCC images of blue, near infra-red and mid infra-red bands of dry and wet season for the year 2002 and 2008 were used to guide the land use and land cover classification and NDVI image interpretation (Figures 3-6). In the FCC images of dry and wet seasons of 2002 and 2008, blue, blackish and purple colour represented the water in the land. Meanwhile, the blackish, blue and purple colour in the FCC images indicated the turbid/shallow water and green colour represented the vegetation in both the images as land use phenomenon. Comparatively more water area was observed on the FCC images in 2002 than 2008 images may be due to long monsoon in the year or immediate rainfall before the satellite passed over.

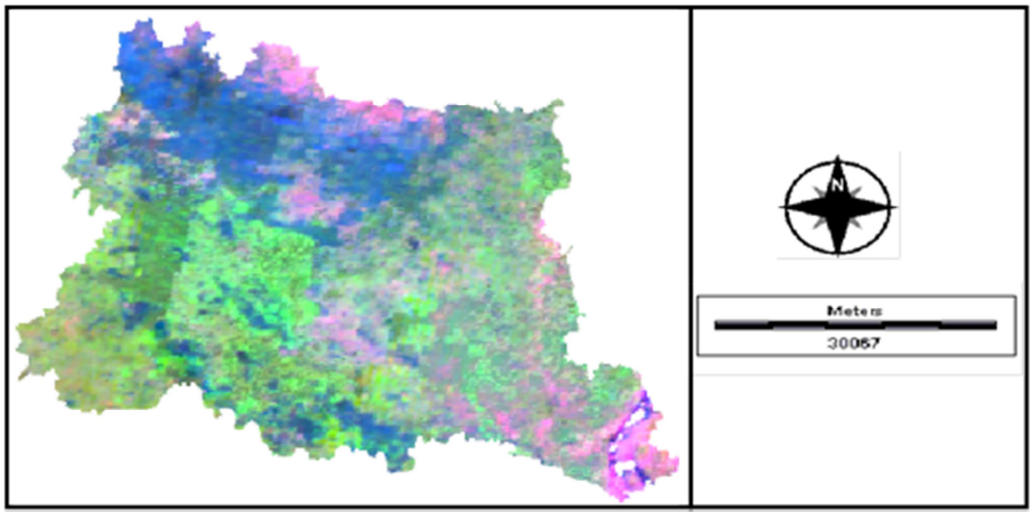


Fig. 3. FCC of Chalan beel of MODIS (250 m) image in dry season of 2002

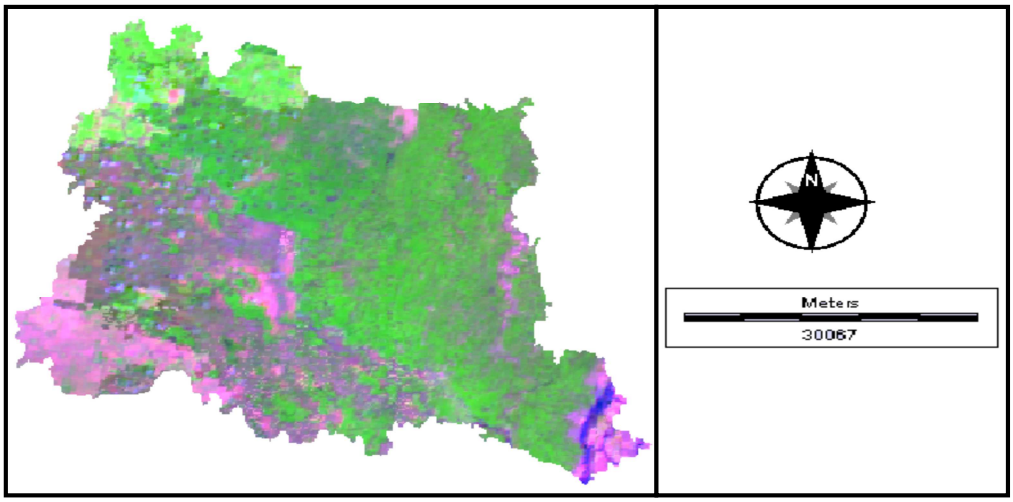


Fig. 4. FCC of Chalan beel of MODIS (250 m) image in dry season of 2008

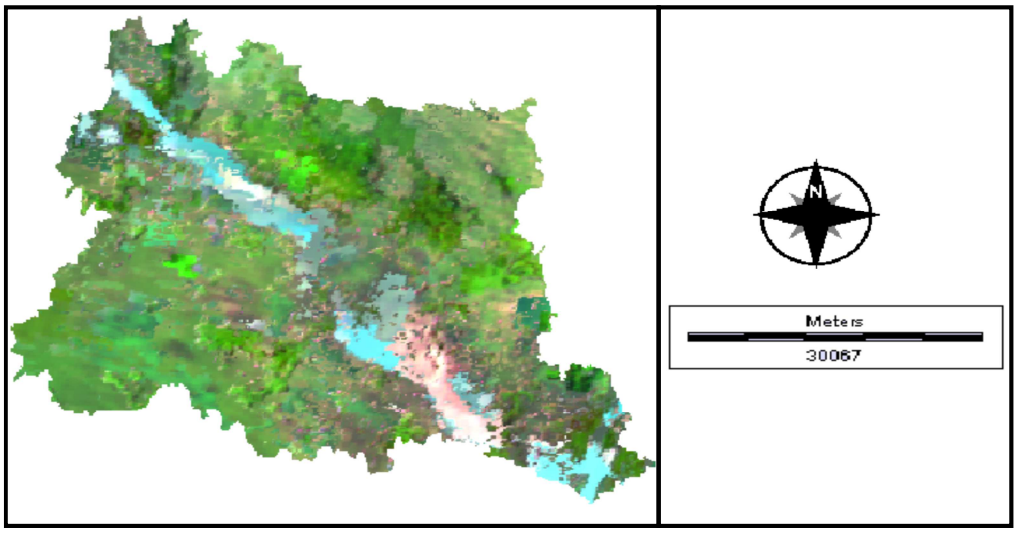


Fig. 5. FCC of Chalan beel of MODIS (250 m) image in wet season of 2002

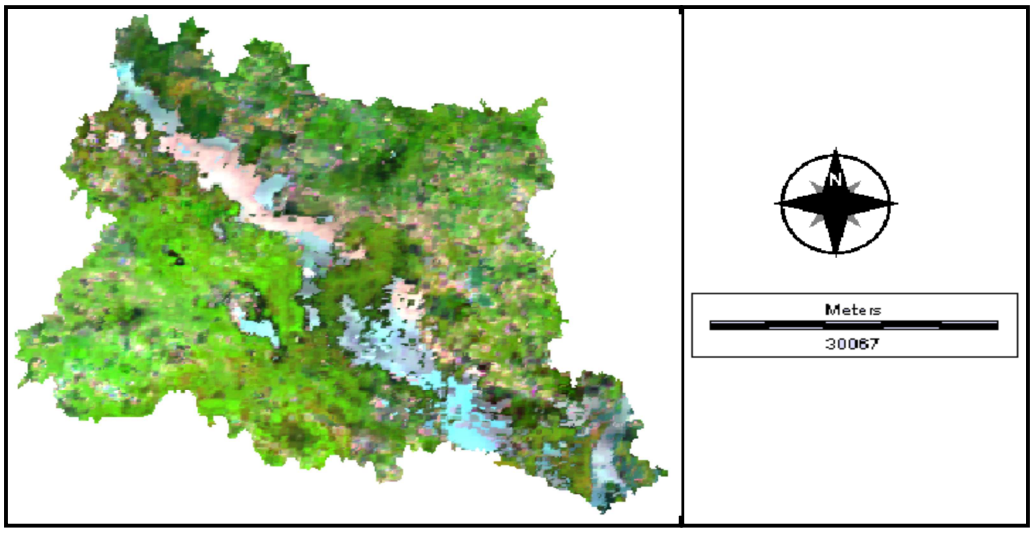


Fig. 6. FCC of Chalan beel of MODIS (250 m) image in wet season of 2008

3.2 NORMALIZED DIFFERENCE VEGETATION INDEX

Normalized difference vegetation index maps of Chalan *beel* were produced (Figures 7-8) where the red, yellow and green colour indicated the vegetation, bare land and water area respectively on the ground. The NDVI images interpretation showed that the water and vegetation areas were higher in 2002 image than in 2008. It is observed that comparatively more vegetative and water area in dry season images in 2002 when compared to 2008 due to late water receding from the *beel* area in 2002.

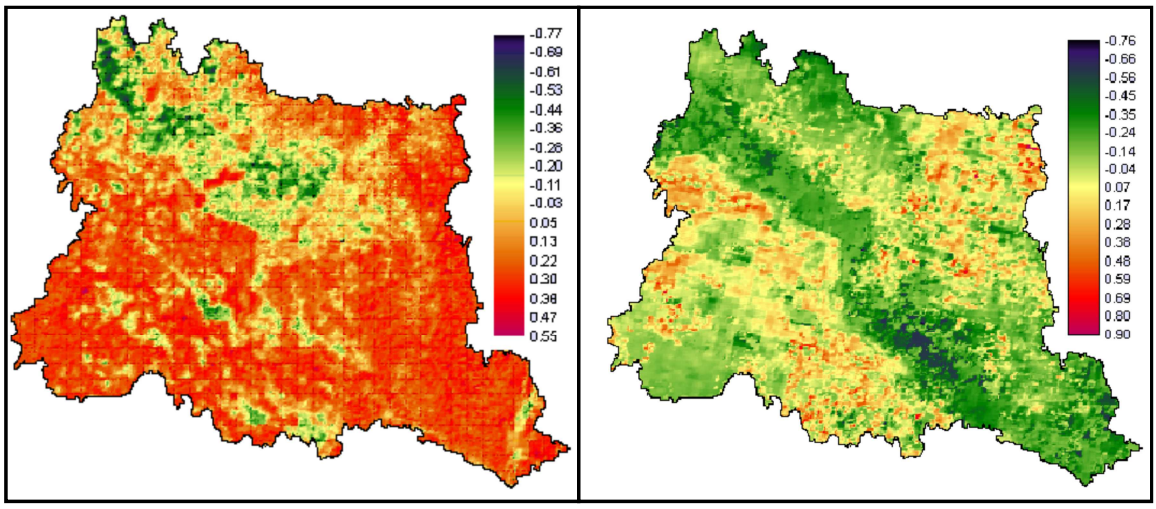


Fig. 7. NDVI of MODIS (250 m) image of Chalan beel in dry and wet season of 2002

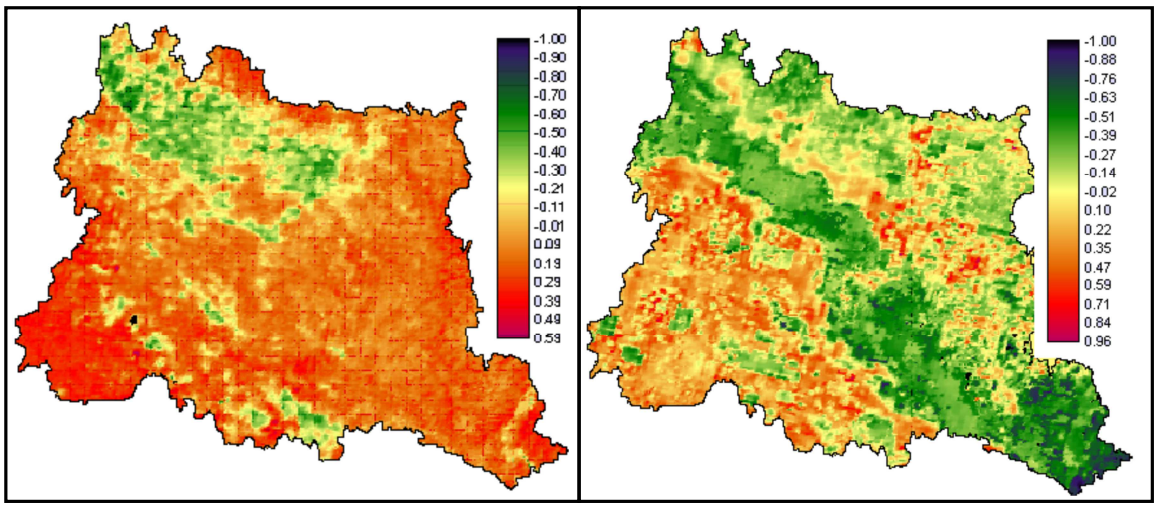


Fig. 8. NDVI of MODIS (250 m) image of Chalan beel in dry and wet season of 2008

Table 2. Percentages (%) of land under different NDVI-groups during 2002 and 2008 in Chalan beel area

Month	Water		Bare land		Low vegetation		Medium vegetation		High vegetation	
	2002	2008	2002	2008	2002	2008	2002	2008	2002	2008
January	28.25	20.63	37.35	0.94	6.87	66.30	27.10	11.96	0.43	0.17
March	6.61	6.50	45.19	0.03	0.28	49.09	45.70	43.73	2.22	0.65
April	0.57	0.50	2.68	0.05	83.54	79.70	13.16	19.71	0.05	0.04
June	20.62	10.32	19.11	1.90	56.48	79.09	3.69	8.01	0.10	0.68
August	17.85	21.58	70.45	0.86	9.02	65.10	2.39	8.65	0.29	3.81
September	16.49	10.73	3.24	1.61	56.60	53.04	23.09	27.28	0.58	7.34

The NDVI images were reclassified in to five land use categories (Table 2). The NDVI values were between -0.77 to +0.55 and -1.0 to +0.53 in dry season in 2002 and 2008 images respectively, that means the state of vegetation were comparatively higher in 2002 images than in the images of 2008. On the other hand, these values were between -0.76 to 0.90 and -1.0 to 0.96, respectively in wet season images for the same years.

3.3 ISOCLUSTER IMAGE ANALYSIS

The isocluster images of Chalan *beel* were produced (Figures 9-12), where the red, yellow and green colours indicated the vegetation, bare land and water area, respectively. Comparatively more water area were observed in dry season images of 2002 than in 2008 images. The land use types differed significantly (P<0.05) in different land types but not in seasons and years except homestead vegetation and bare land in seasons because of crops growth patterns and duration. The water area was more in 2002 images than in 2008 images.

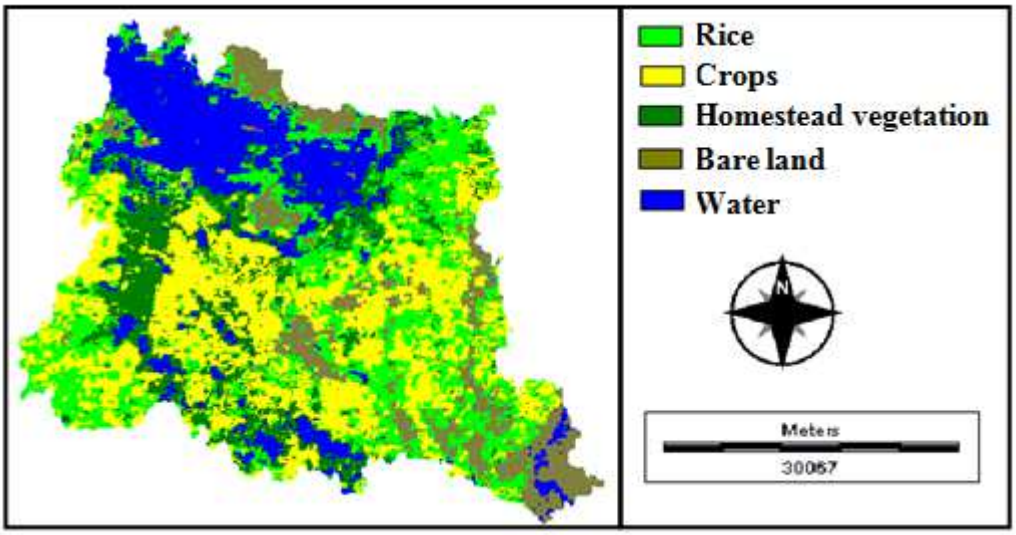


Fig. 9. Isocluster image of Chalan beel MODIS (250 m) in dry season of 2002

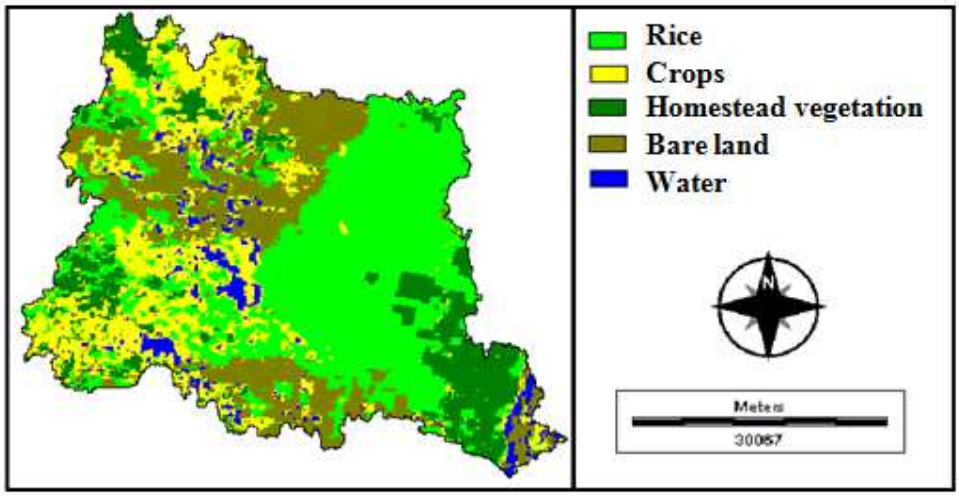


Fig. 10. Isocluster image of Chalan beel MODIS (250 m) in dry season of 2008

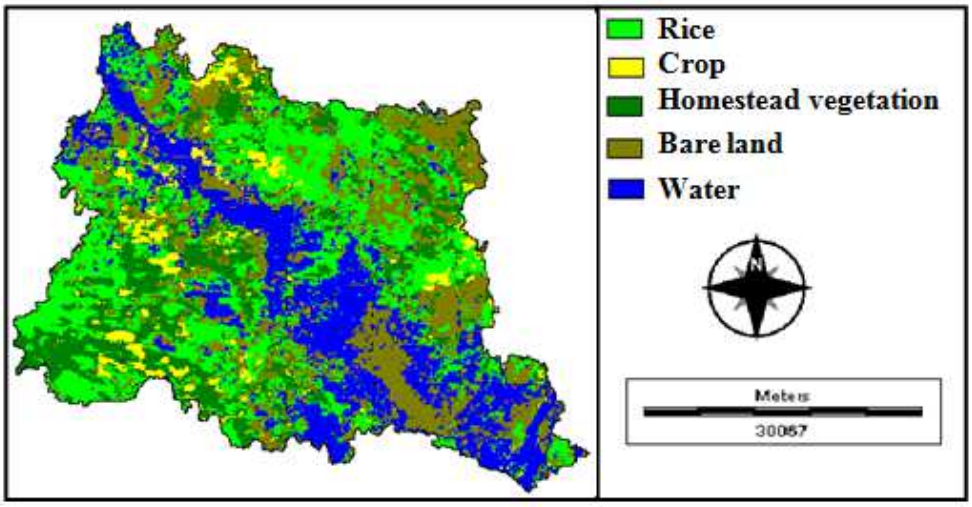


Fig. 11. Isocluster image of Chalan beel MODIS (250 m) in wet season of 2002

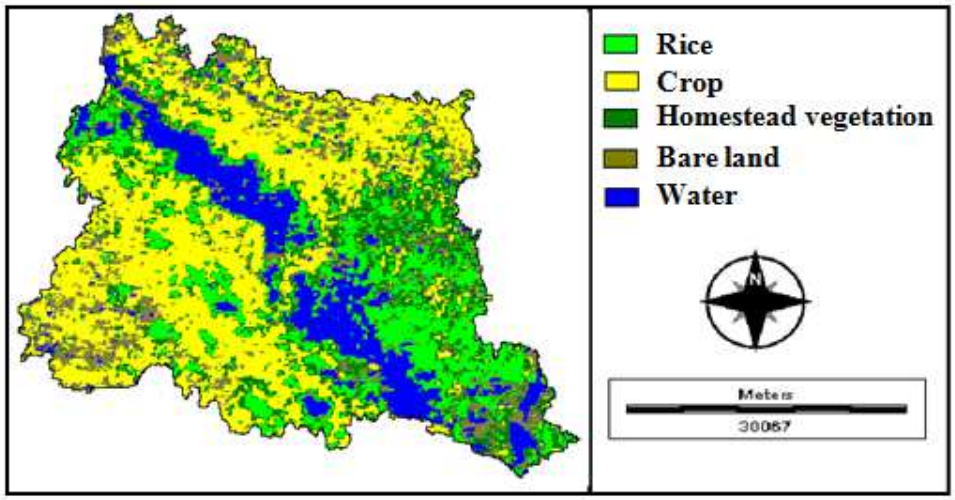


Fig. 12. Isocluster image of Chalan beel MODIS (250 m) in wet season of 2008

A decreasing tendency of crop lands area was observed in 2008 images than in 2002 images. Similarly, the bare land area is increasing while the water area is decreasing in the area (Table 3). The average land use pattern (Figure 13) showed that the higher cropping areas in 2002 images than in 2008 images.

Table 3. Percentages (%) of land under different iso-groups during 2002 and 2008 in Chalan beel

Month	Rice		Crop		Homestead vegetation		Bare land		Water	
	2002	2008	2002	2008	2002	2008	2002	2008	2002	2008
January	42.60	11.13	6.55	35.10	21.75	18.36	8.78	22.90	20.30	12.45
March	56.97	47.89	14.52	15.20	14.98	9.86	12.19	25.70	1.34	1.33
April	41.04	38.59	20.38	19.70	14.10	21.29	20.55	19.40	3.93	1.09
June	40.54	24.81	11.67	24.60	22.13	27.98	13.84	9.42	11.80	13.22
August	39.50	25.66	27.54	26.80	16.67	29.21	2.61	5.94	13.70	12.36
September	41.29	38.33	20.24	17.30	18.39	25.90	4.90	9.29	15.20	9.23

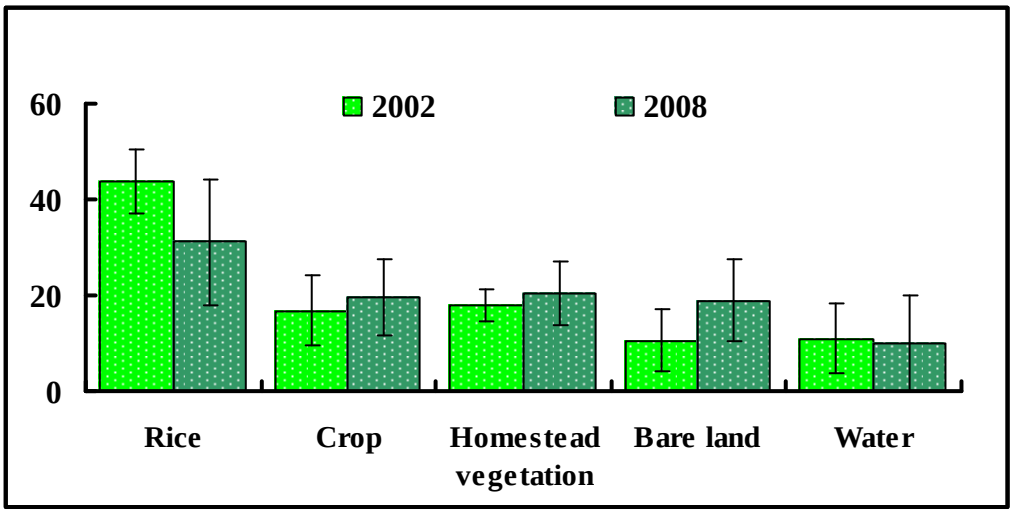


Fig. 13. Comparison of land use pattern as per isocluster analysis during 2002 and 2008 in Chalan beel

3.4 NDVI IMAGE RECLASSIFICATION

The Chalan *beel* NDVI images were reclassified in to two land use categories (Figs. 3.15-3.18) and the total area was calculated. The NDVI images interpretation showed that the water area was higher in 2002 images than in the 2008 images. On the other hand, it was observed from the calculation that more water area in the wet season images of 2008 than in 2002. Abnormally higher water aresa were observed in the northern part in dry season in 2002 images than in 2008 image which might be due to relatively longer monsoon in the year or immediate rainfall before the satellite passed over.

3.5 ISOCLUSTER IMAGE RECLASSIFICATION

Isocluster images were reclassified in to land and water areas, where comparatively higher water area were observed in 2002 images than in 2008 images might be due to low level of water in the distributaries due to the dam created on the trans boundary rivers.

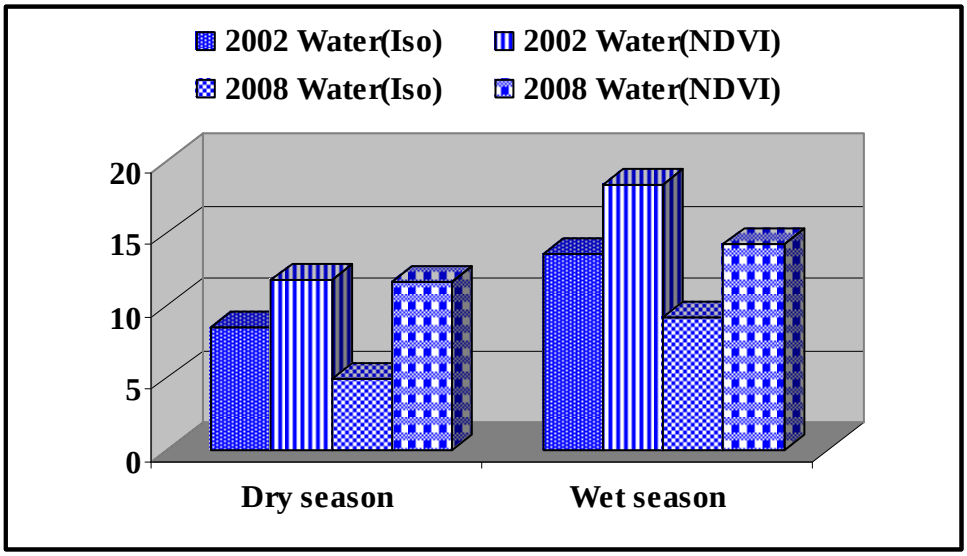


Fig. 14. Comparison of water area during dry and wet seasons of 2002 and 2008 in Chalan beel

3.6 CALCULATION OF WATER AREA

The trend of water areas in different season month in both the years images were analyzed and calculated. The water area differed significantly (P<0.05) in different months and seasons but not in the years in both the images. However, a decreasing trends were observed in 2002 images to 2008 images .The water area was comparatively lower in the wet season images of 2008 than in 202 image which might be due decreasing of water flow in the trans-boundary rivers.

The calculated water area as per NDVI and Isocluster images are presented in Figure 14. The water area as per NDVI images was higher than the Isocluster image because the NDVI image included the moist land within the water category.

4 DISCUSSION

The MODIS AQUA images are very successful in detecting surface water, crop land, irrigated rice fields or natural water body [11]. The higher water area was observed in the FCC image in the month of January of 2002 images in the northern and southern part of study area, however, not in the eastern part i.e., in the river area which might be due to heavy rain fall immediately before satellite pass over or might be due to irrigation in rice field. Again, in 2002, wet season image showed a big water area in the south west portion, which may be the irrigated rice field on that particular year. Therefore, more water area was observed in the FCC images of dry season in 2002. The FCC images of rainy season in both the years showed a large water area in this area. Bangladesh experienced water shortages in the dry season, which significantly disrupted the agricultural practices and socio-economic activities of the country which reflected well in the present findings [1].

The NDVI and Isocluster images interpretation of Chalan *beel* showed that the water area and vegetation were higher in 2002 than that in 2008 but did not differ significantly (P>0.05) which is the indication of water decreasing trend in this area. A study on remote sensing and GIS approach showed that the Nana Kosi watershed at Jammu Himaalaya of India had a period of moisture surplus from June to August and the remaining months are deficit which supports the present finding [8].

In the dry season of 2002, the rivers were observed in the image like thin lines but in 2008 which almost disappeared from the NDVI image. This indicated that the rivers are becoming narrower day by day due to siltation and encroachment. The construction of the Farakka Barrage in 1973 on the Ganges River by neighbouring country has silted up most of its distributaries in Bangladesh leading to huge impact on the ecosystem and biodiversity of those rivers [10]. In dry season, the flow of the rivers in Chalan *beel* are either cut off or substantially reduced the flow and lowering the surface water as well as ground water level causing ecological devastation. In wet season, higher water area in Chalan *beel* were observed compared to the dry season in 2002 and 2008 due to the rain fall. On the other hand, comparatively higher vegetation observed in the dry season of 2002 than that in 2008, might be due to the extend boro rice and short duration winter crops.

The NDVI images of wet season in 2002 showed relatively high water which might be the local flood just before satellite passed overthe area. The lower observed that the water, bare land and vegetation was observed in wet season images of

2008. On the contrary, higher percentage of bare land observed in August, and low vegetation in April and June in both in the years. The significant changes of water and vegetation in different (P<0.05) seasons were observed but not in years images. This might be due to inter-crop gaps and various growing stages of crops [12]. Furthermore, significantly (P<0.05) higher dense vegetation areas were observed in 2008 images than in 2002 images which might be due to social forestation activities in the areas by social forestry programme of Government..

Again, higher water area was observed in NDVI images than that of Isocluster images because the moist lands were included in water category. The moist lands were classified as water in that were included in the water category, as a result, more water area observed in NDVI images than in the Isocluster images [11].

5 CONCLUSION

The land and water area did not differ significantly in the year and seasons but differed significantly among the months. The higher water area observed in the month of January in 2002 image which might be presence of surface water by rain before the satellite pass over, which increased the mean value of dry season. However, the actual situation is that very low amount of water was observed in the month of March and April in both the years images, which is the real threat to the fish and aquatic diversity of the Chalan *beel*. The situation was deteriorated further through the over use of surface and underground water for irrigation. Therefore, the authority should take necessary steps for maintaining aquatic biodiversity with special emphasis on fish biodiversity to have a sustainable fish production from this renowned *beel* in Northwestern Bangladesh.

REFERENCES

[1] A.M.M.M Ahmed and K. Roy, “Utilization and conservation of water resources in Bangladesh," *Development of Sustainable Agriculture*, Vol. 2, pp. 35-44, 2007.

[2] A.H. Arthington, S.R. Balcombe, G.A. Wilson, M.C. Thoms and J. Marshall, “Spatial and temporal variation in fish assemblage structure in isolated waterholes during the 2001 dry season of an arid-zone river, Cooper Creek, Australia,” *Marine and Freshwater Resources*, Vol. 56, pp. 1-11, 2005.

[3] P.B. Bayley, “Factors affecting growth rates of young tropical floodplain fishes: seasonality and density-dependence,” *Environmental Biology of Fishes*, Vol. 21, pp 127-142, 1988.

[4] DoF (Department of Fisheries) , *Jateyo Matshya Soptaho Sangkolon*, Department of Fisheries, Ministry of Fisheries and Livestock, People republic of Bangladesh, 2012.

[5] FRSS (Fisheries Resource Survey System), *Fisheries Statistical Year Book of Bangladesh, 2007- 08*. Twenty Fifth Edition, Department of Fisheries, Ministry of Fisheries and Livestock, Bangladesh, 2008.

[6] D. Gray, S. Zisman and C. Corves, *Mapping of the mangroves in Belize: Technical Report,* University of Edinburgh, Scotland, 1990.

[7] M.R. Hasan, *Oxbow lakes and floodplain fisheries sustainable livelihoods: A lesson from the wetland country, Bangladesh, Book of abstracts,* Seventh INTECOL Interventional wetlands conference, Utrecht, The Netherlands, 2004.

[8] A.S. Jasrotia, A. Majhi and S. Singh, *“Water Balance Approach for Rainwater Harvesting using Remote Sensing and GIS Techniques, Jammu Himalaya, India,”* Water Resource Management, Vol.23, pp 3035-3055, 2004.

[9] Junk, W.B., Bayley, P.B., and Sparks R.E., *The flood pulse in river floodplain systems*, In: D.P. Dodge (ed.), Proc. International Large River Symposium Canadian Special Publications, pp. 110–127, 1989,

[10] Mirza, “The Ganges water sharing treaty, risk analysis of the negotiated discharge,” *International Journal of Water*, Vol. 2, pp. 57-74, 2002.

[11] H. Neil, M.A. Salam and G.R. Lindsay, *Use of Landsat ETM+ and MODIS data for Investigation Land use surface water distribution in Bangladesh as part of a wider GIS based Assessment of Aquaculture potential under a changing climate*, A book of abstracts of workshop jointly organized by Bangladesh Agricultural University, Mymensingh and Institute of Aquaculture, University of Stirling, UK, 2009.

[12] D.P. Rao, V. Raghavswamy, N.C. Gautam, G. Ravi Shankar, L.S. Suresh and M. Mustaba, *“Land use Pattern in Deltas of East Coast with Special Reference to Godavari and Krishna River Deltas,”* The Geological Society, India, pp. 277-285, 1998.

[13] Rouse, J.W. Haas, R.H. Schell and D.W. Deering, *“Monitoring vegetation systems in the Great Plains with ERTS,”* Proceeding of 3rd Earth Resources Technology satellite-1 Symposium Greenbelt, NASA SP-351, 1974.

[14] K. Shahnaz, *Drastic fall in Chalan Beel fish production*, 2005. [Online] Available: http://www.weeklyholiday.net/env.html (September 9, 2005)

[15] L. J Trolier and W. R. Philipson, *"Visual analysis of Landsat Thematic Mapper images for hydrologic land use and cover,"* Photogrammetric Engineering and Remote Sensing, Vol. 52, pp.1531 – 1538, 1986.
[16] R. L. Welcomme, *"River Fisheries. FAO Fisheries"* Technical Paper No. 202, Rome, FAO, 1985.

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EVALUATION DE LA SITUATION ACTUELLE DE PUCERONS NOIR (*Aphis fabae*) DE HARICOT DANS LA REGION BUGORHE, MILIEU RURAL, COTE OCCIDENTALE DU LAC KIVU, SUD KIVU, REPUBLIQUE DEMOCRATIQUE DU CONGO

[EVALUATION OF THE CURRENT SITUATION OF BLACK APHIDS (*Aphis fabae*) BEAN IN THE REGION BUGORHE, RURAL AREA, WEST COAST OF LAKE KIVU, SOUTH KIVU, DEMOCRATIC REPUBLIC OF CONGO]

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ABSTRACT: The study was conducted in the region of Bugorhe whose purpose is to assess where the outbreak of *Aphis fabae* growing seasons and the method of observation, identification key, Past software and microsoft Excel were used. The duration is 12 weeks during the season of 2011 (September-December) and 2012 (September to December) and the B season of 2012 (February-May). Results show the months of November to October 2011, 2012 and March-April 2012 have a high incidence of black aphids while the months of September to December were lower in 2011, 2012 as February 2012, so the attack of aphids develop especially during dry in August to November and in September-November 2012, while in the rainy season (September 2011, October 2012 and December 2011 and 2012, April 2012), colonies of aphids are dense, destroyed by parasitic fungi *Erynia neophides* or *Neozygites*. Larvae or adult beetles and larvae *Syrphis* help control when they devour pucerons. Thus, the auspicious time of the attacks by black aphids *Aphis fabae* is dry season cropping seasons (A or B) as *Aphis fabae* can colonize many cultivated or so spontaneous means of struggle to provide growers with beans in the region Bugorhe plants are based sprays of dimethoate or specific aphicid as pyrimicarb and cultivators of beans are uprooted seedlings of upon detecting virus-infected beans.

KEYWORDS: Incidence, aphicid, pyrimicarb, dimethoate, cultivators of beans.

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RESUME: L'étude s'est déroulée dans la région de Bugorhe et dont l'objet est d'évaluer les saisons culturales où la pullulation d'*Aphis fabae* et la méthode d'observation, la clé d'identification, le logiciel Past et le microsoft Excel ont été utilisés. La durée est 12 semaines au cours de la saison A de l'année 2011 (septembre à décembre) et de l'année 2012(septembre à décembre) ainsi que la saison B de l'année 2012(février à mai).Les résultats montrent les mois de novembre-octobre 2011, 2012 et mars-avril 2012 ont une incidence élevée des pucerons noirs tandis que les mois de septembre-décembre en ont moindres 2011, 2012 comme février 2012, donc les attaques des pucerons se développent surtout en période sèche en août-novembre ainsi qu'en septembre - novembre 2012 tandis qu'en saison pluvieuse(septembre 2011,octobre 2012 et décembre 2011 et 2012, avril 2012), les colonies des pucerons sont denses, détruites par des champignons parasites *Erynia neophides* ou *Neozygites* . Les larves ou adultes de coccinelles et les larves de *Syrphis* contribuent au contrôle quand ils dévorent les pucerons.Ainsi, le moment propice des attaques par les pucerons noirs *Aphis fabae* est en période sèche des saisons culturales (A ou B) car *Aphis fabae* peut coloniser un grand nombre des plantes cultivées ou spontanées donc les moyens de luttes à proposer aux cultivateurs des haricots dans la région de Bugorhe sont les pulvérisations à base du diméthoate ou d'un aphicide spécifique comme le pyrimicarbe et les légumiculteurs de haricots doivent arrachés les plants des haricots virosés dès sa détection.

MOTS-CLEFS: Incidence, aphicide, pyrimicarbe, diméthoate, légumiculteurs.

1 INTRODUCTION

Journal Le point critique de l'alimentation dans les pays tropicaux reste la malnutrition protéique où la viande y apparait souvent comme un produit de luxe. Pour les populations à faible revenu, les légumineuses constituent la source des protéines [1].

Les carences en micronutriments sont actuellement connu comme étant l'un des plus graves problèmes de santé aux quels se trouvent confrontés d'importants secteurs de la population Africaine en générale et de l'Est de la République Démocratique du Congo en particulier. Les principales carences sont celles en fer, zinc vitamines et protéines énergétiques, mais pauvre en apports protéiques, minéraux et vitamines [2].

L'une des préoccupations de la recherche agricole est le développement et la diffusion de technologies en vue d'une croissance de la production agricole pour assurer la sécurité alimentaire et la réduction de la pauvreté. Ces préoccupations sont importantes pour relever les défis de malnutrition et de sous-alimentation conduisant à des pertes en vies humaines et de baisse de productivité de travail [3].

Le haricot commun est l'une des principales légumineuses produites et consommées en Afrique en générale et à l'Est de la République Démocratique du Congo en particulier [4]. Il représente une source substantielle des protéines végétales et contribue dans la sécurité alimentaire car répondant à la demande alimentaire ainsi qu'à la réduction de la pauvreté.

Sur ce, la culture de haricot commun selon qu'il soit des variétés biofortifiées riches en fer, zinc, vitamine, protéiques et autres variétés de haricot, est restée une culture de base, jouant un rôle important dans l'organisme humain et fournit dans certaines régions d'Afrique plus 45% des protéines consommées[5].

Les problèmes les plus importants sont les maladies, les insectes nuisibles ainsi que les problèmes de sols pauvres en azote et en phosphore, de toxicité en aluminium et manganèse et les problèmes de sècheresse [4] mais selon [6], les pertes causées par les insectes sont plus élevées que celles causées par les maladies car les attaques localisées ont augmenté récemment en intensité et en fréquence. Ainsi, le puceron noir du haricot (*Aphis fabae*) est un insecte qui endommage le haricot surtout au niveau des feuilles et qui véhicule certaines maladies comme le virus de la mosaïque du haricot [4], [6], [7].Les symptômes de l'attaque se caractérisent par la présence de colonies d'insectes sur les feuilles, les pétioles et les tiges. Les feuilles sont recroquevillées et boursouflées et souvent recouvertes de miellat de couleur noire, aussi rongées et les boutons floraux perforées par les chenilles.

Actuellement, les variétés biofortifiées et non biofortifiées sont disponibles dans les ménages de nos différents villages de la région de Bugorhe et sont cultivé dans toutes les zones agroécologiques, soit sur la terre ferme et soit encore dans le marais mais ils sont confrontés aussi aux différentes contraintes, affectant sa production.

De ce qui précède, les questions suivantes peuvent être posées : A quel moment des saisons culturales (A ou B), la pullulation de pucerons noirs du haricot (*Aphis fabae*) est élevée ? Quelles sont les moyens de luttes à proposer aux cultivateurs des haricots dans la région de Bugorhe ?

Ainsi, devant les questions énumérées, il serait important de connaître les saisons culturales où la pullulation est élevée car depuis 2011 jusqu'à 2013, la région de Bugorhe connait des perturbations climatiques et une fois le moment est connu, les moyens de lutte seront proposées aux cultivateurs des haricots dans la région de Bugorhe.

Cette étude a pour objet d'évaluer les saisons culturales où la pullulation de pucerons noirs du haricot (*Aphis fabae*) est élevée tout en précisant l'incidence des *Aphis fabae* suivant les saisons culturales dans la région d'étude.

2 MATERIEL ET METHODES

2.1 MILIEU

Cette région de Bugorhe se situe, au sein du territoire de Kabare, à 50 km au nord de la ville de Bukavu. Elle s'étend entre 28° 45' à 28°85' de longitude est et de 2° 15' à 2° 30' de latitude sud avec des altitudes variant entre 1470 m et 2200 m d'altitude (lisière du Parc National de Kahuzi Biega).Le groupement de Bugorhe est couverte d'un sol volcanique et est formée par l'alternance des collines et des vallées et bénéficient d'un climat tropical humide comprenant une longue saison de pluie de 9 mois (septembre à mai) et une courte saison sèche de 3 mois (juin - août). La température annuelle moyenne de l'air est de 19,5 °C et l'humidité relative varie entre 68 % et 75 % offrant un climat favorable à une diversité agricole.

La végétation est constituée d'une savane herbeuse de montagne dominée par des graminées fortement diversifiées et quelques arbustes. Cette végétation a remplacé une végétation primitive constituée de la forêt primaire à *Albizia grandibracteata* dont les reliques sont encore visibles dans les stations de Mugeri, Kakondo et Lwiro [8].

Cependant la région apparaît à première vue comme une "forêt" à bananiers à l'intérieur de laquelle la population autochtone de l'ethnie Shi construit des maisons de type traditionnel ou des cases en boue avec la toiture généralement faite avec les lanières de bananiers. Un réseau hydrique incluant aussi des marais dans les bas-fonds inonde le terrain, facilitant ainsi une agriculture permanente.

Les contraintes majeures de la communauté sont liées à la surpopulation, avec une densité humaine d'environ 350 habitants/km^2 ainsi qu'à l'accès difficile à la propriété de la terre : plus de 60 % de citoyens sont des paysans sans terre, forcés au système agricole de type féodal.

Les terres appartiennent exclusivement aux églises, aux institutions gouvernementales, et aux chefs locaux. Cette situation est une des causes majeures de la pauvreté au niveau des ménages malgré les potentialités géoclimatiques offertes disponibles [9]. Aussi, dans cette contrée, moins de 25 % des chefs de ménages ont accompli les études secondaires, et plus de 50 % des ménages sont dirigés par des couples analphabètes. Ceci conduit à une importante vulnérabilité des ménages [10].

2.2 MATERIEL

Les variétés de haricot *RWR2245*, *RwR10, Hm21*-7 et *M'Sole* constituent le matériel dans cette étude.

2.3 METHODES

La méthode d'observation (directe et détaillée) des plants d'haricots a été faite [11] et pour l'identification de puceron noir du haricot (*Aphis fabae*), de la famille d'homoptère, la clé d'identification [12] a été utilisée. Cette observation a durée 12 semaines au cours de la saison A de l'année 2011 (septembre à décembre) et de l'année 2012(septembre à décembre) ainsi que la saison B de l'année 2012(février à mai). Le comptage des pucerons se faisaient directement au champ sur la feuille, la tige, le pétiole, les gousses et les fleurs et les *Aphis fabae* ont été récoltés, conservés dans de flacons et observés au laboratoire à l'aide d'une loupe.

Les données climatiques ont été obtenues par la station de climatologie du Département de Géophysique au Centre de Recherche en Sciences Naturelles, CRSN- Lwiro.

Incidence (I) correspond au nombre des plants ravagés sur le nombre total des plants enquêtés (pour la variété *RWR2245*:80 plants, la variété *RWR 10* :81 plants, les variétés *Hm21-7 et M'Sole* : 77 plants) multipliés par cent et a été

calculé par la formule (I)= $\frac{\sum_{t-1}^{n} Pt}{N} x100$ Avec Pt= Nombre de pieds ravagés à la période de contrôle et N= Nombre total de plant du carré.

L'analyse de la variance à un seul critère a été utilisée ainsi que l'histogramme pour les données climatiques sur ordinateur à l'aide du logiciel Past et de Microsoft Excel

3 RESULTATS

L'incidence des pucerons noirs au cours de la saison culturale A (2011,2012) et B (2012) ainsi que les analyses de la variance suivi des comparaisons de moyennes deux à deux par la méthode de Turkey sont présentés dans les tableaux 1,2,3,4,5,6,7,8 et 9 et ensuite des graphiques 1,2 et 3.

Tableaux 1. Incidence des pucerons noirs des haricots, saison culturale A(2011) sur la variété Rwr10

Nombre des semaines	Septembre	Octobre	Novembre	Décembre
	Incidence			
1	18.51	382.71	48.14	0.00
2	55.55	504.93	198.76	6.17
3	25.92	259.25	420.98	25.92
4	16.04	141.97	260.49	0.00
5	8.64	264.19	544.44	14.81
6	12.34	43.20	75.30	8.64
7	0.00	149.38	264.19	18.51
8	11.11	100.00	37.03	16.04
9	3.70	144.44	112.34	4.93
10	8.64	119.75	138.24	9.13
11	18.51	50.61	107.49	13.58
12	0.00	6.17	38.27	0.00
Moyenne des semaines	15.00	180.00	187.00	17.00

De ce tableau 1, il ressort que les mois de novembre et celui d'octobre 2011 ont respectivement 187 et 180 *Aphis fabae*, donc une incidence élevée que les mois de septembre et décembre 2011 ayant respectivement 15 et 17 pucerons, analysons statistiquement les données du tableau 1, on a :

Tableau 2. Analyse de la variance des pucerons noirs des haricots, saison culturale A (2011) sur la variété Rwr10

Source de variation	Degré de liberté	Somme de carré	Carré moyen	$F_{observé}$	Signification
Différence entre l'incidence des pucerons noirs	3	22543	74181	9.327	HS
Différence de l'incidence des pucerons noirs par mois	44	349931	7952.98		
Total	47	5724474			

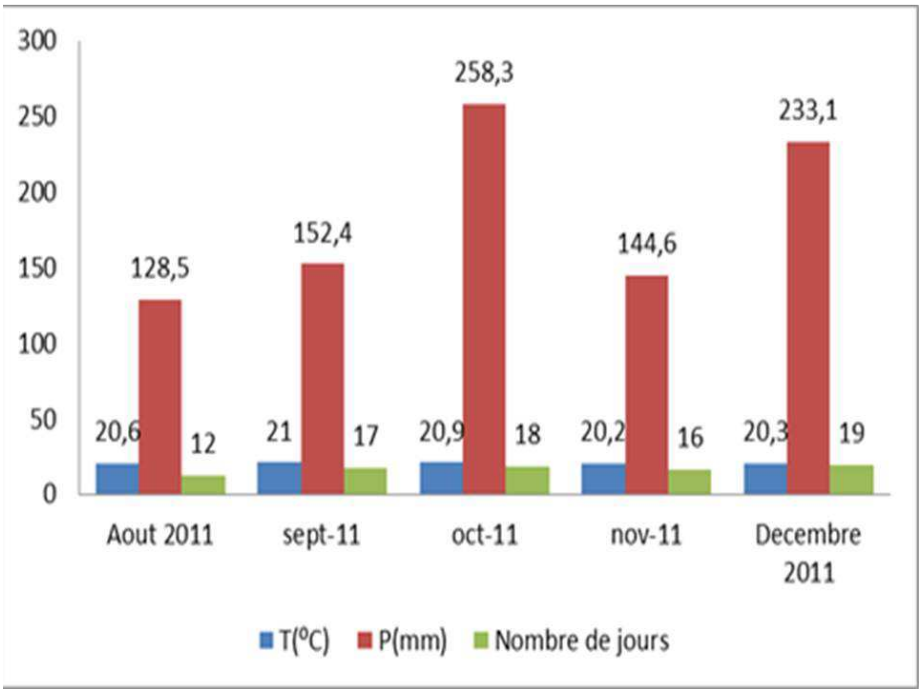
CV : 0.0000687%, avec CV= Coefficient de variation, HS= Hautement significatif

Il ressort de ce tableau 2 d'analyse de la variance que la différence est hautement significative entre l'incidence des pucerons noirs par mois, c'est-à- dire l'incidence des pucerons noirs, *Aphis fabae*, diffère selon les mois donc il y a de mois qui ont une incidence élevée par rapport aux autres ainsi comparons les moyennes deux à deux par la méthode de Turkey.

Tableau 3. Comparaisons des moyennes des pucerons noirs sur les haricots

	Septembre 2011	Octobre 2011	Novembre2011	Décembre2011
Septembre2011		0.003487	0.502307	
Octobre2011	5.212			0.003887
Novembre2011	5.419	0.2072		0.502573
Décembre2011	0.055	5.157	5.364	

En comparant les moyennes deux à deux, nous remarquons que les mois de novembre et d'octobre 2011 ont une incidence élevée des pucerons noirs tandis que les mois de septembre et de décembre en ont moins et voyons l'allure des données climatiques de la période de 2011. Le graphique 1, ci-dessous montre que le nombre de jours de pluies sont inférieurs durant le mois d'août et celui de novembre 2011 tandis qu'il est élevé en septembre et décembre 2011.



Graphique 1. Données climatiques de la saison culturale A , 2011

Tableau 4. Incidence des pucerons noirs des haricots, saison culturale A(2012) sur la variété RwR2245

Nombre des semaines	Septembre	Octobre	Novembre	Décembre
	Incidence			
1	23.75	246.25	262.5	0.00
2	8.75	521.25	413.75	18.75
3	6.25	262.5	148.75	13.75
4	22.5	140.0	43.75	0.00
5	8.75	117.5	0.00	5.00
6	30	196.25	92.50	8.75
7	16.25	267.5	126.25	11.25
8	8.75	121.25	71.25	11.25
9	16.25	128.75	103.75	17.5
10	10.00	92.50	147.5	25.00
11	0.00	6.25	16.25	10.00
12	2.5	1.25	0.00	3.75
Moyenne des semaines	13.00	175.0	119.0	9.00

Il ressort que l'incidence des pucerons noirs est aussi élevée durant les mois de Novembre et d'Octobre 2012, tandis qu'en septembre et décembre 2012, l'incidence est moins élevée c'est-à dire l'incidence d'*Aphis fabae* est faible durant septembre et décembre 2012. L'analyse statique des données par l'analyse de la variance.

Tableau 5. Analyse de la variance de pucerons noirs des haricots, saison culturale A(2012) sur la variété RwR2245

Source de variation	Degré de liberté	Somme de carré	Carré moyen	$F_{observé}$	Signification
Différence entre l'incidence des pucerons noirs	3	155437	518112.3	9.599	HS
Différence de l'incidence des pucerons noirs par mois	44	237487	5397.43		
Total	47	392924			

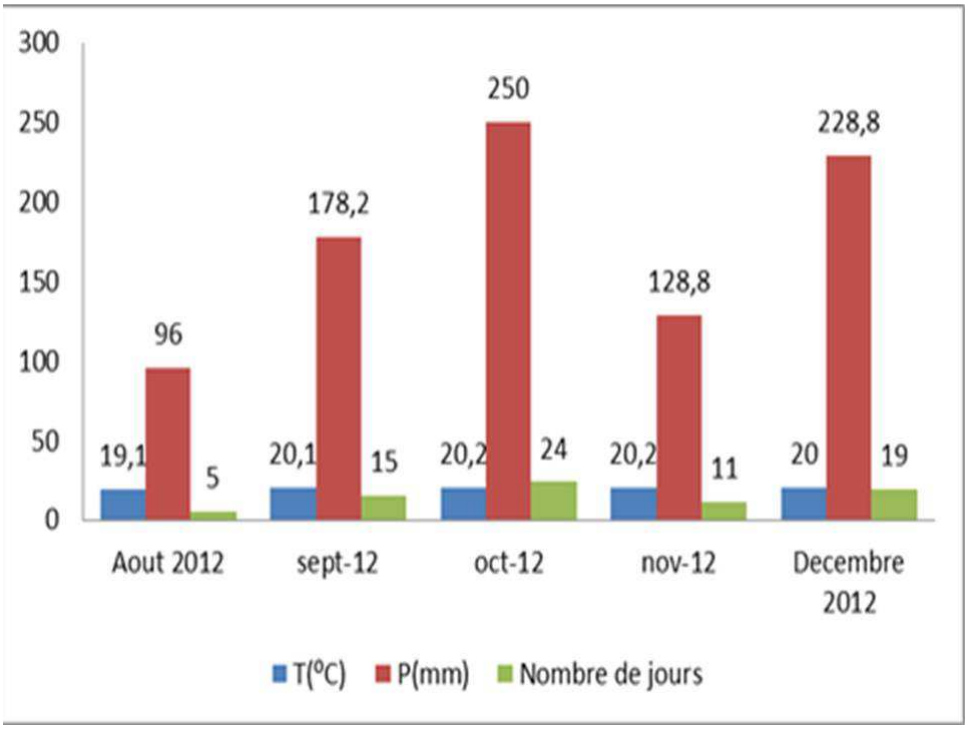
CV : 0.00005403%, avec CV= Coefficient de variation, HS= Hautement significatif

La différence est hautement significative entre l'incidence des pucerons noirs suivant les différents mois d'où la comparaison des moyennes deux à deux par la méthode de Turkey et cette comparaison est présentée dans le tableau 6.

Tableau 6. Comparaisons des moyennes des pucerons noirs sur les haricots

	Septembre 2012	Octobre 2012	Novembre 2012	Décembre 2012
Septembre2012		0.003487	0.502307	
Octobre2012	5.212			0.003887
Novembre2012	5.419	0.2072		0.502573
Décembre2012	0.05503	5.157	5.364	

La comparaison des moyennes deux à deux montre aussi que les mois de novembre et d'octobre 2012 ont une incidence élevée des pucerons noirs (*Aphis fabae*) par rapport aux mois de septembre et de décembre 2012.Les données climatiques sont présentées dans le graphique 2, qui montrent que septembre et novembre 2012 ont peu de jours des pluies que les mois d'octobre et de décembre 2012



Graphique 2. Données climatiques de la saison culturale A , 2012

Tableau 7. Incidence des pucerons noirs des haricots, saison culturale A(2012) sur les variétés Hm21-7 et M'Sole

Nombre des semaines	Février	Mars	Avril	Mai
	Incidence 2012			
1	11.68	532.46	194.80	16.88
2	92.20	610.38	274.02	0
3	27.27	403.89	185.71	31.16
4	12.98	188.31	76.62	0
5	53.24	277.92	148.05	5.19
6	19.48	63.63	96.10	10.38
7	3.89	183.11	248.05	27.27
8	0	276.62	122.07	3.89
9	16.88	187.01	149.35	11.68
10	24.67	125.97	100	18.18
11	9.09	20.77	15.58	1.29
12	0	2.59	11.68	0
Moyenne des semaines	23	239	135	10

Les moyennes de ce tableau montrent qu'aux mois de février et mai 2012, l'incidence *d'Aphis fabae* est moindre par rapport aux mois de mars et avril 2012 où l'incidence est élevée. Analysons statistiquement nos résultats. Le tableau 8 présente l'analyse de la variance.

Tableau 8. Analyse de la variance de pucerons noirs des haricots, saison culturale A(2012) sur les variétés Hm21-7 et M'Sole

Source de variation	Degré de liberté	Somme de carré	Carré moyen	F observé	Signification
Différence entre le nombre des pucerons noirs	3	246539	82179.5	12.37	H.S
Différence entre les pucerons noirs par mois	44	292257	6642.21		
Total	47	538796			

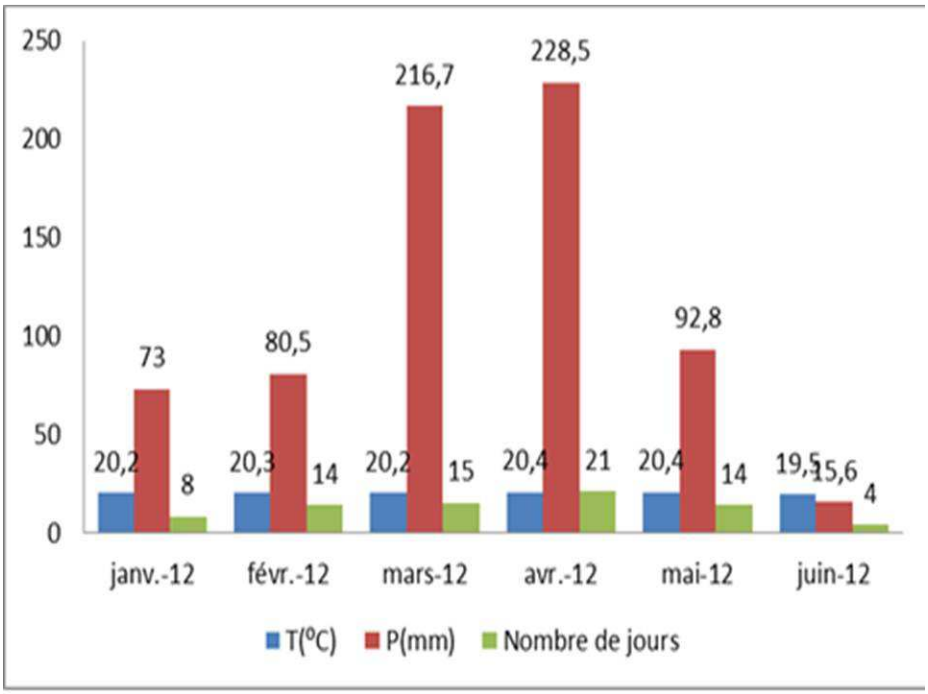
CV : 0.0000005339%, avec CV= Coefficient de Variation, HS= Hautement significatif

L'analyse de la variance montre une différence hautement significative entre l'incidence des pucerons noirs (*Aphis fabae*) au cours des mois c'est-à dire les pucerons noirs ont une incidence élevée selon les différents mois, la comparaison des moyennes deux à deux par la méthode de Turkey est présentée dans le tableau 9, ci-dessous.

Tableau 9. Comparaisons des moyennes des pucerons noirs sur les haricots

	Février2012	Mars 2012	Avril 2012	Mai 2012
Février2012		0.0002118	0.05831	0.9923
Mars 2012	7.095		0.08968	0.0001843
Avril2012	3.684	3.411		0.02975
Mai2012	0.3967	7.491	4.08	

De ce tableau de la comparaison des moyennes, il ressort que les mois de mars et d'avril 2012 ont une grande incidence par rapport aux mois de février et de mai 2012. Analysons par le graphique les données climatiques et au regard de celles-ci le nombre des jours de pluies sont moindres durant les mois de février, mars, mai et sauf en avril 2012 où les jours des pluies sont élevés.



Graphique 3. Données climatiques de la saison culturale B , 2012

4 DISCUSSION

Les résultats montrent d'une part que les mois de novembre et d'octobre 2011 et 2012 ont une incidence élevée des pucerons noirs tandis que les mois de septembre et de décembre en ont moindres, ceux-ci rejoignent [7] ainsi que [12] qui disent que les attaques des pucerons noirs (*Aphis fabae*) se développent surtout en période sèche en août et novembre ainsi qu'en septembre et novembre 2012 tandis qu'en saison pluvieuse(septembre 2011,octobre 2012 et décembre 2011 et 2012), les colonies d'*Aphis fabae* sont denses et détruites par des champignons parasites *Erynia neophides* ou *Neozygites* (Entomophthorales). Les larves ou adultes de coccinelles et les larves de *Syrphis* (Diptères) contribuent également au contrôle quand ils dévorent les pucerons.

D'autre part que les mois de mars et d'avril 2012 ont une grande incidence ceci s'explique car durant la période sèche(février 2012) il y a développement des pucerons noirs ,ainsi, les précipitations élevées du mois d' avril 2012 favorisent les champignons parasites entomophthorales , les coccinelles (larves et adultes) ainsi que les larves de Diptères Syrphes pour contrôler naturellement la population des *Aphis fabae* ([7] , [12]).

5 CONCLUSIONS

Au terme de cette étude dont l'objet est d'évaluer les saisons culturales où la pullulation de pucerons noirs du haricot (*Aphis fabae*) est élevée tout en précisant l'incidence des *Aphis fabae* suivant les saisons culturales dans la région d'étude Bugorhe ,les résultats montrent les mois de novembre et d'octobre 2011 et 2012 ont une incidence élevée des pucerons noirs tandis que les mois de septembre et de décembre en ont moindres, donc les attaques des pucerons noirs (*Aphis fabae*) se développent surtout en période sèche en août et novembre ainsi qu'en septembre et novembre 2012 tandis qu'en saison pluvieuse(septembre 2011,octobre 2012 et décembre 2011 et 2012), les colonies d'*Aphis fabae* sont denses et détruites par des champignons parasites *Erynia neophides* ou *Neozygites* (Entomophthorales). Les larves ou adultes de coccinelles et les larves de *Syrphis* (Diptères) contribuent également au contrôle quand ils dévorent les pucerons.

Ensuite, les mois de mars et d'avril 2012 ont une grande incidence ceci s'explique car durant la période sèche(février 2012) il y a développement des pucerons noirs ,ainsi, les précipitations élevées du mois d' avril 2012 favorisent les champignons parasites entomophthorales , les coccinelles (larves et adultes) ainsi que les larves de Diptères Syrphes pour contrôler naturellement la population des *Aphis fabae* .

Ainsi, le moment propice des attaques par les pucerons noirs *Aphis fabae* est en période sèche des saisons culturales (A ou B) car *Aphis fabae* peut coloniser un grand nombre des plantes cultivées ou spontanées donc les moyens de luttes à proposer aux cultivateurs des haricots dans la région de Bugorhe sont les pulvérisations à base du diméthoate ou d'un aphicide spécifique comme le pyrimicarbe (200 à 300 grammes de matière active par hectare) qui a l'avantage de respecter la faune auxiliaire, éliminent rapidement les pucerons. De plus, connaissant que les *Aphis fabae* sont des pucerons à éviter car les virus de la mosaïque du haricot commun ou mosaïque commune ou encore Bean Commun Mosaic Virus, BCMV) est transmis par eux selon un mode non persistant donc les légumiculteurs de haricots doivent arrachés les plants des haricots virosés dès sa détection.

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REFERENCES

[1] Vandenput R., *Les principales cultures en Afrique centrale*. Tournai: édit. Lesaffre, pp. 458, Yangambi, A et B. Bruxelles: Publ. INEAC., pp. 35, 1981.

[2] http://www.ciat.cgiar.org/africa/pabra.htm,(26 juin 2014).*Des haricots de meilleure qualité pour l'Afrique* …,PABRA/CIAT,2006 .

[3] Centre Technique d'Agriculture CTA. Stratégie communautaire de sécurité alimentaire et pays ACP. Séminaires sur la sécurité alimentaire*. Bruxelles, 20 Octobre au 11 Décembre*, pp. 94, 1998

[4] Nyabyenda P., *Les plantes cultivées en régions tropicales d'altitude d'Afrique*. Les presses agronomiques de Gembloux, Belgique, pp.223, 2009.

[5] Alain D.J., *Cahier d'étude sur le système de production de haricot en Afrique*, CIAT, Colombie, 1986..

[6] Dupriez H. et Simbizi J., *Ravageurs aux champs in Carnets écologiques*. Terre et Vie, 13 rue Laurent Delvaux, 1400, Belgique, pp.116, 1998.

[7] Autrique A. et Perreaux D., *Maladies et ravageurs des cultures de la région des Grands Lacs d'Afrique Centrale*, AGCD, no 24, I.S.A. Bu, Bujumbura, Burundi, pp.232, 1989.

[8] I. K. Balagizi, S. Ngendakumana, H. N. Mushayuma, T. M. Adhama, A. M. Bisusa, B. Baluku et M. Isumbish, " Perspectives de gouvernance environnementale durable dans la région de Lwiro (Sud Kivu, République Démocratique du Congo) ", *VertigO - la revue électronique en sciences de l'environnement* [En ligne], Hors-série 17 | Septembre 2013.

[9] K. Balagizi, " Éducation environnementale comme facteur incitateur de la paix dans les zones post-conflits", *Cahiers du CERPRU*, 19, pp. 35-45, 2010.

[10] Klennert K., *Assurer la sécurité alimentaire et Nutritionnelle*. ImVent. Stuttgart,pp. 303, 2006.

[11] Dagnelie, P., *Statistique théorique et appliquée*. Les presses agronomiques de Gembloux, Belgique, pp. 492, 1988.

[12] http://www.biobest.be (26 juin, 2012) Fiches techniques BIOBEST - Malais, M., Ravensberg, W.J.-1993-Connaître et reconnaître. Mode de vie des ravageurs de serres et de leurs ennemis naturels. Koppert BV, p 109 - Lecoq, H.-1996-Les pucerons : de redoutables vecteurs de virus des plantes. PHM, n° 369, pp. 25-36 - Leclant, F.-1996-Dégâts et identification des pucerons. PHM, n° 369, pp.19-24.

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An Analysis on Biosimilars

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ABSTRACT: Production of biosimilars, similar to the original pharmaceuticals that faces certain challenges like possible need for unique naming to differentiate the various biopharmaceutical products, regulatory framework and commercial opportunities have made the researchers in head over heels to design the appropriate one. Clinical applications have to be the main target that relies on cost-effectiveness and market value.

KEYWORDS: biosimilars, biopharmaceutical products, clinical applications, market value.

1 INTRODUCTION

Given that biosimilars are agents that are similar but not identical to the reference biopharmaceutical, this study aims to introduce and describe specific issues related to the economic evaluation of biosimilars by focusing on the relative costs and effectiveness of biosimilars.

A biosimilar product is defined in the US as one that is “highly similar to the reference product notwithstanding minor differences in clinically inactive components” and for which there are “no clinically meaningful differences between the biological product and the reference product in terms of safety, purity and potency.”

biosimilars are “similar but not the same” or in other words biosimilars are “the twin but not the clone” to the original biologic innovator product.

1.1 CHALLENGES IN BIOSIMILARS

i) Verification of the similarity,

ii) The interchangeability of biosimilars and innovator products,

iii) The possible need for unique naming to differentiate the various biopharmaceutical products,

iv) Regulatory framework,

v) Commercial opportunities as well as guidelines to assist manufacturers in product development,

vi) Intellectual property rights, and

vii) public safety.[2]

2 PHARMACOVIGILANCE OF BIOSIMILARS

Pharmacovigilance, as part of a comprehensive risk management programme, will need to include regular testing for consistent manufacturing of the drug.The most critical safety concern relating to biopharmaceuticals (including biosimilars) is immunogenicity.[2] Pharmacovigilance is important in the biosimilars market because of the limited ability to predict clinical consequences of seemingly innocuous changes in the manufacturing process and the scientific information gap.[2]

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3 FUNDAMENTAL DIFFERENCES FROM GENERICS AND ASSUMPTIONS FOR BIOSIMILARS

Webber defines follow-on (protein) biologics as products that are intended to be sufficiently similar to an approved product to permit the applicant to rely on existing scientific knowledge about safety and efficacy of the approved reference product.[10]

As a number of patents for biologic products are to expire in the next few years, the subsequent follow-on products have generated considerable interest within the pharmaceutical/biotechnological industry as biosimilar manufacturers strive to obtain part of an already large and rapidly growing market.[10]

4 CURRENT REGULATORY REQUIREMENTS EMA

For approval of biosimilars in Europe, the EMA has issued a new guideline describing general principles for the approval of similar biological medicinal products, or biosimilars.[10]

Specifically, the concept papers discuss approval requirements for four classes of human recombinant products containing erythropoietin, human growth hormone, granulocyte-colony stimulating factor, and insulin. The guideline consists of a checklist of documents published to date which are relevant to data requirements for biological pharmaceuticals. In the United States, current approval pathway for follow-onbiologics depends on whether the biologic product is approved under the United States Food, Drug, and Cosmetic.[10]

The first biosimilar molecule approved in April 2006 in Europe by the European Medicines Agency (then EMEA, now EMA) was Omnitrope, a version of somatropin. This was closely followed by another HGH, Valtropin two weeks later. To date, the EU has approved 14 biosimilars, all of which are versions of somatropin, epoetin (EPO) or more recently, filgrastim. Some early applications, (e.g. interferon alpha-2a and insulin) were not successful; either rejected or withdrawn voluntarily.[4]

5 CLINICAL APPLICATIONS

5.1 APPRAISAL OF BIOSIMILAR FILGRASTIM (NIVESTIM™)

A series of rigorous analyses have now demonstrated the bioequivalence of Nivestim and Neupogen in terms of their physicochemical properties, pharmacokinetic, and pharmacodynamic characteristics, as well as their clinical efficacy and safety profiles.[3]

Nivestim may become a valuable and cost-effective treatment option for clinical scenarios, other than chemotherapy-induced neutropenia, where Neupogen is currently used, including severe chronic neutropenia and peripheral blood progenitor cell mobilization.[3]

5.2 RITUXIMAB AND BIOSIMILARS

Rituximab, a chimeric IgG1 anti-CD20 MAb, is a breakthrough MAb for cancer, rheumatoid arthritis, and a wide range of immunologic illnesses.It has received formal FDA regulatory approvals for treatment of non-Hodgkin lymphoma and chronic lymphocytic leukemia and, in combination with methotrexate, as second-line therapy for adult patients with moderate to severe rheumatoid arthritis.[12]

Reditux, the world's first biosimilar MAb for rituximab is a special initiative. Dr Reddy's was the first to gain approval for a rituximab biosimilar in Asia, Latin America, and the Middle East. In the case of rituximab, within 3 years of launch of Reditux, the number of patients receiving this therapy increased more than six-fold in India.[12]

5.3 CANCER IMMUNOTHERAPY

Metastasis occurs in the late stages of cancer development and partly represents the failure of both the innate and adaptive immune systems. Stimulation of the innate immune system may lead to short-term benefits, to have a long- term benefit it must be followed by DC, IL-2/LAK or similar cytotoxic cell infusion. There are many exciting mAbs and drugs developed against various immune-related receptors such as Ipilimumab or PD-1, and for controlling Treg cells and MDSCs.[6]

6 FUTURE STUDIES TO DEMONSTRATE SIMILARITY

- choose a sensitive experimental human model whereby the clinical impact of the originator product is large; thus, by comparing two large impacts, small differences can be easily appreciated
- use a homogeneous cohort of patients that eliminates the intersubject variability and allows variability to be more noticeable between the candidate biosimilars and the originator product
- choose younger patient populations to eliminate the noise from comorbid conditions in older patients;34 this can lead to a smaller sample size.

There may be strategies that allow a "fingerprint"-like identification of highly similar patterns in two different products, which might be used to reduce the scope and extent of the currently required clinical studies.[5]

7 BIOSIMILAR MEDICINES

To date, biosimilars of recombinant human erythropoietins (epoetin alfa and epoetin zeta), G-CSFs (filgrastim), and human growth hormones (somatropin) have entered the European market. In the coming years, patents will expire on some major biopharmaceuticals such as interferons and insulins. Probably, this will lead to the market entry of a number of biosimilars in the near future.[11]

8 INDIAN MARKET

At present, India is one of the leading contributors in the world biosimilar market. India has demonstrated the greatest acceptance of biosimilars, which is reflected from over 50 biopharmaceutical brands getting marketing approval. The Indian biotechnology industry is also gaining momentum, with revenues of over U.S. $ 2.0 billion in 2006, 70% of which is biopharmaceuticals. These are projected to reach up to $580 million by 2012.[8]

Table 1 Approved biosimilars in Europe as of July 2012

International nonproprietary name	Indication	Reference product	Biosimilar	Price (in Belgium)	Year of approval
Somatropin	Treatment of growth hormone deficiency	Genotropin®		€28.7 per mg	1987
			Omnitrope®	€22.4 per mg	2006
Somatropin	Treatment of growth hormone deficiency	Humatrope®		€23.7 per mg	1990
			Valtropin®	–	2006
Epoetin alfa	Treatment of anemia and reduction of transfusion requirements	Eprex®		€101 (10,000 IE/1 mL)	1990
			Binocrit®	€42.49 (1000 IE/0.5 mL)	2007
			Epoetin alfa Hexal®	–	2007
			Abseamed®	–	2007
Epoetin zeta	Treatment of anemia and reduction of transfusion requirements	Eprex®		€101 (10,000 IE/1 mL)	1990
			Silapo®	–	2007
			Retacrit®	€42.49 (1000 IE/0.5 mL)	2007
Filgrastim	Prevention or reduction of neutropenia	Neupogen®		€279.3 per mg	1991
			Biograstim®	–	2008
			Filgrastim Ratiopharm®	–	2008
			Ratiograstim®	–	2008
			Tevagrastim®	€223.4/ mg	2008
			Zarzio®	€223.4/ mg	2009
			Filgrastim Hexal®	–	2009
			Nivestim®	–	2010

The above table shows the approved biosimilars in Europe as of July 2012

(Paul J Declerck, Steven Simoens, 'A European perspective on the market accessibility of biosimilars')[9]

9 COST-EFFECTIVENESS

Biosimilars have been developed for older biopharmaceuticals, for whichsecond-generation biopharmaceuticals are now marketed and have become the standard treatment (eg, second-generation erythropoietins and second-generation G-CSFs).This implies that the cost-effectiveness of the first-generation biosimilar needs to be determined relative to the secondgeneration biopharmaceutical.[11]

The first biosimilar monoclonal antibody is likely to be a copy of the cancer drug rituximab. Initially developed by Biogen Idec in Cambridge, Massachusetts, rituximab is expected to be one of the first monoclonal antibody therapies to go off patent, which Malecki says it may do in Europe as early as 2013. It is also one of the best-sellers: in 2009 the drug earned about $5.61 billion worldwide. In May 2011, the Israeli generics maker Teva Pharmaceuticals announced that its biosimilar version of rituximab is ready for clinical trials.[7]

10 BIOSIMILAR THERAPEUTIC ANTIBODIES

Bio-better antibodies are antibodies that target the same validated epitope as a marketed antibody, but have been engineered to have improved properties.

Second-generation antibodies are panitumumab (Vectibix; Amgen), which followed cetuximab; ofatumumab (Arzerra; Genmab/GlaxoSmithKline), which followed rituximab and adalimumab (Humira/Trudexa; Abbott), certolizumab pegol (Cimzia, UCB) and golimumab (Simponi; Centocor), all of which followed infliximab. The third-generation CD20-specific antibody obinutuzumab (GA101; Glycart/Roche/BiogenIdec) is less immunogenic than rituximab.[1]

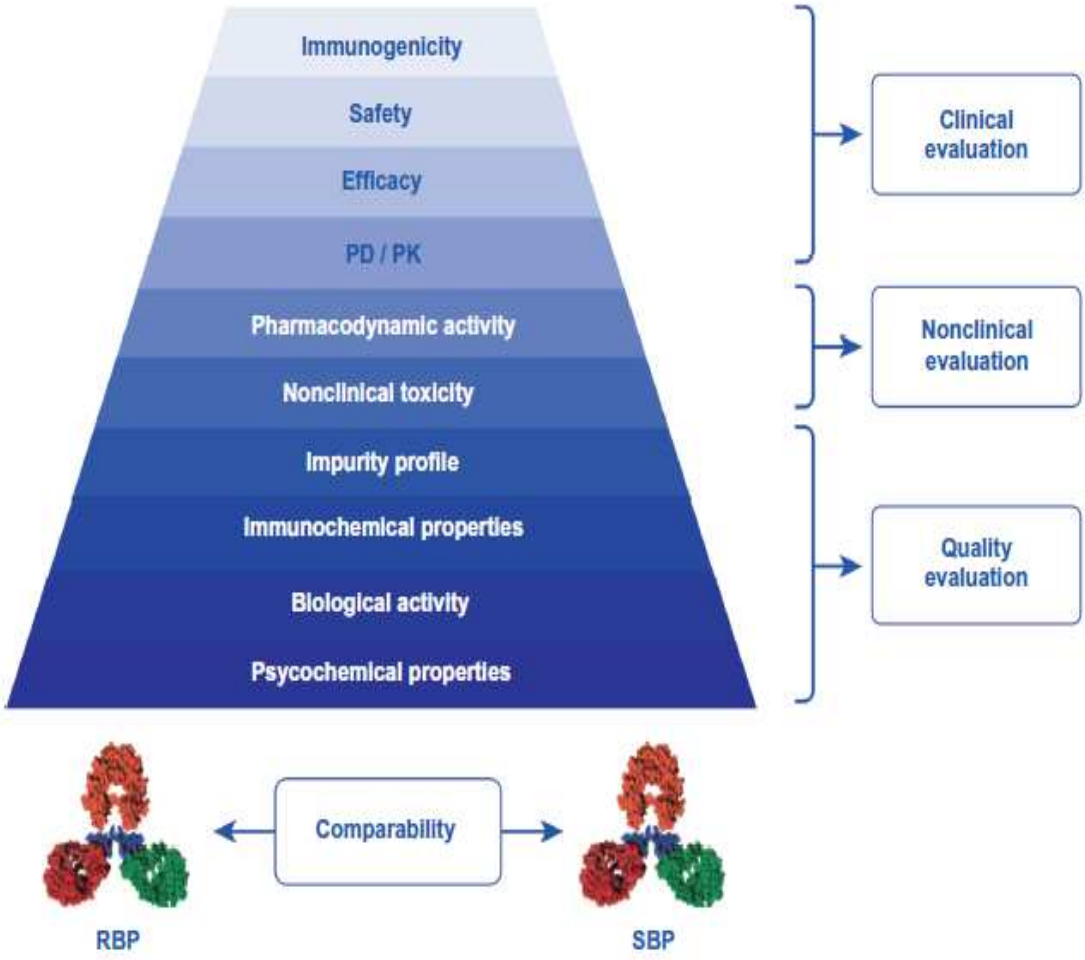


Figure 1 Comparability exercise.
Abbreviations: SBP, similar biotherapeutic product; RBP, reference biotherapeutic product; PK, pharmacokinetics; PD, pharmacodynamics.

FIG COURTESY: Zayrho Desanvicente-Celis, Julian Caro-Moreno, Mateo Enciso-Zuluaga, Juan-Manuel Anaya, 'Similar biotherapeutic products in Latin America. Regulation and opportunities for patients with autoimmune diseases'[13]

11 CONCLUSION

Biosimilars differ from generic drugs because their active ingredients are huge molecules with intricate structures. Such molecules are nearly impossible to replicate in every detail even in the hands of the original manufacturer, minute variations in production yield slight differences. Unlike the relatively simple construction of a small-molecule drug, making a biosimilar is more like placing a complicated family recipe in the hands of a new chef. The overall result may be roughly the same, but it is not exactly how mother used to make it and it may not precisely match the safety and therapeutic effects of the original.[7]

"Not a day goes by when you don't read a press release saying some company is getting into biosimilars," says Michael Malecki ·The revolution in Pharmaceutical industries is going to be only Biosimilars by overcoming the challenges.Way to change the world with goodness.

REFERENCES

[1] Alain Beck, 'Biosimilar, biobetter and next generation therapeutic antibodies', *MAbs.* 2011 Mar-Apr; 3**(2):** 107–110.

[2] Bhupinder Singh Sekhon,Vikrant Saluja. 'Biosimilars: an overview', *Dove Medical Press,* 2011:1 1–11.

[3] Cornelius F Waller, 'Critical appraisal of biosimilar filgrastim (Nivestim™) for febrile and chemotherapy-induced neutropenia' *Dove Medical Press*, 2012:2 1–11.

[4] Fiona M Greer, 'Biosimilar development: from science to market, *Life science technical bulletin*- issue n°47 / july 2011.

[5] Ghaith Noaiseh, Larry Moreland, 'Current and future biosimilars: potential practical applications in rheumatology', *Dove Medical Press*, 2013:3 27–33.

[6] Gianfranco Baronzio, Gurdev Parmar, Irina ZH Shubina, Valter Cassutti, Sergio Giuli, Marco Ballerini, Mikhail Kiselevsky, 'Update on the challenges and recent advances in cancer immunotherapy', *ImmunoTargets and Therapy* 2013:2 39–49.

[7] Heidi Ledford, 'Biosimilar' drugs poised to penetrate market, *Nature* 468, 18-19 (2010).

[8] Monika Misra, 'Biosimilars: Current perspectives and future implications', *Indian J Pharmacol.* 2012 Jan-Feb; 44**(1):** 12–14.

[9] Paul J Declerck, Steven Simoens, 'A European perspective on the market accessibility of biosimilars', *Dove Medical Press*, 2012:2 33–40.

[10] Shein-Chung Chow, Laszlo Endrenyi, Peter A Lachenbruch, Lan-Yan Yang, Eric Chi, 'Scientific factors for assessing biosimilarity and drug interchangeability of follow-on biologics' *Dove Medical Press*, 2011:1 13–26.

[11] Steven Simoens, 'Biosimilar medicines and cost-effectiveness', *Dove Medical Press*, 2011:3 29–36.

[12] Zaina P Qureshi, Jametta S Magwood, Sarveshwari Singh, Charles L Bennett, 'Rituximab and biosimilars – equivalence and reciprocity' *Dove Medical Press*, 2013:3 19–25.

[13] Zayrho Desanvicente-Celis, Julian Caro-Moreno, Mateo Enciso-Zuluaga, Juan-Manuel Anaya, 'Similar biotherapeutic products in Latin America. Regulation and opportunities for patients with autoimmune diseases', *Dove Medical Press*, 2013:3 1–17.

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Dynamics of the exploited population of *Istiophorus albicans* (Latreille, 1804, Istiophoridae) by marine artisanal fishing in Côte d'Ivoire (West Africa)

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ABSTRACT: The dynamics of the exploited population *of Istiophorus albicans* (Atlantic sailfish) from artisanal gillnet fishery was investigated based on length frequency data, using FiSAT software. Specimens were sampled from the artisanal fishery captures in the coastal waters near Abidjan (Côte d'Ivoire), from October 2009 to October 2010. Growth parameters of *I. albicans* were estimated using ELEFAN I method. The asymptotic length (L_∞), the growth rate constant (K) and the theoretical age at length zero (t_0) were estimated to be 231.6 cm fork length, 0.48 yr^{-1} and 0.49 yrs, respectively. The estimated growth performance index (Φ') of *I. albicans* was 4.41. Instantaneous of total mortality coefficient estimated by non seasonalized length converted catch curves (Z) was 1.56 yr^{-1}. Natural mortality (M) estimated by Pauly's empirical equation was 0.63 yr^{-1} and the estimated fishing mortality (F) was 0.93 yr^{-1}. The current rate of exploitation *(E)* was given as 0.60, indicating that the sailfish stock is over fished. From the analysis of probability of capture of each length class we estimated the length at first capture L_c (length at 50 % capture) to be 158.23 cm. The relative yield per recruit analysis incorporating probabilities of capture predicted the maximum exploitation rate E_{max}= 1, confirming that *I. albicans* is being overexploited.

KEYWORDS: asymptotic length, sailfish, exploitation rate, length-frequency.

1 INTRODUCTION

A major challenge facing the sustainable management of fish stocks is to ensure that stock assessments are based on accurate information and identify relevant sources of quantitative and qualitative uncertainty [1]. A few studies have investigated the population structures of some billfishes in Côte d'Ivoire. Sailfish, *Istiophorus albicans*, is a pelagic istiophorid species [2] that is fished by the artisanal technical in Côte d'Ivoire since 1988 [3]. This species is widely distributed in the tropical and temperate waters of the world [4]. In the Atlantic Ocean, sailfish occurred throughout in subtropical and tropical waters, and occasionally in Atlantic temperate waters [5]. Geographical limits based on commercial catches is approximately 40°N in the western North Atlantic, 50°N in the eastern North Atlantic, 40°S in the western South Atlantic, and 32°S in the eastern South Atlantic [5]. Sailfish are a member of the billfish family Istiophoridae that also includes marlins and spearfishes, and are highly regarded by recreational fishers for their spectacular gamefish characteristics [6]. Some reports of age and growth of sailfish caught in the Atlantic Ocean are: [7] analyzed size-frequency distribution; references [8], [9] used spines; [10], [11] analyzed otoliths; [6] used spines to estimate age and describe growth of sailfish caught in the Gulf of Arabia. Some investigations of sailfish age and growth in the Pacific Ocean are: [12] estimated sailfish growth through the size frequency of specimens caught by longline vessels in the eastern China Sea from 1952 to 1955. Reference [13], [14], [15] used the fourth spine of the dorsal fin to determine age and describe growth of fish caught in the southern part of the Gulf of California, along the Taiwan coast and Mazatlan coast, Sinaloa (Gulf of California), respectively.

Istiophoridae hold an important place among the fish caught by the artisanal fishery with drift gillnets in Ivorian coastal waters [16]. Despite the fisheries importance of *I. albican*s, its life-history parameters needed for stock assessment and management are unknown in Ivorian Exclusive Economic Zone (EEZ). The capacity of exploited populations to sustain yields

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is a function of their demographic characteristics such as longevity, growth and mortality rates. Quantitative estimation of these parameters, therefore, is paramount to understanding the population dynamics and associated status of exploited species [17]. For the management of fish resources, knowledge of various population parameters and exploitation level (*E*) of that population is required. Growth and mortality model parameter estimates are required for analytical fisheries management. Age determination of fish is needed in order to complete the knowledge about the abundance and fluctuations of any species [18]. Knowledge of these parameters is important in fishery management in determining whether an area is heavily fished or under-exploited to allow possible management measure to be taken [19]. Traditional methods of studying the dynamics of exploited fish stocks were mostly based on age-structured data. However, use of computers and theoretical advantages of analytical methods based on length-frequency data led to their development during the 1980s ([20], [21], [22] and widespread use in recent years (e.g. [23], [24], [25], [26]). Length-frequency data is easier to obtain than age-structured data, and correctly ageing fishes in tropical waters may be difficult due to reduced seasonal growth contrast [27] or problems in interpreting otolith growth increments [28]. Thus, length-frequency methods were used to overcome such difficulties [26].

The objective of the present study was to estimate the population parameters and exploitation level of *I. albicans* to assess the stock position of the species from ivorian coastal waters.

2 MATERIAL AND METHODS

There are many tools for assessing exploitation levels and population dynamics of a stock. Of those, FiSAT II (FAO-ICLARM Fish Stock Assessment Tools) package (http://www.fao.org/fi/statist/fisoft/fisat/index.htm) has been most frequently used for estimating population parameters of fish [29] because it needs only length–frequency data. The advantage of this technique is that within 1 year it is possible to assess any fish stock if sufficient length–frequency data is available [30]. Parameters estimates were based on length-frequency analyses (LFA). Sailfish are caught daily by an artisanal gillnet fishery and landed at the port of Abidjan. This study was carried out from October 2009 to September 2010. For each specimen, the lower jaw fork length (LJFL to the nearest centimetre) was measured. The data were then grouped into fork length classes by 10cm intervals. Subsequently the data were analyzed using the FiSAT software as explained in detail by [31]. Asymptotic length (L_∞) and growth coefficient (*K*) of the von Bertalanffy growth function (VBGF) were estimated by means of ELEFAN (Electronic LEngth Frequency ANalysis) routine using the FAO–ICLARM Package FiSAT II [31], by modal progression analysis using NORMSEP (Normal Separation) method [32]. K-scan routine [24] was conducted to assess a reliable estimate of the *K* value. ELEFAN routine of FiSAT using a non-parametric, was preferred over more sophisticated approaches, because it makes less demand on the underlying data, and especially because it can accommodate any unknown number of cohorts originating of the same year [33]. To find the best growth curve passing through the maximum number of peaks, different starting samples and starting lengths were subjected to the goodness-of-fit tests by assessing the ratio ESP/ASP. The standard version of the VBGF is defined by the equation:

$$L_t = L_\infty\left(1 - e^{-K(t-t_0)}\right)$$

where L_t is the mean length at age *t*, L_∞ the asymptotic length, *K* the growth coefficient, *t* the age of the *I. albicans* and t_0 is the hypothetical age at which the length is zero [34]. According to reference [35], empirical equation for the theoretical age (t_0) at length zero was used to obtain this parameter:

$\log_{10}(-t_0) = -0.392 - \log_{10} L_\infty - 1.038 \log_{10} \mathrm{K}$. This parameter is not calculated by the ELEFAN method.

The estimates of L_∞ and *K* were used to estimate the growth performance index (Φ') [36] of *I. albicans* using the equation:

$$\Phi' = 2\log_{10} L_\infty + \log_{10} K$$

Mortality estimates were obtained as described in reference [37]. The total mortality coefficient, *Z* (year^{-1}) was estimated by a length-converted catch curves (LCC) [31]. This method consists in pooling all the distributions while maintaining their relative importance for a single frequency distribution, which reduces the part of the sampling biases [22]. *Z* is then calculated on the descending part of this single global distribution. As *Z* is determined in a given age or size range, the estimation makes sense only within this range.

Natural mortality rate, *M* (year^{-1}) was estimated using Pauly's equation [22] based on L_∞, *K* and the mean annual environmental temperature of the species concerned, as implemented in the FiSAT II package:

$$\log_{10} \mathrm{M} = -0.0066 - 0.279 \log_{10} L_\infty + 0.6543 \log_{10} \mathrm{K} + 0.4634 \log_{10} \mathrm{T}$$

where *M* is the natural mortality, L_∞, the asymptotic length, *K* refers to the growth coefficient of the VBGF and *T* is the mean annual habitat temperature (◦C) of the water in which the stocks live. Here it is 28 ◦C. Once *Z* and *M* were obtained, then fishing mortality *F* (year^{-1}) was estimated using the relationship:

$F = Z - M$ where *Z* is the total mortality, *F* the fishing mortality and *M* is the natural mortality. The exploitation level (*E*) was obtained by the relationship according to reference [21]: $E = F/Z$. The parameter *E* expresses the proportion of a given cohort/population that ultimately dies due to fishing given existing exploitation pressure [38]. We used the ascending left part of the length-converted catch curve to analyse the probability of capture of each length class i [39]. This entails dividing the numbers actually sampled by the expected numbers (obtained by backward extrapolation of the straight portion of the catch curve) in each length class of the ascending part of the catch curve. The lengths at 50% capture (L_c) were estimated by plotting probabilities of capture against the mid-lengths.

The recruitment patterns of *Istiophorus albicans* were also estimated by analysis of pooled length frequency data. Restructured samples were used [40]. Recruitment pattern was presented in terms of the percentage of recruitment vs. time (months).

Length-based Virtual Population Analysis was performed on the pooled annual length frequencies of *I. albicans* from the system to estimate the mean number in the population and the overall fishing mortality by length group. Virtual population analysis (VPA) is still commonly used for assessing freshwater and marine fisheries resources because of its moderate data requirement and simple algorithm [41].

Our relative yield per recruit (*Y'/R*) and relative biomass per recruit (*B'/R*), reference [38] method as modified by [42] were executed using knife-edge selection procedure. This method assumes that fishes smaller than L_c are not captured by the gear. The predicted values were obtained by substituting the input parameters of L_c/L_∞ ($L_c$is the minimum length captured; obtained from the extrapolation of length converted catch curve) and M/K in the FiSAT II package and according to the model,

$$Y'/R = EU^{M/K}\,[1 - (3U/1 + m) + (3U^2/1 + 2m) - (U^3/1 + 3m)],$$

where $U = 1 - (L_c/L_\infty)$ is the fraction of growth to be completed by the fish after entry into the exploitation phase, $m = (1 - E)/(M/K) = (K/Z)$, and $E = F/Z$ is the exploitation rate, i.e., the fraction of mortality of the fish caused by the fishermen, *F* the instantaneous fishing mortality coefficient and L_c is the length at first capture.

The relative biomass-per-recruit (*B'/R*) was estimated from the relationship:

$$B'/R = (Y'/R)/F.$$

The *M/K* ratio was calculated with the formula according to reference [42]:

$$Ln(M/K) = -0.22 + 0.3\ Ln\ (T)$$

Then we computed E_{max} (the value of exploitation rate *E* giving the maximum relative yield-per-recruit), $E_{0.1}$ (the value of E at which marginal increase in *Y'/R* is 10% of its value at *E*=0), and $E_{0.5}$ (the value of *E* at 50% of the unexploited relative biomass-per-recruit) through the first derivative of the function according to reference [38]. All these methods were provided by the FiSAT II package.

3 RESULTS

3.1 GROWTH PARAMETERS

The growth parameters L_∞ and K were obtained for the best fit with L_∞ = 231.60 cm and *K*= 0.48 year^{-1}. For these estimates through ELEFAN I the response surface (Rn) was 0.235 for the curve from the K-scan technique (fig. 1). The estimated value for the growth performance index (Φ') of *Istiophorus albicans* during the present investigation was 4.41. The estimated values for theoretical age (t_0) at length zero were - 0.491 years. Length-frequency histogram and corresponding VBGF curve are presented in fig. 2. The LJFL varied from 90 to 220 cm for females and from 80 to 200 cm for males. For females, L_∞ = 231 cm, *K*= 1 year^{-1} and score=0.318, Φ'= 4.73, $t_0$was calculated as – 0.35 years. For males, the parameters were: L_∞ = 210 cm, *K*= 0.45 year^{-1} and score=0.346, Φ'= 4.30, t_0 = - 0.51 years. Females had a better growth than males as indicated by the calculated LJFL at age (Table).

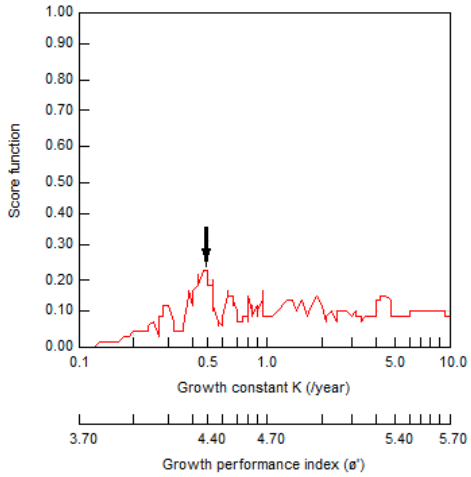


Fig. 1. K-scan routine for determining best growth curvature giving best value of asymptotic length with growth performance indices in Istiophorus albicans

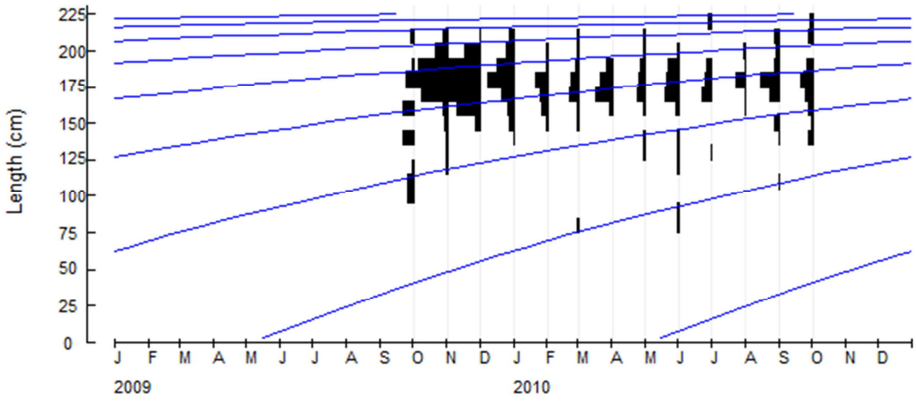


Fig. 2. Lower jaw fork length (LJFL) frequency histograms and the corresponding curves for unsexed individuals combined von Bertalanffy growth function of Istiophorus albicans in the Coastal Zone of Côte d'Ivoire

Table 1. Lower jaw fork length (LJFL) at age for females, males and combined sex calculated from the VBGF

Age (Years)	LJFL at age (cm)		
	Females	Males	Combined sex
1	171.22	103.56	118.33
2	208.97	142.13	161.51
3	222.90	166.72	188.23
4		182.41	204.76
5		192.41	214.99
6		198.78	221.32

3.2 MORTALITY PARAMETERS AND EXPLOITATION

In this study, the temperature used was 28 ◦C, the average water temperature in the 12 months in coastal waters. Using L_∞ and K estimates from ELEFAN 1 (L_∞ = 231.6 cm, K = 0.48 year^{-1}), the calculated values of the instantaneous rates of natural mortality are M = 0.63 year^{-1}.

The instantaneous rates of total mortality obtained by the length converted catch curve (LCC) was Z = 1.56 year^{-1} for 4–6 years of age (fig. 3).

This value come from the growth parameters estimated from ELEFAN routine.

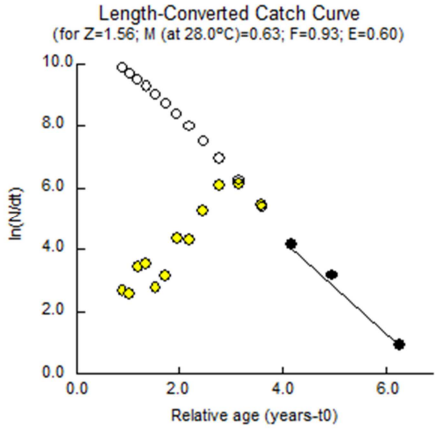


Fig. 3. Lower jaw fork length (LJFL) converted catch curve and mortality estimates for unsexed individuals combined, calculated from the parameters of the von Bertalanffy growth function of Istiophorus albicans at a mean temperature of 28◦C. Z, instantaneous rate of total mortality; M, instantaneous rate of natural mortality; F, instantaneous rate of fishing mortality; E, exploitation rate ($E = F.Z^{-1}$).

Based on our *Z* from the LCC, the fishing mortality (*F*) was 0.93 year^{-1}.

From the estimates of the instantaneous of fishing and total mortalities, an exploitation rate (*E*) of 0.60 was obtained for *I*. *albicans* from artisanal gillnet fishery, which is highest than the optimum level of exploitation (*E*=0.50). According the sex, LCC resulted in higher mortality estimates for females (Z = 1.54 year^{-1}, *M* = 1.01 year^{-1} and *F* = 0.53 year^{-1}) than for males (Z = 0.93 year^{-1}, *M* = 0.61 year^{-1} and *F* = 0.32 year^{-1}).

3.3 PROBABILITIES OF CAPTURE

The size of fish at various probabilities was presented by the fig. 4. The estimated sizes at 25, 50 and 75% probabilities of capture of *I*. *albicans* were respectively 149.35, 158.23 and 167.10 cm.

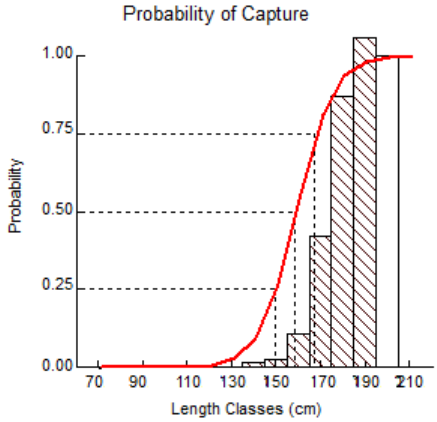


Fig. 4. Figure 4 Logistic selection curve for probability of capture of each length class of Istiophorus albicans in the Exclusive Economic Zone of the Côte d'Ivoire, L_{25}=149.35 cm, L_{50}=158.23 cm (=length at first capture Lc), L_{75}=167.10 cm

3.4 RECRUITMENT PATTERN

The recruitment patterns of *Istiophorus albicans* to the ivorian coastal waters is presented in fig. 5. This graph shows that there is one major and one minor pulsed recruitment peak in a year, both of which overlap in time to give one continuous recruitment pattern. The percentage recruitment values for the different months were: 7.08 % (January), 5.63 % (February), 8.25 % (March), 11.63 % (April), 16.80 % (May), 11.85 % (June), 10.23 % (July), 13.60 % (August), 6.36 % (September), 4.76 %

(October), 3.08 % (November) and 0.0 % (December). The highest recruitment period occurred from March to August with a large peak in May, accounting for 16.80 %.

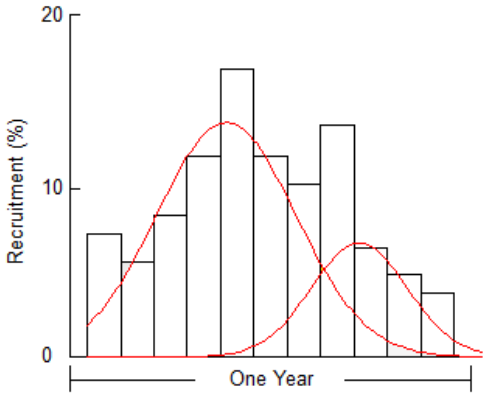


Fig. 5. Recruitment pattern of Istiophorus albicans from the artisanal fishery captures in the coastal waters near Abidjan (Côte d'Ivoire)

3.5 VIRTUAL POPULATION ANALYSIS

Virtual Population Analysis performed of *I. albicans* indicated that the minimum and the maximum fishing mortalities were recorded for the mid-lengths 80 and 190 cm, respectively (fig. 6). At first, fishing mortality was inconsiderable and constant. The peak was obtained with 1.188 year^{-1}.

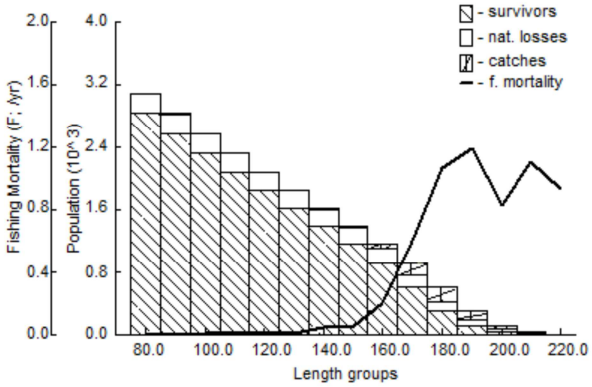


Fig. 6. Length-based Virtual Population Analysis Istiophorus albicans

4 RELATIVE YIELD PER RECRUIT AND RELATIVE BIOMASS PER RECRUIT

The fraction of growth to be completed by the fish after entry into the exploitation phase (*U*) was 0.32. Two dimensional relative yields per recruit prediction models incorporating probabilities of capture are given in fig. 7 and the isopleths diagram are given in fig. 8. The relative yield per recruit (*Y'/R*) increases up to maximum and then stabilizes. The knife edge selection procedure for the analysis of relative yield per recruit (*Y'/R*) gave a predicted value of 1.00 (E_{max}). The computed current exploitation rate (*E*) of 0.60 is slightly lower the predicted $E_{max}$of 1.00. The exploitation rate at which marginal increase occurred in the relative yield per recruit was 10% of its value at *E*=0, whereas ($E_{0.1}$) was 1.00. The exploitation rate ($E_{0.5}$), which, corresponds to 50% of the virgin (i.e., the unexploited stock) relative biomass per recruit was 0.42. The mean ratio of length at first capture (L_c) and asymptotic length (L_∞) was 0.68, while that of natural mortal (*M*) and growth rate (*K*) was 2.18.

According to the isopleths diagram (fig. 8), the optimum values of L_c/L_∞ to obtain optimum exploitation rate was between 0.50 and 0.70. It is a simulation of the response of yield per recruit of *I. albicans* in the sea to changes in length at first capture L_c and exploitation rate *E* over a wide range of values.

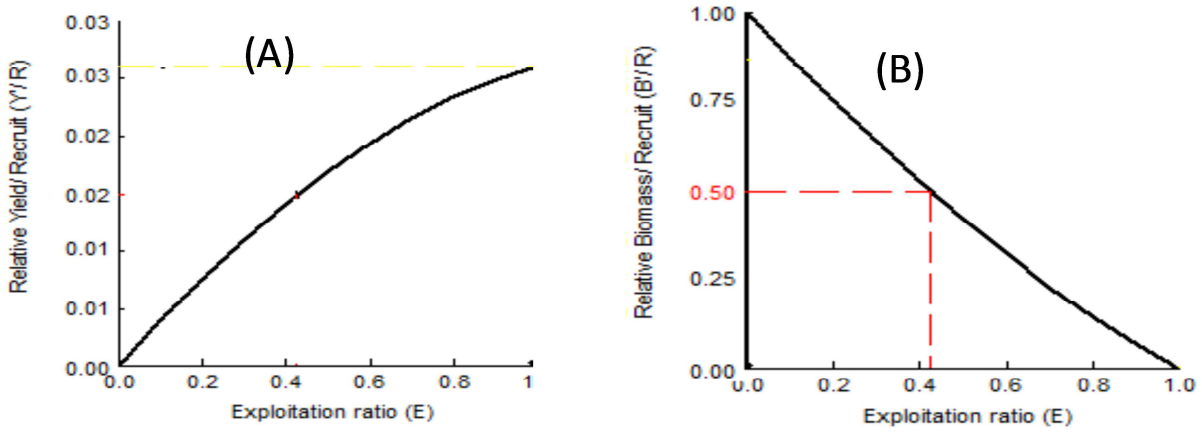


Fig. 7. (A) Relative yield per recruit and (B) relative biomass per recruit for Istiophorus albicans as computed using knife edge recruitment method. Input parameters: L_c/L_∞=0.683, M/K=2.18. Output parameters: E_{max}=1.00, $E_{0.1}$=1.00, $E_{0.5}$=0.42

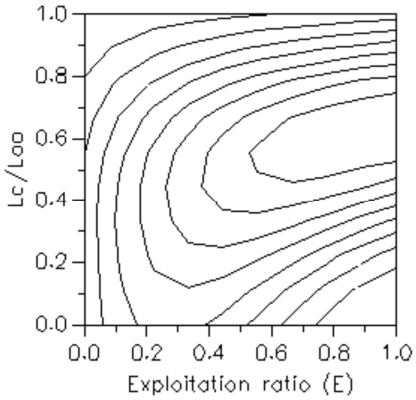


Fig. 8. Yield isopleths for Istiophorus albicans. The yield contours predict the response of relative yield-per-recruit of the fish to changes in L_c (length at first capture) and E (exploitation rate). L_c/L_∞ values represent varying scenarios equivalent to a change in mesh size and E corresponds to changing levels of F/Z. The dotted line is the actual computed value of the critical ratio L_c/L_∞ =0.68

5 DISCUSSION

In tropical and sub-tropical waters, despite the difficulty in determining age of fish, unfortunately the dynamic pool models have been under-utilized for defining management strategies in fisheries. However, with the development of the length-based stock assessment methodologies, it is possible to investigate population dynamics of fish stocks in tropical waters [24].

The asymptotic length L_∞ calculated by the ELEFAN routine was 231.6 cm. The ranges of L_∞ with a wide range of K parameters were analysed to determine the optimum pairs of growth constants with best fit (maximum Rn, score). Usually, the Rn value range between 0 and 1 in the ELEFAN-FiSAT package. The oscillation parameter (C) and winter point (WP) were assumed to be 0 as it is a tropical species. L_∞ is the largest theoretical mean length that a species could attain (granted it grows throughout life) in its habitat given the ecological peculiarities of that environment, and K is the speed it grows towards this final size. Fin spine ageing is the most common technique used to estimate age and growth parameters of large pelagic billfishes from the families Istiophoridae and Xiphiidae [43], [15]. Although, our tool for the calculation of growth parameters is based on the analysis of length-frequency data (FiSAT II), ours computed values of *K* = 1.0 year^{-}1 for females, 0.45 year^{-1} for males and 0.48 year^{-1} for combined sex for *I. albicans* in the ivorian EEZ were greatly higher than the K values recorded in the literature (0.145 year^{-1} for females and 0.115 year^{-1} for males, [14]; 0.29 year^{-1} for females and 0.42 year^{-1} for males, [6]; 0.18 year^{-1} for females and 0.16 year^{-1} for males, [15]). This difference could be due to spatial differences in growth, the range of ages and sizes used in the analysis, or the form of the growth model applied [14]. Comparisons of

growth rates of populations and species are important in fisheries science and ecology for a range of management and academic reasons [23]. However, there is no straight forward way to undertake such comparisons. One stock can grow faster than the other when young and slower than the other when older. Thus, growth comparison is a multivariate problem that must take into consideration both the growth rate (K) and the asymptotic size (L_∞). The index of growth performance (Φ') is a useful tool for comparing the growth curves of different populations of the same species and/or of different species belonging to the same order [44]. The growth performance index (Φ') calculated in this study was equal to 4.41 for combined sex, 4.73 for females and 4.30 for males. Despite the diverse source of data (length frequency data and spines) and the different computational methods used for obtaining $L_\infty$and K, the overall growth performance indices are very similar to each other ([14], Φ'=3.99 for the females and 3.86 for the males; [6], Φ'=4.02 and 4.03 respectively for the females and for the males; [15], Φ'=4.05 for the females and 4.02 for the males). All fish of a given length, including the law of growth in length is known, can be assigned a theoretical age t and therefore a date of birth. The month in which births were the most abundant is May. Length converted catch curve for Istiophorus albicans from Ivorian Exclusive Economic Zone (EEZ) suggested short life expectancy (6 years). Reference [7] estimated age and growth of western Atlantic sailfish and suggested rapid growth and short (4 year) life expectancy. Also, [7], [12] used length frequency analysis and concluded that sailfish are a very fast growing and short-lived species. Reference [8] reported age classes (without validation) up to 8 years by enumerating incremental circuli (bands) in dorsal fin spines, but indicated that enlargement of the spine's vascular spongy core eroded the early growth bands in older individuals. For the same area, [9] indicated differences in size, mostly when fish were 2 years old; females grew faster than males and had greater variation in size and weight. [13] reported no difference in growth between sexes in the southern Gulf of California. Along the coast of Taiwan, [14] mentioned size differences between genders, females (80–232 cm LJFL) being significantly larger than males (78–221 cm LJFL). In the Arabian Gulf, [6] specifies that females were larger (129–199 cm LJFL) than males (125–177 cm LJFL). [15] observed differences in the growth between sexes and in observed lengths. Female sailfish showed a faster growth rate than males. In the present study, females were larger (90–220 cm LJFL) than males (80–200 cm LJFL). The length-at-age estimates presented in Table confirmed that females had a better growth than males.

Seasonal growth does not appear to be an adequate description of growth of I. albicans stocks, in spite of the presence of a seasonal upwelling phenomenon in the area [23]). The instantaneous natural mortality coefficient M, apart from indicating the fraction of death caused by all possible causes except fishing, is a necessary input in the computation of many models in fish population dynamics study. However, direct and reliable estimate of M in an exploited population is difficult to obtain. Among fish, natural mortality is found to be correlated with reproductive success [45]. Generally M/K is used as an index for checking the validity of M and K values estimated by different methods and it is known to range from 1.5 to 2.5 [38]. The M/K ratio obtained in the present study (2.18) was well known within this range. The higher fishing mortality (0.93 year^{-1}) versus natural mortality (0.63 year^{-1}) observed for I. albicans indicates that the fisheries are developed. The model of [22] for M estimation was derived from data obtained from 175 different fish stocks distributed in 84 species, both freshwater and marine, and ranging from polar to tropical waters. Ipso facto, the model should yield reliable results. As a rule of thumb, if Z/K ratio < 1, then the population is growth-dominated; if it is > 1 then it is mortality-dominated; if it is 1 then mortality balances growth in such population according to reference [46]. Thus in this investigation, the Z/K value of 3.25 that implies this population is highly mortality-dominated. Also, this result suggested a high level of exploitation.

The recruitment pattern established in this study revealed an all year round recruitment with two peaks (one major and the other secondary).

Virtual population analysis (VPA) has been widely applied to estimate the abundance of commercial fish stocks since its development [47]. This method is an estimation technique that reconstructs the historical abundance of a fish stock by accounting for the catch and natural deaths accruing each year to the cohorts comprising the stock. The peak of fishing mortality (1.2 / year) observed (fig. 6) indicates fishing pressure on individuals lengths 160 cm and 200 cm.

The maximum exploitation rate (E_{max}), which gives maximum relative yield per recruit, is estimated at 1 and greatly differs from the exploitation rate (0.60) estimated in this study. This further suggests that the stock of *I. albicans* is probably being over fished both in terms of yield per recruit and biomass per recruit as implemented by [48]. This is based on the assumption that in an optimally exploited stock, natural and fishing mortalities should be equal or E = 0.5 [48]. This implies that the fisheries are developed and the fishing is eumetric with large fish being caught at high effort level. However, the ratio L_c/L_∞ according to reference [49], 0.68 > 0.5 indicates that captures dominated by tall length fishes.

In the relative yield per recruit and biomass per recruit prediction models the descending curves showed decrease in biomass / recruit (*B'/R*) as exploitation ratio increased. The other curve showed increase in yield / recruit (*Y'/R*) with increase in exploitation ratio (*E*) up to E_{max}. $E_{0.5}$ is the value of *E* associated with a 50 % reduction of the biomass (per recruit) in the unexploited stock. The present current estimated exploitation rate (*E*) of 0.60 is slightly lower than the predicted maximum

value of 1.00, computed yield per recruit (knife edge selection procedure) analysis. The implication is that the stock is overexploited. A stock assessment provides decision makers with much of the information necessary to make reasoned choices. A fishery stock assessment describes the past and current status of a fish stock.

6 CONCLUSION

This study aims at to estimate the growth parameters and to highlight the effect of fishing on the stock of Atlantic sailfish EEZ Ivorian using the FiSAT software. Females had a better growth than males. Recruitment is continuous throughout the year and is marked by a large peak in May. A large predominance of mortality on growth in the species and fishing mortality on natural mortality exists. The fisheries are developed and fishing is eumetric with large fish being caught at high effort level. The sailfish stock is overfished.

Management recommendations: This study recommends that the current exploitation rate be reduced. It is so necessary to reduce fishing mortality. Also, it is important to create policies for Atlantic sailfish.

REFERENCES

[1] R. J. Marriott, D. J. Adams, N. D. C. Jarvis, M. J. Moran, S. J. Newman and M. Craine, "Age-based demographic assessment of fished stocks of *Lethrinus nebulosus* in the Gascoyne Bioregion of Western Australia," *Fisheries Management and Ecology*, vol. 18, pp. 89–103, 2011.

[2] Schneider W., *FAO species identification sheets for fishery purposes. Fields guide to the commercial marine resources of the Gulf of Guinea*. FAO Regional Office for Africa, Rome, 1992.

[3] K. N'Da and G. R. Dédo, *Exploitation du voilier Istiophorus albicans (Istiophoridae, Latreille, 1804) par la pêcherie artisanale maritime en Côte d'Ivoire*, SCRS, 2008.

[4] Beardsley, Jr. G. L., Merrett, N. R., and Richards, W. J., *Synopsis of the biology of the sailfish Istiophorus platypterus* (Shaw and Nodder, 1791), In: R. S. Shomura, and F. Williams (Eds.), Proceedings of the International Billfish Symposium, Part 3. Species Synopses, Kaliua-Kona, Hawaii, NOAA Technical Report, pp. 95–120, 1975.

[5] Nakamura I., *FAO Species Catalogue, Billfishes of the World.* FAO Fisheries Synopsis, vol. 5, no. 125, 1985.

[6] J. P. Hoolihan, "Age and growth of Indo-Pacific sailfish, *Istiophorus platypterus*, from the Arabian Gulf," *Fisheries Research*, vol. 78, pp. 218–226, 2006.

[7] D. P. de Sylva, "Studies on the age and growth of the Atlantic sailfish, *Istiophorus americanus* (Cuvier), using length–frequency curves," *Bulletin of Marine Science of the Gulf and Caribbean*, vol. 7, pp. 1–20, 1957.

[8] J. W. Jr. Jolley, "The Biology and Fishery of Atlantic Sailfish *Istiophorus platypterus*, from Southeast Florida," *Florida Marine Research Publications*, vol. 28, pp. 1–31, 1977.

[9] Hedgepeth, M. and Jolley, J. W. Jr., *Age and growth of sailfish Istiophorus platypterus, using cross sections from the fourth dorsal fin spine*, In: E. D. Prince, and L. M. Pulos (Eds.), Proceedings of the international workshop on age determination of oceanic pelagic fishes: Tunas, billfishes and sharks, NOAA Technical Report, pp. 131–136, 1983.

[10] R. L. Radtke and J. M. Dean, "Morphological features of the otoliths of the sailfish, *Istiophorus platypterus*, useful in age determination," *Fishery Bulletin*, vol. 79, 360–367, 1981.

[11] E. D. Prince, D. W. Lee, C. A. Wilson and J.M. Dean, "Longevity and age validation of a tag-recaptured Atlantic sailfish, *Istiophorus platypterus*, using dorsal spines and otoliths," *Fishery Bulletin*, vol. 84, pp. 493-502, 1986.

[12] T. Koto and K. Kodama, "Some considerations on the growth of marlins, using size-frequencies in commercial catches. I. Attempts to estimate the growth of sailfish,"*Fisheries Research Laboratory*, vol. 15, pp. 97-108, 1962.

[13] R. M. Alvarado-Castillo and R. Felix-Uraga, "Growth of *Istiophorus platypterus* (Pisces: Istiophoridae) from the mouth of the Gulf of California," *Revista de Biología Tropical*, vol. 46, pp. 115–118, 1998.

[14] W. C. Chiang, C. L. Sun and S. Z. Yeh, "Age and growth of sailfish (*Istiophorus platypterus*) in waters off eastern Taiwan," *Fishery Bulletin*, vol. 102, no. 2, pp. 251–263, 2004.

[15] J. S. Ramírez-Pérez, C. Quiñonez-Velázquez, L. A. Abitia-Cardenas and F. N. Melo-Barrera, "Age and growth of sailfish *Istiophorus platypterus* (Shaw in Shaw and Nodder, 1792) from Mazatlan, Sinaloa, Mexico," *Environmental Biology of Fishes*, vol. 92, no. 2, pp. 187–196, 2011.

[16] Y. N. N'Goran and J. B. Amon Kothias, *Captures des Istiophoridés par la pêcherie artisanale ivoirienne et effort de pêche de 1988 à 2004*. SCRS, 2006.

[17] E. Grandcourt, T. Z. Al Abdessalaam, F. Francis and A. Al Shamsi, "Age-based life history parameters and status assessments of by-catch species (*Lethrinus borbonicus*, *Lethrinus microdon*, *Pomacanthus maculosus* and *Scolopsis taeniatus*) in the southern Arabian Gulf," *Journal of Applied Ichthyology*, vol. 26, pp. 381–389, 2010.

[18] A. El-Haweet, M. Hegazy, H. Abuhatab and E. Sabry, "Validation of length frequency analysis for *Boops boops* (Bogue) growth estimation," *Egyptian Journal of Aquatic Research*, vol. 31, no. 1, pp. 399–408, 2005.
[19] N. Niamaimandi, A. B. Arshad, S. K. Daud, R. C. Saed and B. Kiabi, "Population dynamic of green tiger prawn, *Penaeus semisulcatus* (De Haan) in Bushehr coastal waters, Persian Gulf," *Fisheries Research*, vol. 86, pp. 105–112, 2007.
[20] R. Jones, *Assessing the effects of changes in exploitation pattern using length composition data (with notes on VPA and cohort analysis)*. FAO Fisheries Technical Paper, 1984.
[21] Gulland J. A., *Length-based methods in fisheries research: from theory to application*, In: D. Pauly, and G. R. Morgan (Eds.), Length-based methods in fisheries research, ICLARM Conference Proceedings, Manila, Philippines, pp. 335–342, 1987.
[22] Pauly D. and Morgan G. R., *Length-based methods in fisheries research*, ICLARM Conference Proceedings, Manila, Philippines, 1987.
[23] C. B. García and L. O. Duarte, "Length-based estimates of growth parameters and mortality rates of fish populations of the Caribbean Sea," *Journal of Applied Ichthyology*, vol. 22, pp. 193–200, 2006.
[24] S. Dadzie, F. S. Abou-Seedo and J. Moreau, "Population dynamics of *Parastromateus niger* in Kuwaiti waters as assessed using length–frequency analysis," *Jounal of Applied Ichthyology*, vol. 23, pp. 592–597, 2007.
[25] A. García Vásquez, J. C. Alonso, F. Carvajal, J. Moreau, J. Nuñez, J. F. Renno, S. Tello, V. Montreuil and F. Duponchelle, "Life-history characteristics of the large Amazonian migratory catfish *Brachyplatystoma rousseauxii* in the Iquitos region, Peru," *Journal of Fish Biology*, vol. 75, pp. 2527–2551, 2009.
[26] Y. J. Lin and W. N. Tzeng, "Vital population statistics based on length frequency analysis of the exploited Japanese eel (*Anguilla japonica*) stock in the Kao-Ping River, southern Taiwan," *Journal of Applied Ichthyology*, vol. 26, pp. 424–431, 2010.
[27] S. E. Campana, "Accuracy, precision and quality control in age determination, including a review of the use and abuse of age validation methods," *Journal of Fish Biology*, vol. 59, pp. 197–242, 2001.
[28] B. Morales-Nin and J. Panfili, "Seasonality in the deep sea and tropics revisited: what can otoliths tell us?" *Marine and Freshwater Research*, vol. 56, pp. 585-598, 2005.
[29] S. M. N. Amin, M. A. Rahman, G. C. Haldar, M. A. Mazid and D. Milton, "Population dynamics and stock assessment of *Hilsa shad*, *Tenualosa ilisha* in Bangladesh," *Asian Fisheries Science*, vol. 15, pp. 123–128, 2002.
[30] S. M. Al-Barwani, A. Arshad, S. M. Nurul Amin, S. B. Japar, S. S. Siraj and C. K. Yap, "Population dynamics of the green mussel *Perna viridis* from the high spat-fall coastal water of Malacca, Peninsular Malaysia," *Fisheries Research*, vol. 84, no. 2, pp. 147–152, 2007.
[31] F. C. J. Gayanilo, P. Sparre and D. Pauly, *FAO-ICLARM Stock Assessment Tool II (FiSAT II), User's Guide, revised version*, Rome, 2005.
[32] V. Hasselblad, "Estimation of parameters for a mixture of normal distributions," *Technometrics*, vol. 8, pp. 431–444, 1966.
[33] M. L. D. Palomares and D. Pauly, "The growth of jellyfishes," *Hydrobiologia*, vol. 616, pp. 11–21, 2009.
[34] S. J. Newman, "Growth, age estimation and preliminary estimates of longevity and mortality in the moses perch, *Lutjanus russelli* (Indian ocean form), from continental shelf waters off north-western Australia," *Asian Fisheries Science*, vol. 15, pp. 283–294, 2002.
[35] D. Pauly, *Theory and management of tropical multispecies stocks*. ICLARM Studies and Reviews, 1979.
[36] D. Pauly, "Tropical fishes: patterns and propensities," *Journal of Fish Biology*, vol. 53(Suppl A), pp. 1–17, 1998.
[37] J. Moreau and B. Nyakageni, "*Luciolates stapperssi* in Lake Tanganyika. Demographical status and possible recent variations assessed by length frequency distributions," *Hydobiologia*, 232, 57–64, 1992.
[38] R. J. H. Beverton and S. J. Holt, *Manual of methods for fish stock assessment*, Part 2, Tables of yield functions, FAO Fisheries Technical Paper, vol. 38, 1966.
[39] P. Sparre, *Computer programs for fish stock assessment: Length-based Fish Stock Assessment (LFSA) for Apple II Computers*. FAO Fisheries Technical Paper, vol. 101(Suppl 2), 1987.
[40] J. Moreau and F. X. Cuende, "On improving of resolution of the recruitment pattern of fishes," *ICLARM Fishbyte*, vol. 9, pp. 45–46, 1991.
[41] Y. Chen, Y. Jiao, C. L. Sun and X. Chen, "Calibrating virtual population analysis for fisheries stock assessment," *Aquatic Living Resources*, vol. 21, pp. 89–97, 2008.
[42] Pauly, D.and Soriano, M. L., *Some practical extension to the Beverton and Holt's relative yield per recruit model*, In: J. L. Maclean, L. B. Dizon, and L. V. Hosillo (Eds.), The First Asian Fisheries Forum, Asian Fisheries Society, Manila, Philippines, pp. 491–496, 1986.
[43] R. K. Kopf, K. Drew and R. L. Jr. Humphreys, "Age estimation of billfishes (*Kajikia* spp.) using fin spine cross-sections: the need for an international code of practice," *Aquatic Living Resources*, vol. 23, pp. 13-23, 2010.

[44] P. Sparre, E. Ursin and S. C. Venema, *Introduction to tropical fish stock assessment*. Part 1. FAO Fisheries Technical Paper, vol. 306, pp. 1–376, 1987.

[45] D. R. Gunderson, "Trade off between reproductive effort and adult survival in oviparous and viviparous fishes," *Canadian Journal of Fisheries and Aquatic Sciences*, vol. 54, pp. 990–995, 1997.

[46] J. P. Barry and M.J. Tegner, "Inferring demographic processes from size-frequency distributions: simple models indicate specific patterns of growth and mortality," *Fishery Bulletin*, vol. 88, pp. 13–19, 1990.

[47] H. Yamaguchi and T. Matsuishi, "Effects of sampling errors on abundance estimates from virtual population analysis for walleye Pollock in northern waters of Sea of Japan," *Fisheries Science*, vol. 73, pp. 1061–1069, 2007.

[48] Gulland, J. A., *The fish resources of the oceans*. Fishing New Books, London, 1971.

[49] Pauly, D., and Moreau J., *Méthodes pour l'évaluation des ressources halieutiques*. Collection de l'INP de Toulouse. Cépaduès-éditions. Toulouse, France, 1997.

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Effect of lag-phase in the transition from oxic to anoxic conditions on the performance of the sequencing batch reactor

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ABSTRACT: Sequencing batch reactors (SBRs) are usually preferred as small and decentralized wastewater treatment systems. Using a frequent enough switching between oxic and anoxic conditions, it is possible to bypass the second step of nitrification (i.e. conversion of nitrite to nitrate nitrogen) in SBR. The effect of oxic/anoxic ratio (R) on nutrient removal from municipal wastewater was examined in 5 m^3 pilot-scale SBR operated at ambient temperature. During the react phase, the reactor was intermittently aerated specific aeration intervals. DO, pH and oxidation–reduction potential (ORP) in the reactors were real-time monitored. It was found that partial nitrification followed by denitrification successfully occurred in the intermittently aerated SBR system with R =3/6 (30 min oxic/60 min anoxic). Results showed aeration ratios, above R > (1/6), do not have a significant effect on COD and TSS removal efficiency.

KEYWORDS: Sequencing Batch Reactor, Oxic/Anoxic, Nutrient Removal.

1 INTRODUCTION

Intermittently aerated reactors have been successfully used for nitrogen removal from wastewater by achieving partial nitrification denitrification (PND) technology for combined carbon and nitrogen removal ().Intermittently aerated reactors can potentially be optimized if used to perform partial nitrification followed by denitrification via nitrite, resulting in reduced oxygen demand for ammonia removal and reduced organic substrate for denitrification. We hypothesized that aeration cycles with sufficiently short aerated periods or sufficiently long nonaerated periods can provide appropriate conditions for partial nitrification and denitrification via nitrite. This process is based on the facts that, since nitrite and nitrate are intermediary compounds in nitrification and denitrification, a partial nitrification to nitrite and denitrification from accumulated nitrite, instead from nitrate, would be feasible to remove high concentrations of nitrogen compounds in the wastewaters [1-4]. In contrast to the traditional biological nitrogen removal (BNR) process, PND has the following advantages [5-6]: Lower oxygen consumption by 25% in the aerobic phase implies 60% energy saving in the entire process, the requirement for electron donors is as much as 40% lower in the anoxic phase, NO_2denitrification rate is 1.5 to 2 times higher than NO_3denitrification rate and reduction of the generated sludge by up to 75%. The inhibition of nitrite-oxidizing bacteria (NOB) is critical for PND because NOB oxidizes NO_2^- to NO_3^- and converts partial nitrification to complete nitrification [7]. Several parameters, including DO concentration [8], temperature, pH [9], SRT [10], substrate concentration, ratio of carbon to nitrogen (C/N) [11], aeration pattern, and chemical inhibitor,...etc. have been found to selectively inhibit NOB. Intermittent aeration favors partial nitrification [12]. a SBR system was operating with a “react” phase divided into three sets of consecutive aerobic and anoxic periods with a duration ratio of 1:3, the nitrogen removal was achieved via nitrite. This was attributed to the suppression of the nitrite-oxidizers activity due to the short aerobic phase duration [13]. PND was successfully completed using the aeration control strategy, even though the temperature decreased from 32 °C to 21°C [14]. Reference [15] showed that the aeration per cycle, taking advantage of the lag-time of nitrite-oxidizers behind ammonia-

oxidizers was important parameters for effective PND in the proposed SBR. The removal efficiency of N and P was improved when anoxic reaction time as long as possible when allocating anoxic/aerobic reaction time within a cycle, and also the first and last reactions of cycle in SBR should be anoxic and aerobic, respectively. Each anoxic or aerobic time in a cycle should be over 30 minutes for high removal of nitrogen and phosphorus, but the repetition frequencies of alternate anoxic/aerobic state may be insignificant in removal efficiency [16]. Reference [17] studied the operation of SBR under three different variations of aerobic-anoxic sequence, viz. 4:4, 5:3 and 3:5 hours. It has been observed that 85 to 92% of soluble COD removal would be possible at the end of 8.0 hour of overall reaction period, irrespective of the length of the aerobic react period. In the case of 4:4 hour operating cycle, reasonable degree of nitrification (88-100%) and denitrification (73-75%), along with 91-94% of organic carbon removal have been achieved, which has been considered to be the optimum performance of the reactor. In this study, different lag phases were adopted to treat a real wastewater in order to reduce the final COD and nitrogen concentration. The ratio of aerobic/anoxic for each cycle was different.

2 MATERIALS AND METHODS

2.1 THE SEQUENCING BATCH REACTOR

The experiment set-up was located in the laboratory of water and wastewater laboratory (Elminia, Egypt). The pilot-scale SBR (Figure 1) was composed cylindrical plastic tank with holding capacity of $5m^3$ made of high density polyethylene, electrical control panel for distributing power supply and controlling the operation of pumps and the implementation of SBR phases for the treatment of influent sewage. Two electric pumps for the suction of raw sewage equipped with a highly reliable grinder system, two centrifugal pumps for the recirculation of mixed liquor and aeration through the use of a venturi aspiration device, two centrifugal pumps for the decanting of treated effluent from the SBR reactor to the chlorination tank and two similar pumps for the disposal of chlorinated effluent to the final receptor. The SBR was operated in a fill and draw mode following a predefined and repeated cycle.

During all reaction phases, a mixing device (centrifugal pump) kept the reactor contents under homogenous conditions at all times and achieves aerobic conditions. Treated wastewater was discharged from the reactor until a predefined minimum reactor water level was reached. The reactor was equipped with a floating-probes system for on-line monitoring of pH (mod.1200-S sc LANGE), ORP (1200-S sc LANGE), temperature (PT-100), DO (LDO sc LANGE) , Sc 1000 probe module for connecting up to4 sc sensors and SC 1000 display module with GSM for remote data interrogation and remote operation.



Figure 1: photo of the SBR pilot plant.

The SBR was operated by means of an in-house developed data acquisition and control software program developed by Laboratory of Biochemical Engineering and Environmental Technology, Patras University, Greece (LBEET). The software was able to repeat over time a previously defined cycle operation by controlling the switching on/off of aeration, the centrifugal pumps, the mixing device, and the air supply. The monitoring module was able to acquire on-line sensors presenting them in a graphical interface.

2.2 ANALYTICAL METHODS

A wide range of techniques was employed to address the research objectives defined in this study. It includes reactor process studies, chemical oxygen demand (COD), Ammonium ($N\text{-}NH_4$), Nitrite (NO_2), Nitrate (NO_3), Phosphate (PO_4), total suspended solids (TSS), volatile suspended solids (VSS), The combination of these multi-disciplinary techniques has helped

deliver significant outcomes. mixed liquor suspended solids (MLSS) and mixed liquor volatile suspended solids (MLVSS) were analyzed according to the analytical methods 2540D and 2450E of Standard Methods (APHA 1998). Total and soluble chemical oxygen demand was analyzed by adapting the analytical method ISO 6060-1989, DIN 38409-H41-H44. Ammonium ($N\text{-}NH_4$) was analyzed by adapting the analytical method 4500-NH_3.B-C of Standard. For ammonium determination, the sample was distilled. The ammonia in the distillate has been determined by Ion Chromatography (ICS 1100). Phosphate was analyzed by adapting method 4110B of Standard Methods APHA (1998) described in nitrates and nitrites determination (3.3.9II).

2.3 CHEMICALS

The chemicals used in IC measurement were supplied by fisher scientific UK limited, reagent (LCK 514) used for analysis of COD were supplied by HACH Lange GMBH, Germany.

3 RESULTS AND DISCUSSION

In order to study the effect of lag-phase in the transition from oxic to anoxic conditions on organic materials removal in SBR, 24 hours cycles with different oxic/anoxic periods were studied. Definitions of the cycles studied in this study are shown in Table (1).

TABLE 1. OPERATION CONDITIONS FOR THE CYCLES THAT WERE STUDIED

Cycle No.	Cycle 1	Cycle 2	Cycle 3	Cycle 4	Cycle 5
Oxic period (min)	0	10	20	30	60
Anoxic period (min)	60	60	60	60	60
Total COD (mg/l)	471	841	1263	1418	1168
Ammonia (mg/l)	11.9	17.4	29	6.4	17.5
Nitrite (mg/l)	0.11	3.7	0.01	0.01	0.01
TSS(mg/l)	1200	2120	2110	1418	2350
pH	7.5	7.29	7.78	7.68	7.82
Temp. (°C)	24	30.8	29.5	29.4	31.9

The DO value began to increase in all sets with the beginning of aeration (aerobic phase) in the reactor. It was observed that the DO value reached 2.0 to 2.5 mg/L. At the start of anoxic react period most of the cases, DO was found to be less than 1 mg/L and at the end of anoxic react period the value becomes less than 0.5 mg/L. The results (Fig. 2) show that 80 and 53 % of COD and TSS was removed at the end of the cycle 1 on the other hand, the concentration of ammonium in the end of the cycle was slightly increased, as shown in Fig. 3, this may be attributed to prolonged anoxic time periods. During the low dissolved oxygen (average DO level of less than 1.0 mg/L), incomplete nitrification will occur, which will lead to a build-up of ammonium within the SBR due to the insufficient aeration time to convert the ammonia to nitrate.

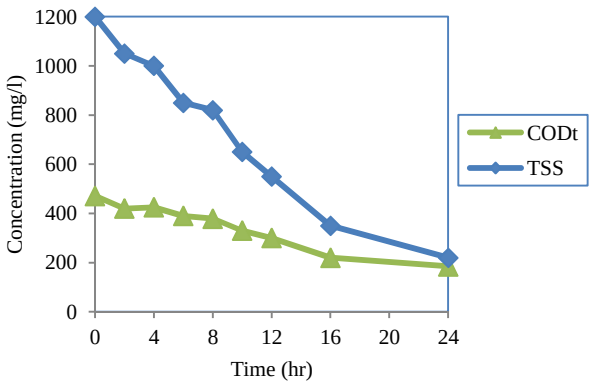


Fig. 2. Profile of COD_t and TSS during cycle (1).

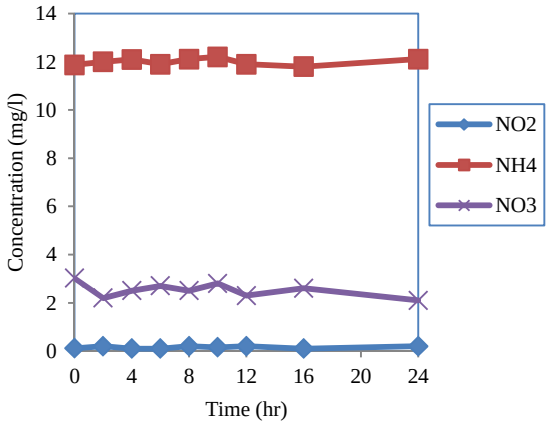


Fig. 3. Profile of ammonium, nitrite and nitrate during cycle (1).

During cycle 2 the biological nitrogen removal was achieved via nitrites (by-passing nitrates). Ammonium nitrogen was removed at the end of the cycle (93.8 %), the concentration of nitrates and nitrites in the end of the cycle was 3.5 and 0.0 (Fig. 4). The results in Fig. (5) show that 82 and 92 % removal efficiency of COD and TSS respectively was obtained.

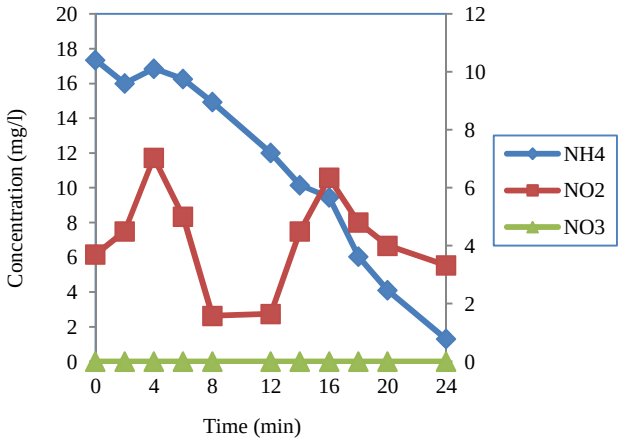


Fig. 4. Profile of ammonium, nitrite and nitrate during cycle (2)

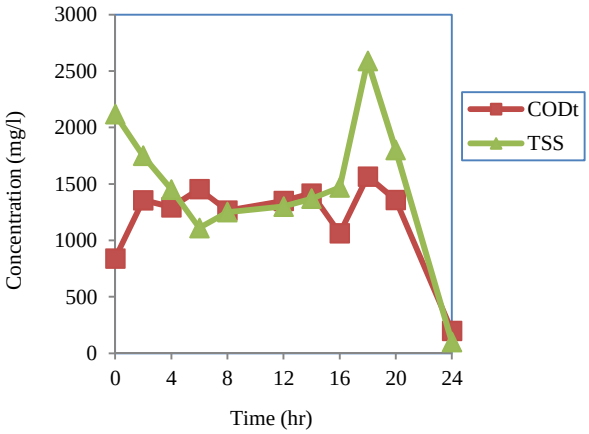


Fig. 5. Profile of COD_t and TSS during cycle (2).

In cycle 3, as shown in Fig. (6), ammonium was removed by 41 %, indicating low removal efficiency, and this ratio was not enough for nitrification/denitrification. Removal efficiency of COD and TSS was 86 and 98% respectively (Fig. 7).

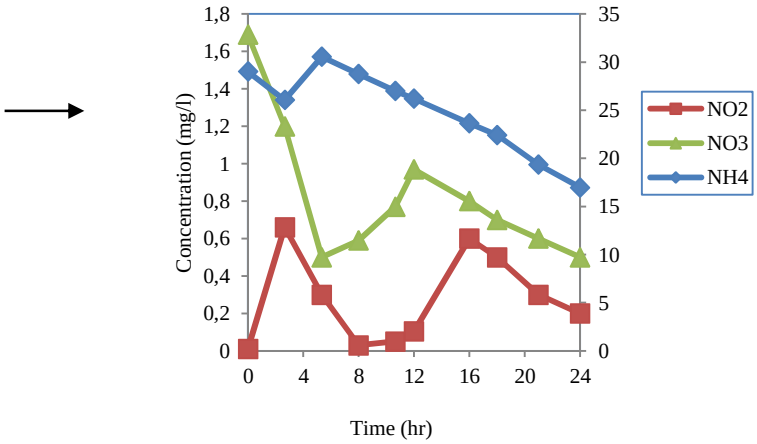


Fig. 6. Profile of ammonium, nitrite, nitrate and phosphate during cycle (3).

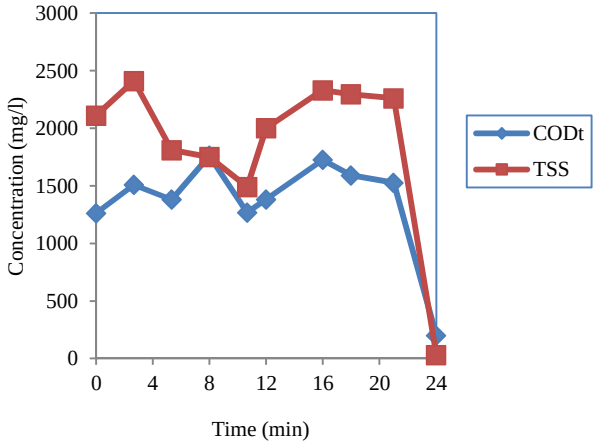


Fig. 7. Profile of COD_t and TSS during cycle (3).

In case of cycle (4) period of 30 min aerobic and 60 min anoxic, it has been observed that at the end of 24 hour cycle period, ammonia oxidation was found to be 100% ; the concentration of nitrates and nitrites in the end of the cycle was 0.94 and 1.7 mg/l, refer to successful PND process. Removal efficiency of COD and TSS in this cycle was 90 and 98% respectively (Fig. 9).

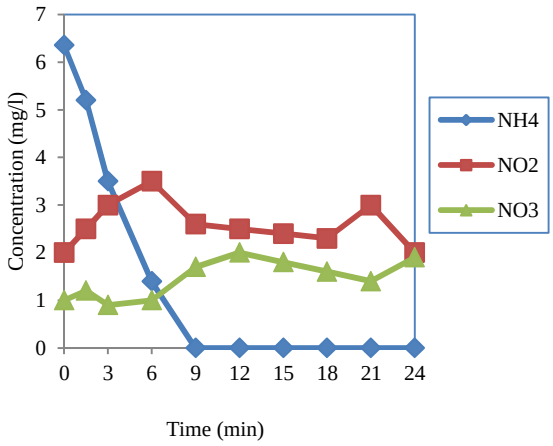


Fig. 8. Profile of ammonium, nitrite, nitrate and phosphate during cycle (4).

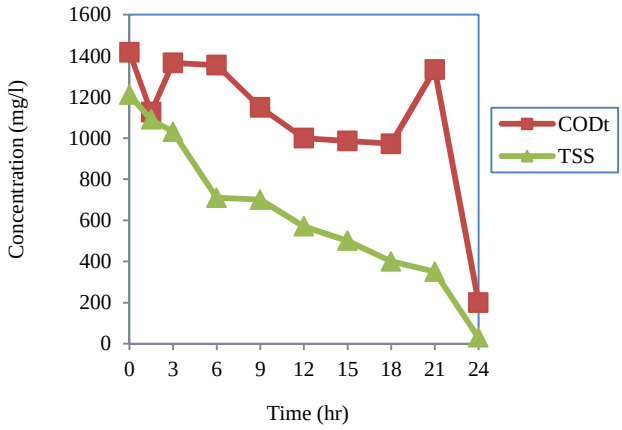


Fig. 9. Profile of COD_t and TSS during cycle (4).

Ammonium nitrogen was 12.75 mg/l at the end of the cycle 5 with removal efficiency 27 % (Fig. 10), while the concentration of nitrates and nitrites in the end of the cycle was 1 and 3 mg/l, indicating low degree of PND. The results in Fig. (11) show that 84 and 98 % removal efficiency of COD and TSS respectively was obtained.

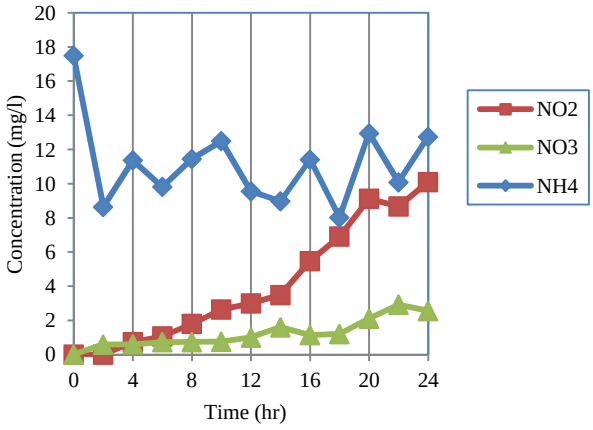


Fig. 10. Profile of ammonium, nitrite, nitrate and phosphate during cycle (5).

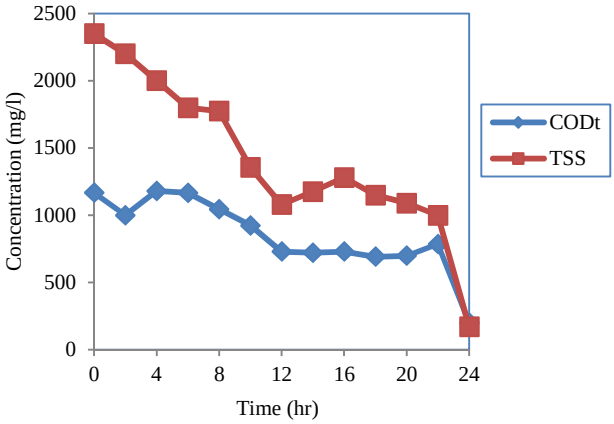


Fig. 11. Profile of COD_t and TSS during cycle (5).

In the present work, the effect of lag phase on COD and nitrogen removal from wastewater was investigated. It is revealed from Figures (2, 5, 7, 9 and 11) that the concentration of COD decreases slightly with an increase in the aeration time from 10-hrs to 60-min, the COD level has decreased rapidly during aerobic react period as compared to its rate of removal during anoxic condition. These results denote that aerobic heterotrophs are prominence in SBR at earlier react period. However, organic carbon requirement during denitrification stage also satisfied. When aeration time increased to 60-min, the removal of COD was increased from 80 to 84% (Fig. 12).

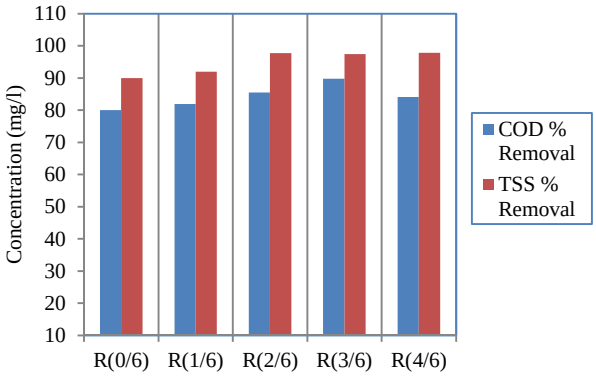


Fig. 12. Summary of the results.

In all cycles, the gradient of ammonium concentration at the beginning and the end of the aeration phase was clearly higher than gradient of nitrate concentration. This means that unbalanced ammonium oxidation-to-nitrate or nitrite and ammonium removal from wastewater in the aeration phase were observed. There was also a variation in N removal efficiency with aeration time. It was observed that N removal is not directly proportional to aeration time, This indicates that total anoxic reaction period should be optimized to improve nitrogen removal,

4 CONCLUSION

Effect of lag-phase in the transition from oxic to anoxic conditions was selected as operational parameter to study the optimization of biological carbon and nitrogen removal from municipal wastewaters. Results showed that changing time of aeration period from 0.0 to 60 min do not have a significant effect on COD and TSS removal efficiencies and just slight difference of COD changes via time (Fig.12). On the other hand, the lag-phase plays an important role in PND process, when the aeration time changed, the ammonia oxidation profile and the PND process varied differently, i.e. the optimum condition was R =3/6 (30 min oxic, 60 min anoxic), where complete removal of ammonium was achieved.

ACKNOWLEDGMENT

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REFERENCES

[1] Jenicek P., Svehla P., Zabranska J., Dohanyos M., 2004. Factors affecting nitrogen removal by nitritation/denitritation. Water Sci. Technol. 49 (5–6), 73–79.
[2] Fux C., Velten S., Carozzi V., Solley D., Keller J., 2006. Efficient and stable nitritation and denitritation of ammonium-rich sludge dewatering
[3] liquor using an SBR with continuous loading. Water Res., 40 (14), 2765-2775.
[4] Ruiz G., Jeison D., Rubilar O., Ciudad G., Chamy R., 2006. Nitrification-denitrification via nitrite accumulation for nitrogen removal from wastewaters. Biores. Tech., 97 (2), 330-335.
[5] Aslan S., Dahab M., 2008. Nitritation and denitritation of ammonium-rich wastewater using fluidized–bed biofilm reactors. J. Hazard. Mater. 156, 56–63.
[6] JianLong W., Ning Y., 2004. Partial nitrification under limited dissolved oxygen conditions. Process Biochemistry 39 (10): 1223-1229.
[7] [6] Peng Y. Z, Zhu G. B., 2006. Biological nitrogen removal with nitrification and denitrify cation via nitrite pathway. Appl. Microbiol Biotechnol 73(1):15–26.
[8] Hidaka T., Yamada H., Kawamura M., Tsuno H., 2002. Effect of dissolved oxygen conditions on nitrogen removal in continuously fed intermittent-aeration process with two tanks. Water Sci. Technol. 45:181–188.
[9] Third K. A., Paxman J., Schmid M., Strous M., Jetten M. S., Cord-Ruwisch R., 2005. Enrichment of anammox from activated sludge and its application in the CANON process. Microb Ecol 49(2):236–244.
[10] Liu, Y., Chen, Y., Zhou, Q., 2007. Effect of initial pH control on enhanced phosphorus removal from wastewater containing acetic and propionic acids. Chemosphere 66, 123–129.
[11] Holakoo L., Nakhla G., Bassi A. S. and Yanful E. K., 2007. Long term performance of MBR for biological nitrogen removal from synthetic municipalwastewater. Chemosphere 66(5), 849-857.
[12] Chiu Y. C., Lee L. L., Chang C. N., Chao A. C., 2007. Control of carbon and ammonium ratio for simultaneous nitrification and denitrification in a sequencing batch bioreactor. Int Biodeterior Biodegrad. 59(1):1–7
[13] Pollice A., Tandoi V., Lestingi C., 2002. Influence of aeration and sludge retention time on ammonium oxidation to nitrite and nitrate. Water Res 36(10):2541– 2546.
[14] Katsogiannis A. N., Kornaros M., Lyberatos G., 2003. Enhanced nitrogen removal in SBRs bypassing nitrate generation accomplished by multiple aerobic/anoxic phase pairs. Water Sci. Technol. 47(11), 53–59.
[15] Peng Y. Z. and Zhu G. B., 2004. Use of C/N ratios as fuzzy control parameter for improved nitrogen removal in step-feed biological nitrogen removal process. Environ Inform Arch, 2: 706–713.
[16] Yoo H., Ahn K., Lee H., Lee K., Kwak Y. and Song K., 1999. Nitrogen removal from synthetic wastewater by simultaneous nitrification and denitrification (SND) via nitrite in an Intermittently-aerated reactor Wat. Res. 33, 1, 145-154.
[17] Lee Y. W., Kim Y. J., Chang N. I., Lee J. G. and Lee B. H., 2007. Development of sequencing batch reactor with step feed and recycle. Water Science & Technology 55 (1-2): 477-484.
[18] Debsarkar A., Mukherjee S. and Datta S., 2006. Sequencing batch reactor (SBR) treatment for simultaneous organic carbon and nitrogen removal- A laboratory study. Journal of Environ. Science & Eng. 478 (43): 169-174.

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Investigation for the Wireless Communication and intended about the 5th Generation Technology

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ABSTRACT: What's to come for portable remote correspondence systems will be accomplished a few eras as which have been accomplished. This sort of advancement will drive the researchers of data innovation in industrial region. This paper investigates future mobile systems with stress on re-configurability focused around cognitive and programming characterized radios. Fifth Generation (5G) system building design comprising of reconfigurable multi-technology center and 5G system structural engineering - The Master-Core and in addition equipment and programming for the 5G Master-Core innovation is propose. The proposed system is implemented by nanotechnology, distributed computing and focused around All IP Platform. The paper highlights 5G primary improvement challenges and outlines why there is a need for 5G. It likewise surveys in a word the development of remote and cell frameworks concentrating on four primary key variables: radio access, information rates, and data transfer capacity and exchanging plans notwithstanding change in network architecture.

KEYWORDS: Quality of Service (QoS),), Long Term Evolution (LTE), All-IP Network (AIPN), Remote Server Control Unit (RSCU), Parallel Multimode (PMM), Base Transceiver Station (BTS), Network Control Unit (NCU).

1 INTRODUCTION

Science and Technology makes the world global as well as many impossible communication makes by them possible. It is true that Science and Technology are connected in hand to hand, where Science is a method of practicing knowledge, as well as the knowledge itself, on the other hand technology is the application of science.

However, Current world is constantly compacted because of the improvement of science and its advances. Throughout the last few decades, the world has seen incredible changes in the telecommunications' industry because of science and engineering and this has found from the development of mobile and wireless communication technology like, Wi-Fi from IEEE 802.11 wireless network, WiMAX from IEEE 802.16 wireless and mobile network 3G mobile networks (UMTS and CDMA 2000), LTE (Long Term Evolution) and 4G also supplementary networks, for example, Personal Area Network (like Bluetooth) otherwise sensor network.

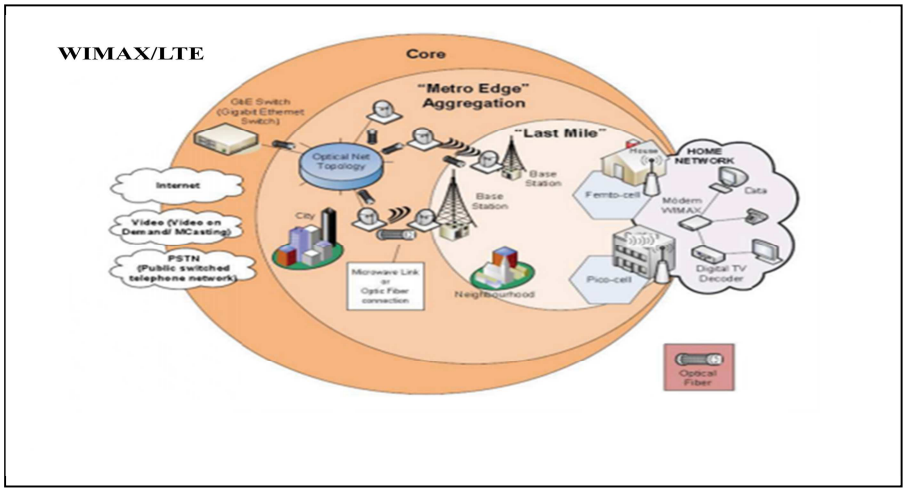


Fig. 1. Wireless 4G Network Architecture [1]

To expand the scope of high limit thickness ranges or in vicinity of hindrances – a case most successive in urban situations cells are supplemented by littler cells like, Pico-cells serving a decreased number of client. Note that base stations are one of the basic components for the expense counts in the advancement of 4g innovations, since these oblige a much higher thickness of radio stations than 3g to convey the guaranteed information rates, a variable that relies on upon the amount of simultaneous clients imparting this asset, their closeness to the base station and various different occasions related with accessible hindrances and impedance.

Furthermore, Mobile terminals incorporate mixed bag of interfaces, for example, GSM (Global System of Mobile Communication) is one, which are dependent upon antiquated circuit exchanging, the engineering that is going into its last decade of presence. These advances (predominantly cell eras) contrast from one another dependent upon four primary viewpoints: radio access, transmission capacity (Bandwidth), Data Rates (information rates) , and exchanging plans or Switching Schemes [2]. These contrasts have been recognized in past wireless generation like, 1G, 2G, 2.5G (GPRS), 2.75G (EDGE) and 3G, 3.75G (HSUPA), 4G and so forth. In agreement to, we are investigating the most development cell innovation, could be 5G. This generations' Technology remains for fifth Generation Mobile Technology.

However, 5G engineering has changed to utilize phones inside high data transmission as well as it is a parcel exchanged remote framework with wide zone scope and high throughput. Those generations' innovations use CDMA and BDMA and millimeter remote that empowers seed is more excellent than 100mbps at full versatility and higher than1Gbps at low portability. Moreover, The 5G advances incorporate numerous types of progressed characteristics which make 5G innovation most effective and in gigantic request within a brief period of time. It is not astonishing, such a colossal accumulation of engineering being incorporated into a little gadget. Again, the 5G engineering gives the cellular telephone clients more characteristics and effectiveness. A client of cellular telephone can undoubtedly snare their 5G innovation device with laptops or tablets to get broadband web connectivity. Up till now taking after characteristics of the 5G engineering now surface- High determination is offered by 5G for amazing portable clients, it additionally offers bidirectional immense transmission capacity [2], higher information rates and the finest Quality of Service (QoS) like, examined underneath in the paper.

Right away a days, all Wireless systems are sending to all-IP guideline, that means all information and indicating will be exchanged through IP on system layer [3].the reason for the All-IP Network is to totally change more than hundred years of legacy system foundation into a rearranged and institutionalized system with a solitary basic base for all administrations [4]. Keeping in mind the end goal to actualize 5G engineering, MasterCore procedure is required to apply All-IP Network (AIPN) legitimately. Consequently, the MasterCore plane is considered. The 5G MasterCore is a meeting of Parallel Multimode (PMM), Nanotechnology, Cloud Computing, and All IP Platform likewise 5g-IU engineering. These advances have their own particular effects on existing remote systems which make them into the 5G.

2 LITERATURE REVIEW

In the year of 1895, Guglielmo Marconi opened the route for cutting edge remote interchanges by transmitting the three-dot Morse code for the letter 'S' over a separation of three kilometers utilizing electromagnetic waves[3]. From this

starting, wireless communications has formed into a key component of cutting edge social order [5]. The Mobile remote industry has begun its innovation creation, insurgency and advancement since right on time 1970s. In the past few decades, versatile remote innovations have been arranged as stated by their era or generation, which to a great extent details the kind of administrations and the information exchange rates of each one class of innovations.

However, 0g alludes to pre-cellular portable telephony engineering in 1970s. These cellular phones were typically mounted in autos the other hand trucks; however briefcase models were additionally made. s. Technologies utilized as a part of 0g frameworks included PTT (Push to Talk), Mobile Telephone System (MTS), Improved Mobile Telephone Service (IMTS), Advanced Mobile Telephone System (AMTS), OLT (Norwegian for Offentlig Landmobile Telefoni, Public Land Mobile Telephony) what's more MTD (Swedish shortening for Mobilelefonisystem D, or Mobile telephony system D) [6], then again, 0.5g is a assembly of advances with enhanced characteristic than the essential 0G technologies. These early cellular phone frameworks could be recognized from prior shut radiotelephone frameworks in that they were accessible as a business benefit that was some piece of people in general exchanged phone system, with their own particular phone numbers, as opposed to some piece of a shut system, for example, a police radio or taxi dispatch framework.

Moreover, 1G is the first-generation remote phone innovation, cell phones. These are the analog base cell phone guidelines that were acquainted in the 1980s.it alludes with the era of remote telecommunication innovation, more famously known as cellphones.1G innovation supplanted 0G innovation, which offered portable radio phones and such technologies as Mobile Telephone System (MTS) Advanced Mobile Telephone System (AMTS). Its successor, 2G, which made utilization of advanced indicators, 1G remote system utilized analog radio signal. A voice call gets modulated to a higher frequency of something like 150 MHz and is transmitted between radio towers with the assistance of 1G. This is done utilizing a system called Frequency-Division Multiple Access (FDMA), on the other hand, the Second Generation (2G) phone engineering is dependent upon GSM whose full meaning is Global System for Mobile Communication. Second era was propelled in Finland at the year of 1991. Digital system has included with the 2G Mobile Communication; this framework is still basically utilized as a part of distinctive parts of the world. This era primarily utilized for voice correspondence additionally offered extra administrations, for example, SMS and email. In this era two computerized regulation plans are utilized; one is time division different access (TDMA) and the second is code division numerous access (CDMA) [7] and recurrence band is 850-1900 MHz In 2G, GSM engineering uses eight channels for every transporter with a terrible information rate of 22.8 kbps (a net rate of 13 kbps) in the full rate channel and an edge of 4.6 milliseconds (ms) term [8].the group of this era incorporates of 2G, 2.5G and also the 2.75G.

Furthermore, the third generation, 3G remote frameworks, was produced in the late 1990s and the first business 3G system was propelled by NTT Do Co Mo in Japan manifest FOMA, based on W-CDMA innovation on 1st of October, 2001 [9]. This era administrations consolidate fast versatile access with Internet Protocol (IP)-based administrations. The principle characteristics of 3G engineering incorporate remote web base access, media administrations, email, and feature conferencing. The 3g W-CDMA air interface standard had been intended for —always packet based remote service, so that workstation, amusement gadgets and phones might all impart the same remote system and be joined web at whatever time, anyplace [10]. 3G frameworks offer high information rates up to 2 Mbps, in excess of 5 MHz channel transporter width, contingent upon versatility/speed, and high range productivity. The information rate upheld by 3G systems depends likewise on the environment the call is, no doubt made in; 144 kbps in satellite and country open air, 384 kbps in urban outside and 2mbps in indoor and low go outside [11], again, The main effective field trial for 4G was led in Tokyo, Japan on June 23rd, 2005. NTT Do Co Mo was effective in accomplishing 1Gbps constant packet transmission in the downlink at a moving rate of about20km/h. To give remote administrations at whenever and anyplace, terminal versatility is an absolute necessity in 4G framework. Terminal portability permits portable customers to wander crosswise over geographic limits of remote systems. From the brief study it is found that, there are two fundamental issues in terminal portability: area administration and handoff administration. With area administration, the framework tracks and spots a versatile terminal for conceivable association. Area administration includes taking care of all the data about the wandering terminals, for example, unique and current found cells, validation data and so forth. Then again, handoff administration supports continuous interchanges when the terminal wanders. Versatile Ipv6 (Mipv6) is an institutionalized IP-based versatility convention for Ipv6 remote frameworks. In this outline, every terminal has an Ipv6 personal residence. At whatever point the terminal moves outside the nearby system, the personal residence gets invalid, and the terminal acquires a newipv6 location (called a care-of address) in the location by system [12]. The outline and enhancement of approaching radio access procedures and a further development of the existing framework, the Third Generation Partnership Project (3GPP) had set out the establishments of what's to term Long Term Evolution (LTE) propelled models the 3GPP candidate for 4G technology [13]. The target qualities of crest range proficiency for LTE Advanced frameworks were set to30bps/Hz and 15 Bps/Hz in downlink and uplink transmission separately. Separated from the different access plans, upgraded various information numerous yield (MIMO)

channel transmission strategies and far reaching coordination around numerous cell locales called facilitated multipoint (CoMP) transmission were acknowledged as the key systems for LTE [14].

3 ANALYSIS FOR THE FIFTH GENERATION OF WIRELESS COMMUNICATION

5G system is expected as the flawlessness level of remote correspondence in cellular innovation. Wire system is presently turned into the memory of past. Mobiles are a specialized instrument as well as serve numerous different purposes. All the past remote developments are enthralling the effortlessness of telephone and data conferring however 5G is bringing an alternate touch and making the life accurate flexible life. The new 5G framework is foreseen that will upgrade the organizations and procurements offered by it.

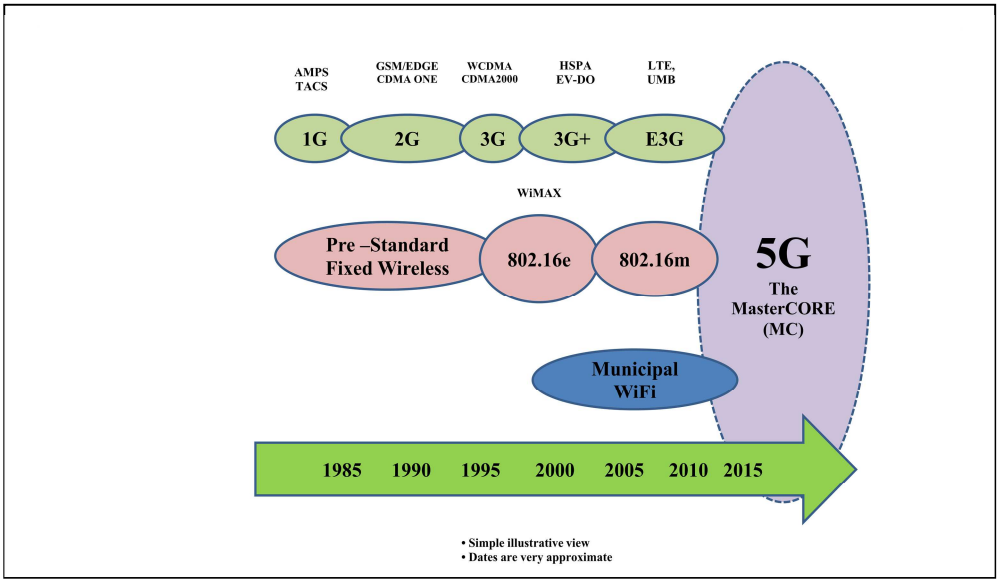


Fig. 2. Assessment of Mobile Technology

3.1 BASIC COMPARISON BETWEEN THE 5TH WITH OTHER TECHNOLOGY

Table 1. Basic Difference between the technology of 3G, 4G and 5G, [15] [16] [17]

Features	3G	4G	5G
Data Bandwidth	2Mbps	2Mbps to 1Gbps	1Gbps & Higher (as demand)
Frequency Band	1.8 - 2.5 GHz	2 - 8 GHz	3-300GHz
Standards	WCDMA CDMA-200 TD-SCDMA	All access convergence are including : OFMDA,MC-CDMA Network-LMPS	CDMA & BDMA
Technology	Broad bandwidth CDMA,IP technology	Unified IP And seamless combination of broadband LAN/WAN/ PAN and WLAN	Unified IP and seamless combination of broadband, LAN/WAN/PAN/WLAN and technologies for 5G new deployment (could be OFDM etc.)
Service	Integrated high quality audio, video and data	Dynamic information access, wear-able devices, HD streaming; global roaming;	Dynamic information access, wear-able devices, HD streaming; any demand of users; upcoming all technologies; global roaming smoothly;
Multiple Access	CDMA	CDMA	CDMA & BDMA
Core Network	Packet Network	All IP Network	Flatter IP Network & 5G Network Interfacing(5G-NI)
Definition	Digital Broadband, packet data	Digital Broad band, Packet data, All IP	Digital Broadband, Packet data All IP, Very high throughput
Hand off	Horizontal	Horizontal & Vertical	Horizontal & Vertical
Start from	2001	2010	2015

3.2 NECESSITY FOR THE FIFTH GENERATION

As a client perspective, the real distinction between present eras and needed 5G systems must be something else than expanded greatest throughput; different prerequisites incorporate [2].

- To make 5G commonsense for different kinds of radio access innovations there ought to be a normal stage one of a kind for all the advances.

- For remote get to and back pull utilization of millimeter wave frequencies is exceptionally advantageous.
- It could greatly improve the situation income for current worldwide administrators and also interoperability will get to be more practical.
- Enhanced and inventive information coding and adjustment procedures, which incorporates channel bank multi bearer path in plans.
- With the backing of diverse conduction focuses with related scope and encompassing the alternative of a supple use of assets for up connection and down connection transmission in each one cell is accomplished by predominant interruption and portability administration.
- World Wide Wireless Web (WWWW), remote based web provisions that incorporate full sight and sound proficiencies past 4G velocities.
- More requisitions joined together with Artificial Intelligent (AI) as human life will be encompassed by counterfeit sensors which could be corresponding with cellular telephones.
- Not hurtful to human wellbeing. Less expensive activity charges because of low base organization costs as well as their have also a good option for use the antenna system with smart beam.
- More secure; better cognitive radio/SDR Security and also higher framework level unearthly effectiveness.
- More level battery utilization and also have Better scope and high information rates accessible at cell edge.
- Various simultaneous information exchange ways, moreover, Conceivable to1Gbps and higher information rate in versatility.

5G is to be another engineering that will give all the conceivable requisitions, by utilizing one and only general gadget, and interconnecting a large portion of the officially existing correspondence frameworks. From that generations' terminals will be an upgradable multimode and cognitive radio- empowered. It will have programming (Software) characterized radio tweak plans. All the obliged upgradable programming ought to be downloaded from the Internet on the run. The 5G portable systems will concentrate on the advancement of the client terminals where the terminals will have admittance to diverse remote advances in the meantime and will combine different streams from different innovations. Also, the terminal will settle on a definitive decision around distinctive remote/portable access system suppliers for a given administration.

3.3 HIGH GROUND FOR THE FIFTH GENERATION NETWORK FROM THE MASTERCORE TECHNOLOGY

The Technology of MasterCore has been intended for limitless remote administration; therefore Computer , excitement gadgets and cell telephone might all impart the same remote system and could be joined with web whenever, anyplace. It's intended for 5G correspondence framework to satisfy the boundless focus up to the following two centuries, the basic characteristics as emulating; Documents could be downloaded (even films) inside seconds and also pages will transfer very nearly immediately. Moreover, it have able to good support for playing effortlessly web amusements as well as 5G gadgets are relatively less unreasonable than 3G and 4G gadgets. Furthermore, utilizing 5G the battery runs out quick and Finest Quality of Service (QoS). Again, all Networks might be assembled on a stage as well as effortlessly help past eras. New organizations of 5G might be associated specifically with The MasterCore by 5G -IU (5G Interfacing Unit) without All IP idea. No restriction as client requests also Capacity to backing for the new services.

In addition, world consolidation administrations are accessible also the MasterCore's fittings and programming (Software) are upgradeable. Additionally, fit to top client's interest off to one century from now as well as Endorsers can store information in focal stockpiling, again remote PCs could be controlled by handsets also has able to supporter can utilize provision programming without establishment as a part of own gadgets that gave by the MasterCore. Moreover, Security is circulated a few layers and the MasteCore can deal with all securities of PSTNs, MSC, and BTS and so forth.

3.4 QUALITY OF SERVICE

Next Generation Networks (NGN) comprises of help functionalities for information (Data) transport, and control transport, and additionally functionalities for backing of applications and services. The estimation of movement is a fundamental control action so as to give Quality of Service, [18]. What's more 5G correspondence frameworks are outlined by the finest Quality of Service (QoS). Quality of Service (QoS) alludes to a system's capacity to attain most extreme data transmission and arrangement with other system execution components like dormancy, lapse rate and uptime. Quality of service likewise includes controlling and overseeing system assets by setting necessities for particular sorts of information (feature, sound, records) on the system. Quality of service is solely connected to system movement produced for feature on interest, IPTV, VoIP, streaming media, videoconferencing and internet gaming. The essential objective of nature of administration is to give necessity to systems, including committed transmission capacity, controlled jitter, low idleness and

enhanced misfortune attributes. Its advances supply the basic building hinders that will be utilized for future business provisions within yard, wide region systems and administration supplier systems. There are three major parts for essential QoS execution [19].

Firstly, distinguishing proof and checking methods for organizing QoS from end to end between system components, Secondly, QoS inside a solitary systems' component and thirdly, QoS arrangement, administration, and bookkeeping capacities to control and manage end-to-end activity over a system.

3.5 EXCEPTIONAL APPLICATION

There have some exceptional applications with common features for the fifth generation of wireless communication such as, one can know climate, temperature, and area and so forth of one another when discussion is going on again, Students can go to any class of any foundation of the world without going there by WCSM. Moreover, a specialist can treat patients of different nations from a spot. It is possible to monitor wherever in the world from anyplace. Furthermore, Batteries could be charged by utilizing system without charger as well as it could be conceivable to imagine energetic all the planets and the Universe.

4 A RECOMMENDED ARCHITECTURE FOR THE FIFTH GENERATION COMMUNICATION NETWORK

Terminals and system segments are alertly overhauled to new circumstance. System specialists utilize the upgradeability to present worth included administrations all the more effectively. Upgradeability is dependent upon cognitive radio. Cognitive radio innovations incorporate the capability of gadgets to focus their area and area's data (for example, climate, temperature and so forth.), sense range utilized by neighboring gadgets, change recurrence, modify yield power and considerably adjust transmission parameters and qualities. A cognitive radio is a transceiver (shaft) that can comprehend and react to its nature's domain. Subsequently cognitive radio concerns cell phones and systems which are computationally shrewd about radio assets and related correspondences to investigate client correspondence needs and give remote administrations, be fitting to those needs. Consequently, the radio is mindful and cognitive about progressions in its surroundings and reacts to these progressions by adjusting working aspects somehow to enhance its execution. Furthermore, the fitting proposed structural engineering of the 5G MasterCore innovation is indicated beneath in figure 3.

4.1 THE MASTERCORE

The 5G potential will oblige the configuration of a solitary remote client terminal ready to obvious work in diverse heterogeneous access systems.

A completely upgradable terminal transforms its correspondence capacities relying upon system and client requests. What's more, the primary test for an upgradable MasterCore is to manage expanding number of diverse radio access advances dependent upon strong interoperability criteria and components. A center could be a joining of the previously stated nanotechnology, Parallel Multimode (PMM) technology, distributed computing and cognitive radio, upgradable and dependent upon All IP Platform and 5G-IU is known as the MasterCore. The 5G MasterCore is an upgradable and multi-advances center. The MasterCore upgradability could be a modification toward oneself and made adjustment to an alterably changing environment or mission turned adjustment to meet a given set of mission prerequisites with the point of enhancing administration conveyance and range use. The MasterCore progressions are its correspondence capacities relying upon system status and/or client requests. Upgradability could be in both programming and equipment. Fittings upgradability is fundamentally performed by administrators, adding extra gears to build system limit at a particular time.

On the other hand, in programming upgradability and with the force of SDR, system is powerfully upgradable, which implies that the projects and also the correspondence interfaces between the preparing components are updated at run-time. Upgradable equipment and programming fragments have been indicated in the MasterCore Technology (MCT) in Figure 3. Distinctive handling components are utilized for diverse purposes. The broadly useful processors are completely programmable to perform diverse computational assignments. The piece graph of the MasterCore structural engineering is demonstrated in Figure 3.

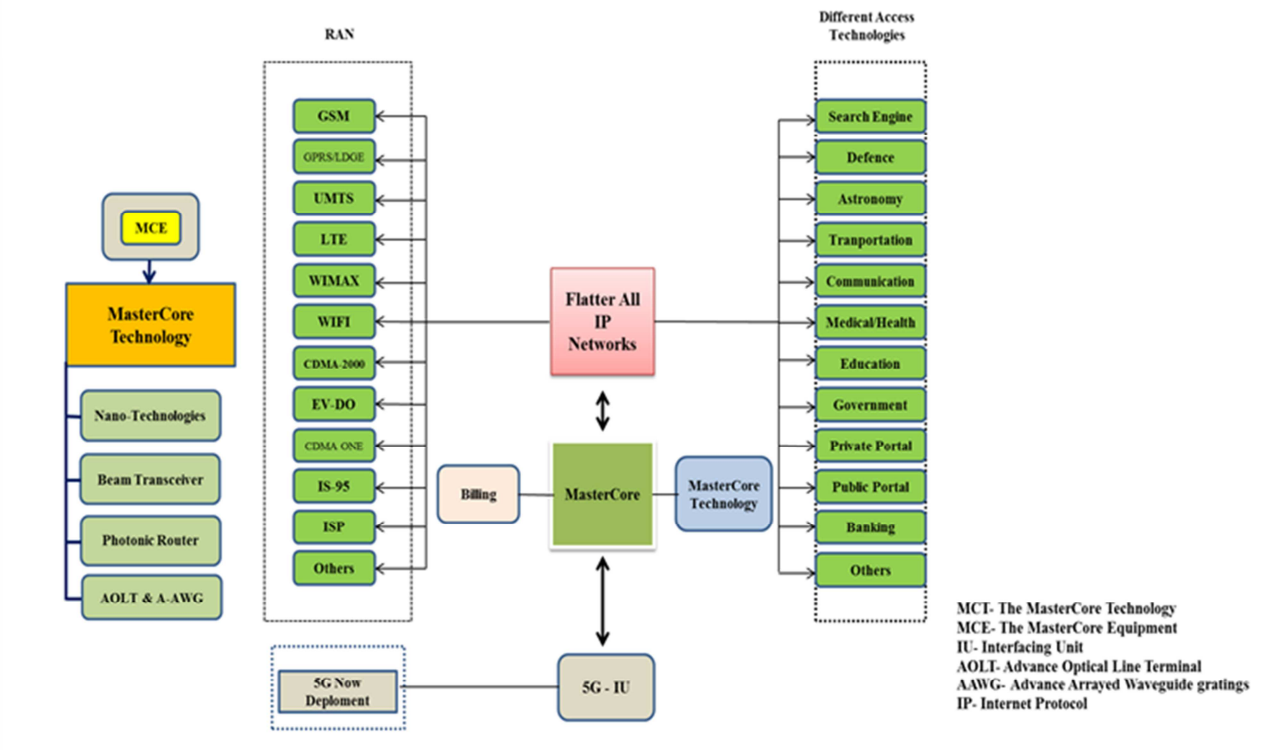


Fig. 3. The MasterCore Architecture

4.2 THE MASTERCORES TECHNOLOGIES (MCT)

The 5G MasterCore is a merging of beneath notice innovations. These innovations have their own particular effect on leaving remote system which makes them into 5G. The diverse portions of the MasterCore Technology (MCT) are shown underneath in figure 4.

4.2.1 PARALLEL MULTIMODE (PAM)

In 5G Wireless Communication Systems, The MasterCore might be worked into parallel multimode, for example, All IP Network Mode, 5G Network Mode, where in All IP Network Mode controls all system innovations of RAN and DAT (Different Access Networks) up to 5G new organizations. 5G Network Mode deals with all new organizations dependent upon 5G therefore 5G system frameworks will be more effectiveness, capable and less convoluted. Any administration mode could be opened under 5G-NDM (New Deployment Mode) as WCSM (World Combination Service Mode).

However, World Combination Service Mode gives a few administrations around endorsers that might be utilized within uncommon purposes for instance; a speaker composes on white board that shows on an alternate board without feature in any nation of the world and the other way around also discussion and feature. For Parallel Multimode, any new administration could be included effectively so arrangement of the system no needs to change. Truth be told all modes run at once constantly (such as, parallel).

4.3 ALL IP NETWORK

The All-IP Network (AIPN) is an advancement of the 3GPP framework to satisfy the expanding requests of the mobile communication market. It is a typical stage legitimate for various kinds of radio access advances. AIPN centered fundamentally on the upgrades of parcel exchanged innovation yet now it gives a proceeded advancement and enhancement as far as both execution and expense. The key profits of AIPN structural planning incorporates a mixture of diverse access frameworks' procurement, more level expenses, general consistent get to, and expanded client fulfillment and lessened framework dormancy. Anyway with the preferences of IP come a few dangers: as information stream all the more

unreservedly and the web is open to engineers as well as to all way of offenders and infections, designers and drivers confront new security challenges which ought to be explained legitimately.

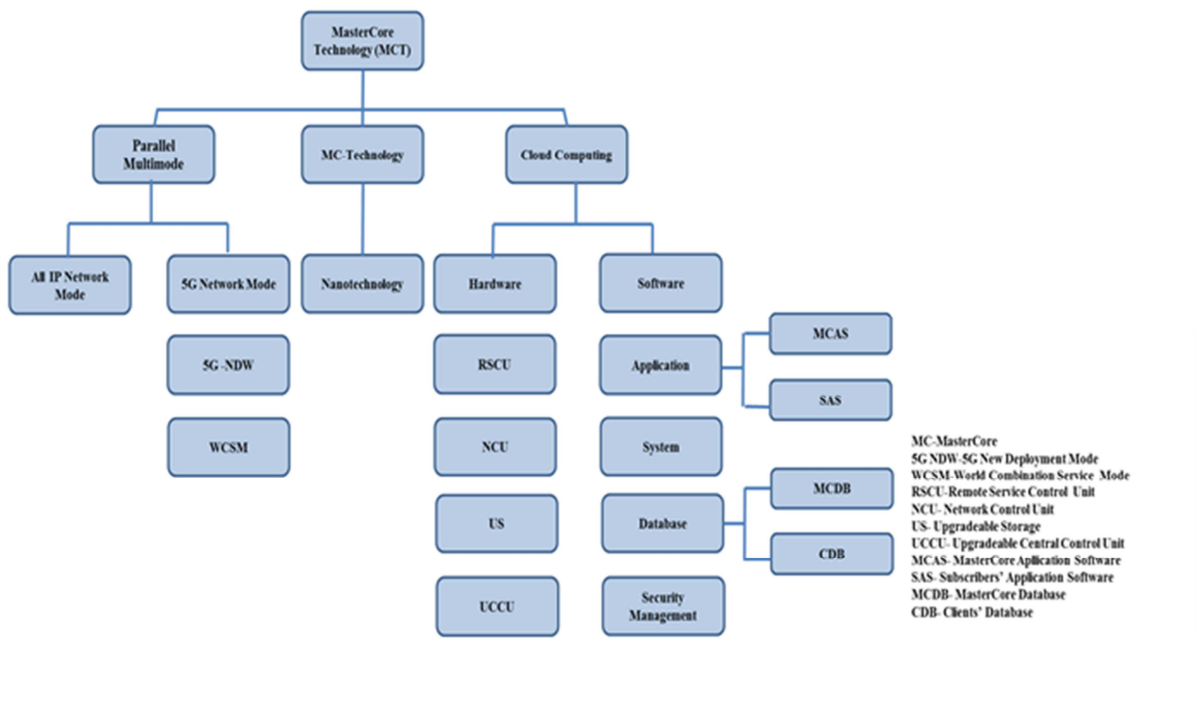


Fig. 4. Segments of the MasterCore Technology

4.4 NANO TECHNOLOGY

Nanotechnology is the requisition of nanotechnology to control handle on nanometer scale between 0.1 to 100nm.the field is otherwise called Molecular Nanotechnology (MNT) where MNT manages control of the structure of matter dependent upon atom-by-atom and molecule by molecule engineering. Nanotechnology is acknowledged as the following mechanical insurgency, and the telecommunications business will be drastically changed by it in a couple of years. As what's to come provisions will require more memory and figuring force to offer higher information rates, current innovations cannot resolve these challenges. Luckily, nanotechnology could give powerful answers for force effective processing, sensing, memory development, and human machine cooperation. [20] [21].

Nanotechnology has demonstrated to its effect on both portable and the center system as takes after. Firstly, the cell phone has gotten to be more than a specialized gadget in current world; processing and correspondence are primed to serve the client in an insightful way. Cell phones together with the discernment, inserted in human situations, will make another stage that empowers pervasive sensing, processing, and correspondence. With nanotechnology cellular telephones can go about as keen sensors that have requisitions in numerous businesses, around them transportation, correspondences, drug and security. Secondly, the center system (Core Network) obliges rapid and a solid ability to control and interoperate expanding number of heterogeneous access advances. At present, nanotechnologies are utilized within Digital Signal Processing (DSP) Fabrication; presenting new recognitions in DSP planning that builds the general framework speed and limit.

Separated from this it has its effect on sensor and in addition security. This is acknowledged as a most huge in telecommunication.

4.5 CLOUD COMPUTING

“Cloud processing is a model for empowering universal, helpful, on-interest system access to an imparted pool of configurable registering assets (like, Servers, Networks, Applications, Storage, and Services) that could be quickly provisioned and discharged with negligible administration exertion or administration supplier communication " a definition from [22]. Henceforth, distributed computing is an engineering that uses the web and focal remote server to keep up information and requisitions. In 5G systems this focal remote server could be a substance supplier. Distributed computing permits buyers and

business to utilize provisions without establishment and access their particular records at any machine with web access. The same idea is going to be utilized within multi-center innovation where the client tries to get to his private record structure a worldwide substance supplier through distributed computing.

4.5.1 HARDWARE

In MasterCore innovation, get together of equipment is situated into a few units to keep up entire system framework appropriately, likewise troubleshooting in center system right away.

Thus, proficiency of the center is suitable with requested administrations. Equipment arranged into diverse units as: Firstly, Remote Server Control Unit (RSCU) gives an extraordinary open door to control remote server of clients' systems. It shows the quick state of remote server. Besides, Network Control Unit (NCU) gives control of the interchanges around MS, BSC, MSC and PSTN. Thirdly, Upgradeable Storage (US) alludes to build the capacity as need as interest and Fourthly, Upgradeable Central Control Unit (UCCU) gives the offices to control all units midway.

4.5.2 SOFTWARE

Software Defined Radio (SDR) profits from today's high transforming force to create multi-band, multi-standard base stations and terminals. In spite of the fact that in future the terminals will adjust the air interface to the accessible radio access engineering, at present this is carried out by the framework. A few foundation additions are normal from SDR. Case in point, to expand system limit at a particular time (such as, throughout a games occasion), a driver will reconfigure its system including a few modems at a given. Base Transceiver Station (BTS). SDR makes this reconfiguration simple. In the setting of 4G frameworks, SDR will turn into an empowering agent for the conglomeration of multi-standard pico/micro cells. For a producer, this could be a capable support to giving multi-standard, multiband gear with lessened improvement exertion and expenses through concurrent multi-channel handling.

Firstly, 5G will be single bound together standard of diverse remote systems, including remote innovations (Such as, IEEE 802.11), Local Area Network/Wide Area Network/ Personal Area Network and WWWW, brought together IP and consistent synthesis of broad band.

Secondly, Programming Defined Radio, Packet layer, implementation of packets, encryption, adaptability and so forth, In figure 2 are demonstrated diverse order fragments of 5G product, for example,

a) Application: The MasterCore Application Software (MCAS) alludes to all requisition programming are required as to give services and managements. Supporter's Application Software (SAS) is introduced halfway so endorser runs a project without introducing on his own gadgets. All administrations of provision programming are given from focal server.

b) System: System software is that kind of Operating System for the Fifth Generation of MasterCore Networking.

c) Database: The Mastercore Database (MCDB) programming alludes to oversee and store all information of entire framework those are required. Customer's Database (CDB) programming deals with all information of client's server those hold all vital data of clients and clients' systems.

d) Security Management: Securities (clients to the MasterCore) will be overseen midway by Security Management (SM) software.

4.6 FIFTH GENERATION INTERFACING UNIT

5G Interfacing Unit acts to make the most effective of 5G remote correspondence framework. Since, different types of radio access innovations are consolidated in a typical stage are intricate type of collection. It will be more perplexing in future when included new radio access advances. This is the reason, 5G-IU is utilized between new organizations and center system so that 5G remote correspondence framework is effectively sensible.

4.7 THE MASTERCORE EQUIPMENTS

Cellular telephone has gotten to be more than a specialized gadget in present day world it has transformed into a personality of a single person. In 5G MasterCore these versatile and different gadgets such as, local networking devices,

Laptop are nearby systems administration gadgets and so on are alluded as the MasterCore Equipments (MCE) as they are enhanced with nanotechnology, Beam Transceiver, Advance Optical Line Terminal (AOLT), Advance Arrayed Waveguide Gratings (AAWG). Nanotechnology alludes NanoEquipments (NE) are Morph, Graphene's Transistor, GPS, Micro-Micro Phones, Liquid lens, Intelligent Batteries and Nanosensor [23]. One of the focal dreams of the remote business points at surrounding knowledge, reckoning and correspondence constantly accessible and prepared to serve the client in an astute and productive way. This obliges that the gadgets are portable.

Moreover, Cell phones together with the insights and effective that will be installed in human situations – home, office, open spots – will make another stage that empowers universal sensing, registering, and correspondence Specs of MasterCore Equipments given as follow: Firstly, Sense the environment, which means like the phone will tell to his user about the weather, the amount of air pollution present etcetera, Secondly, Self Cleaning means the phone cleans by itself, Thirdly, self powered, which means the phone derives its energy/power from the sun, water, or air, Fourthly, Transparent means see through phones and Fifthly more and more reliable.

5 FUTURE ANALYSIS

This sort of reconciliation may cause the handoff issue once the versatile clients moving starting with the one engineering then onto the next, which confine the development of portable clients. The Mix-data transfer capacity information way is intended to tackle this issue and make the fifth generation in true remote world. It could be presented around the year 2020. 6G incorporates the 5G cell systems and satellite systems to make worldwide scope. This can supply versatile web to clients at anyplace, in any case and whenever. It could be presented around the year 2030. Since the route satellite systems have being developed by five countries, which make the space handoff/roaming is trouble. Therefore, 7G need to fathom this problem. From our era bearings, it might be presented around the year 2040.

6 CONCLUSION

The paper examined 5G primary improvement challenges and illuminated the need for 5G. We have proposed the MasterCore innovation and its equipment and programming execution. This paper serves to move forward stronger interfaces between individuals working in diverse fields making future ideas of mobile communication, All IP network, internet services, cloud computing and nanotechnologies. The Fifth Generation innovation incorporates all sorts of progressed characteristics which makes 5G mobile engineering most influential and in gigantic request in not so distant in future.

REFERENCES

[1] Feijoo, Claudio, *The Mobile Communications role in the Next Generation: The Case of Spain*, 22nd European Regional Conference of the International Telecommunications Society (ITS2011), Budapest, 18 - 21 September, 2011: Innovative ICT Applications - EmergingRegulatory, Economic and Policy Issues.

[2] Dr. Anwar M. Mousa, Prospective of Fifth Generation Mobile Communications, International Journal of Next-Generation Networks (IJNGN) Vol.4, No.3, September 2012.

[3] Available online: http://www.scribd.com/doc/93686537/4G-5G-and-its-beyond-technology-6G

[4] Available online: http://ytd2525.wordpress.com/category/all-ip-networks/

[5] Gagan Preet Kaur, Joni Birla, Jitender Ahlawat, Generations of Wireless Technology, International Journal of Computer Science and Management Studies (ijcsms), Vol. 11, Issue 02, Aug 2011 ISSN (Online): 2231-5268.

[6] Lee, W. C.Y., "Lee's Essentials of Wireless Communications," McGraw-Hill, New York, NY, 2001.

[7] Xichun Li, AbudullaGani, RosliSalleh, Omar Zakaria 2009, The Future of Mobile Wireless Communication Networks,"2009 International Conference on Communication Software and Networks.

[8] Vijay K. Garg and Joseph E. Wilkes, "Principles & Applications of GSM," Published by Dopling Kindersley (India) Pvt. Ltd., licensees of Pearson Education in South Asia, First Impression, 2006.

[9] UMTS World (2009). "UMTS/3G History and Future Milestones", [Online] Available: http://www.umtsworld.com/umts/history.htm

[10] Theodore S. Rappaport, "Wireless Communications Principle and Practice," published by Pearson Education (Singapore) Pte. Ltd,. Second Edition, Chapter Two.

[11] Imthiyaz Ali, —5G the Nanocore" March 5, 2011

[12] Naik, G., Aigal, V., Sehgal, P. and Poojary, J. (2012). Challenges in the implementation of Fourth Generation Wireless Systems, International Journal of Engineering Research and Applications (IJERA) 2(2)L: 1353-1355
[13] Parikh, J. and Basu, A. (2011). LTE Advanced: The 4G Mobile Broadband Technology International Journal of Computer Applications 13 (5): 17-21.
[14] 3GPP TR 36.814, V9.0.0, 2010, Further Advancements for E-UTRA Physical Layer Aspects, March2010.
[15] Engr. Muhammad Farooq, Engr. Muhammad Ishtiaq Ahmed, Engr. Usman M Al,*"Future Generations of Mobile Communication Networks" Academy of Contemporary Research Journal V II (I), 15-21, ISSN: 2305-865, January 2013*
[16] Available Online: http://spectrum.ieee.org/telecom/wireless/millimeter-waves-may-be-the-future-of-5g-phones
[17] Available Online: http://www.slideshare.net/noorec786/generations-of-network-1-g-2g-3g-4g-5g
[18] ITU-T, Y.2173, —*Management of performance measurement for NGN",* September 2008
[19] Available Online: http://www.techopedia.com/definition/9049/quality-of-service
[20] Ermolov V. et al. —*Significance of Nanotechnology for future wireless devices and Communications", The 18th Annual IEEE International Symposium on PIMRC'07*
[21] R.K.Jain, Risal Singh, —*Role of Nanotechnology in future wireless and communication systems", National seminar proceeding, Academy of Business & Engineering Science Ghaziabad, pp-19-28, 16-17th January 2009*
[22] Peter Mell and Timothy Grance, *"The NIST Definition of Cloud Computing" US National Institute of Standards and Technology Special Publication 800-145, September 2011*
[23] Imthiyaz Ali, *5G the Nanocore, March 5, 2011*

BIOGRAPHY

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Clinical Studies to Evaluate Pancreatic Functions in the Patients of Type 2 Diabetes Mellitus

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ABSTRACT: Diabetes mellitus is a chronic metabolic disorder which is associated with hyperglycemia. It is caused by a derangement in the secretion or function of the endocrinal portion of the pancreas. The aim of the present study was to determine the blood glucose, MDA, amylase levels in 50 cases of type 2 Diabetes Mellitus and to compare and correlate these parameters with those 50 of age and sex matched healthy controls. Glucose and amylase concentrations were analyzed spectrophotometrically by kits in all patients with DM as well as in the control subjects but MDA concentrations was measured by manual methods The results of type 2 DM were compared with control group using One way ANOVA-test to compare parameters in different studied groups. The results show a significant elevation ($P \leq 0.05$) in levels of glucose, MDA, amylase of type 2- diabetic patients in comparison healthy subjects.

KEYWORDS: Type 2 diabetes mellitus, Pancreas, Glucose, Malon dialdehyde (MDA), Amylase.

1 INTRODUCTION

Diabetes mellitus is characterized by absolute or relative deficiencies in insulin secretion and/or insulin action associated with chronic hyperglycemia and disturbances of carbohydrate, lipid and protein metabolism. Long-term vascular complications represent a major cause of morbidity and mortality in patients with diabetes mellitus. In addition, various biochemical disorders associated with vascular complications, such as hyperlipidemia and oxidative stress which frequently co-exist with diabetes mellitus (1), appear inadequate to explain the increased risk of vascular diseases. The observations suggest that additional factors may be involved in the acceleration of diabetic vascular disease.

The islets of Langerhans make up a small but critical mass of the pancreas that is composed of key endocrine cells. The main cell types within the islets are b, a, d, F and e cells that secrete hormones such as insulin, glucagon, somatostatin, pancreatic polypeptide and grehlin, respectively. Together, these cells help regulate energy metabolism by hormonal control and in particular glucose homeostasis. The majority of the islets consist of the pancreatic b-cells, making up about 70% of total islet volume (2).

As it known that Diabetes mellitus is one of the world's major diseases, with an estimation of 347 million adults affected in 2011 (3). Type 2 diabetes mellitus, by far the most common type, is a metabolic disorder of multiple etiology characterized by carbohydrate, lipid and protein metabolic disorders that includes defects in insulin secretion, almost always with a major contribution of insulin resistance (4). In this context, the inhibition of carbohydrate digestive enzymes is considered a therapeutic tool for the treatment of type 2 diabetes (5). The most important digestive enzyme is pancreatic alpha-amylase. Amylase are hydrolysis enzymes catalyses the hydrolysis of complex carbohydrate molecules into smaller components. Human amylase is termed (α-amylase) or endoamylase because of its ability to spilt poly saccharide α(1-4) linkage in a random manner. The end product of α-amylase action on poly saccharide is the formation of dextrans maltose and some glucose molecules(6).

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Lipid peroxidation, owing to free-radical activity, plays an important role in the development of complications of diabetes. Although increased levels of lipid peroxidation, as a consequence of free radical activity, have been reported in type 2 diabetes with vascular complications (7)(8) other studies failed to detect any significant elevation in lipid peroxidation in diabetic patients,(9) probably owing to heterogeneity of the patient population. Hence, in this study, we have evaluated the levels of Malondialdehyde (MDA) (index of lipid peroxidation) in patients of type 2 diabetes without complications and related it with amylase levels with a Possible Correlation between them and compared to healthy subjects .

2 MATERIALS AND METHODS

This study was conducted in AL-Hussein Education Hospital and the Special Center of the Endocrine Glands and Diabetes in Thi-Qar.for a period of seven months. 50 normal healthy subjects with fasting blood sugar (FBS) < 6.20 mmol/L were selected as control group. The ages ranged from 20 to 65 years. 50 patients of type 2 Diabetes mellitus whose (FBS) > 17.58 mmol/L were included in this study. About (10 mL) of fasting venous sample all included subjects were taken and allowed to clot to get serum by putting it in empty disposable tube's centrifuge to separate it in the centrifuge at 3000 (*rpm*) for 10 min, the serum samples were separated, stored at (-20˚C) for later measurement biochemical parameters, unless used immediately.

Serum glucose was determinate by an enzymatic colorimetric test on basis of Trinder-Reaction (10)(11). MDA in plasma was performed as described by Fong *et al* (12). The amylase activity was measured by an enzymatic method (13).

The results were analyzed statistically expressed as mean ± standard deviations (mean ± SD) by using **SPSS** version 10.0. and correlation coefficients on the suitable software. P values of < 0.05 were considered as statistically significant.

3 RESULTS AND DISCUSSION

3.1 IN GENERAL

Clinical characteristics of the study subjects are shown in Table 1. Serum glucose concentrations were significantly higher (P≤0.05) in type2 diabetic group in comparison with control group. The MDA concentration in type2 diabetic were a significantly higher in comparison with control group (P≤0.05). However, an apparent increase was also observed in concentrations of serum amylase in type2 diabetic in comparison with control group (P≤0.05) as shown in figures (1)(2)(3). There was a significant (p value <0.05) positive correlation between the fasting blood glucose levels and serum MDA (Pearson's correlation coefficient, r= 0.95) also a positive correlation between the fasting blood glucose levels and serum amylase activity (Pearson's correlation coefficient, r= 0.89) in the diabetic patients as shown in figures (4)(5).

Table 1. Clinical characteristics of the study subjects.

Clinical characteristics of the subjects	Control group	Type2 diabetic group
N	50	50
Age (years)	20-60	20-60
Fasting Blood Glucose(mmol/L)	4.99 ± 1.09[a]	17.37± 2.01[b]
Serum MDA (nmol/L)	6.58 ± 4.36[a]	70.92 ± 2.03[b]
Serum Amylase(U/L)	40.19 ± 10.50[a]	175.35 ± 21.74[b]

*** Each value represents mean ± SD values with non identical superscript (a, b …etc.) were considered significantly differences (P ≤ 0.05).**

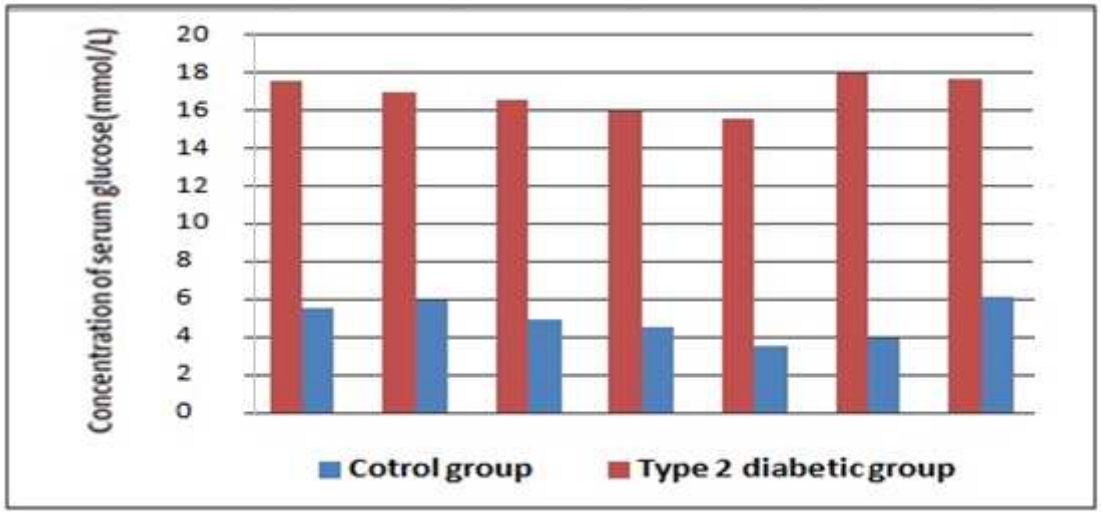


Fig. 1. Comparison of fasting blood glucose levels in control group and type 2 diabetic group

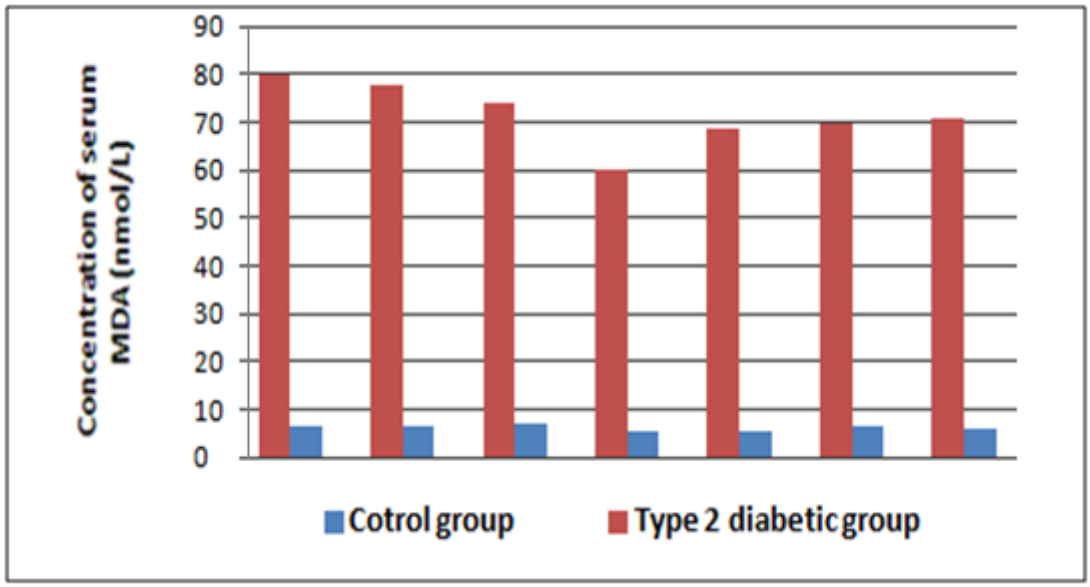


Fig. 2. Comparison of MDA levels in control group and type 2 diabetic group

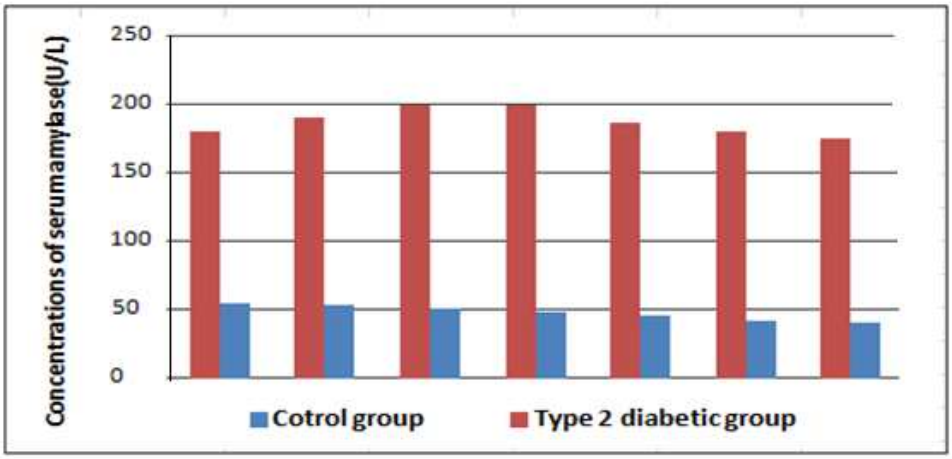


Fig. 3. Comparison of serum amylase levels in control group and type 2 diabetic group

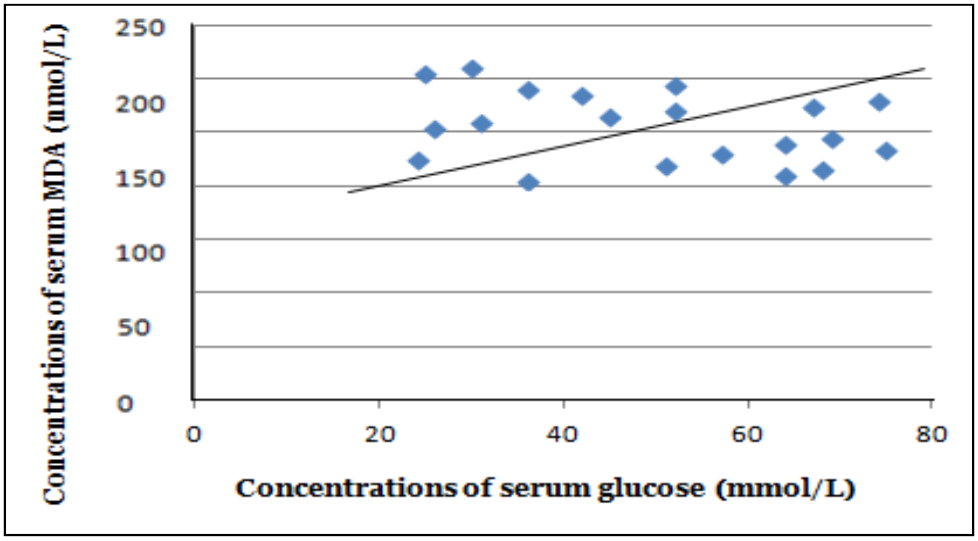


Fig. 4. Correlation of serum MDA with serum glucose levels in diabetic patients showing a positive correlation (r=0. 95).

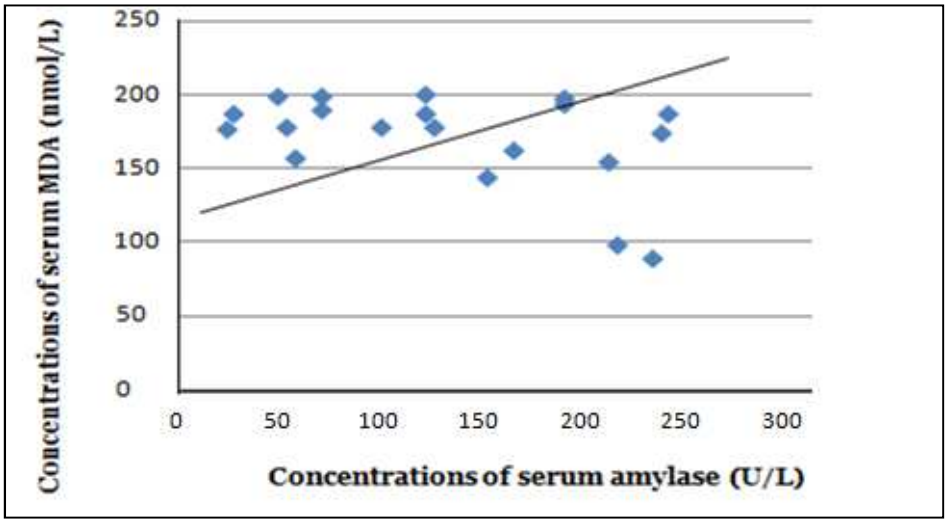


Fig. 5. Correlation of serum MDA with serum amylase levels in diabetic patients showing a positive correlation (r=0.89).

It will be known that diabetes is a group of endocrine diseases developing as a result of relative or real lack of insulin hormone, or disturbances of its interaction will be the cells of an organism, therefore the steady increase of sugar (glucose) content in blood develops hyperglycemia (14).

Glucose is the major source of energy used by the cells. However, glucose cannot enter the cell unless the presence of insulin is there. In a normal working of pancreas, the right amount of insulin is produced to move glucose into the cells. In an abnormal pancreas, little or no insulin is produced, or the body cells do not respond to the insulin that is produced, it leads to accumulate glucose in the blood and elevation of its levels and causes Diabetes Mellitus(15).

Table(1) shows a significant elevation in concentration of serum glucose levels in type 2 diabetic group in comparison with control group (P≤0.05).

This finding is matched with the result of Tan *et al* (2001) (16) and Annette *et al* (2003)(17) and the reason of this state is due to the weakness of β-cell , modicums of insulin production as well as responding and increasing of its resistance. Where all this appears by aging so glucose levels increase with this type.

Also, a positive correlation relationship between MDA and glucose levels in Diabetes Mellitus patients we found. Sinha R., *et al* (2004)(18) also found this positive correlation relationship between MDA and glucose in Diabetes Mellitus patients. Figure (3) the positive correlation relationship between MDA and glucose in Diabetes Mellitus patients) correlation coefficient of this relation is (r=0.95).

Table (1) shows a significant increase in concentration of serum MDA levels in type 2 diabetic group in comparison with control group (P≤0.05)

Because of hyperglycemia is associated with the increase of the oxidative stress and free radicals production (19) so it's effected on oxidant-antioxidant balance where there is an imbalance between concentrations of reactive oxygen species (ROS) and antioxidants. However, excessive ROS accumulation will lead to cellular injury, such as damage to proteins, DNA and lipid membranes.

We found that lipid peroxidation marker (MDA) were higher in patients with type 2 diabetes compared with control groups, and this may be due to the increasing of oxidative stress in type2 diabetes because of the exposure to prolonged periods of hyperglycemia, which causes glucose to be in its highest levels. Our study confers with the study conducted by Jain *et al*(1999)(20) and West *et al*(2000)(21) and similar finding was reported by Dierckx *et al*(2003)(22).

A significant increase was found in concentration of serum amylase levels in type 2 diabetic group in comparison with control group (P≤0.05) as shown in table(1). The result also showed a positive correlation relationship between MDA, the marker of lipid peroxidation and serum amylase in patient groups (r=0.89) .These results was shown in Figure (4).

According to the results of this study there are an increase in amylase levels was related with the insulin deficiency and the glucagon excess in diabetes affect the normal milieu of the pancreas (23). Our results suggest that the low serum amylase levels in diabetes are associated with an impaired insulin action due to insulin resistance and/or inadequate insulin secretion, as was indicated by the raised blood glucose levels in our study (24).

Clinical characteristics of the study subjects are shown in Table 2. Serum glucose concentrations were significantly higher (P≤0.05) in T2DMA group in comparison T2DMY group. The MDA concentration in T2DMA were a significantly higher in comparison with T2DMY group (P≤0.05). However, an apparent increase was also observed in concentrations of serum amylase in T2DMY in comparison with T2DMA (P≤0.05) as shown in figures (4)(5)(6).

Table 2. Clinical characteristics of the study subjects according to the age

Clinical characteristics of the subjects	T2DMY	T2DMA
N	25	25
Age (years)	20-40	41-60
Fasting Blood Glucose(mmol/L)	15.39± 2.14[a]	18.14± 4.01[b]
Serum MDA (nmol/L)	68.50±1.95[a]	71.37±3.67[b]
Serum Amylase(U/L)	190.85±6.99[a]	180.83±4.55[b]

*** Each value represents mean ± SD values with non identical superscript (a, b …etc.) were considered significantly differences (P ≤ 0.05).**

T2DMA: Type 2 Diabetes Mellitus age (20-40)

T2DMY: Type 2 Diabetes Mellitus age (41-60)

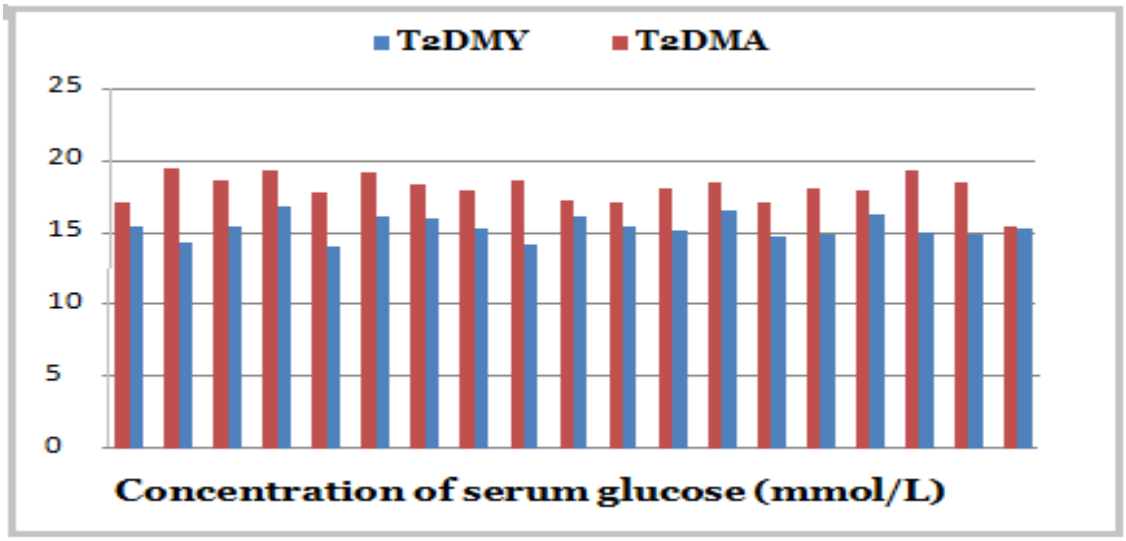


Fig. 6. Comparison of fasting blood glucose levels in T2DMA and T2DMY groups

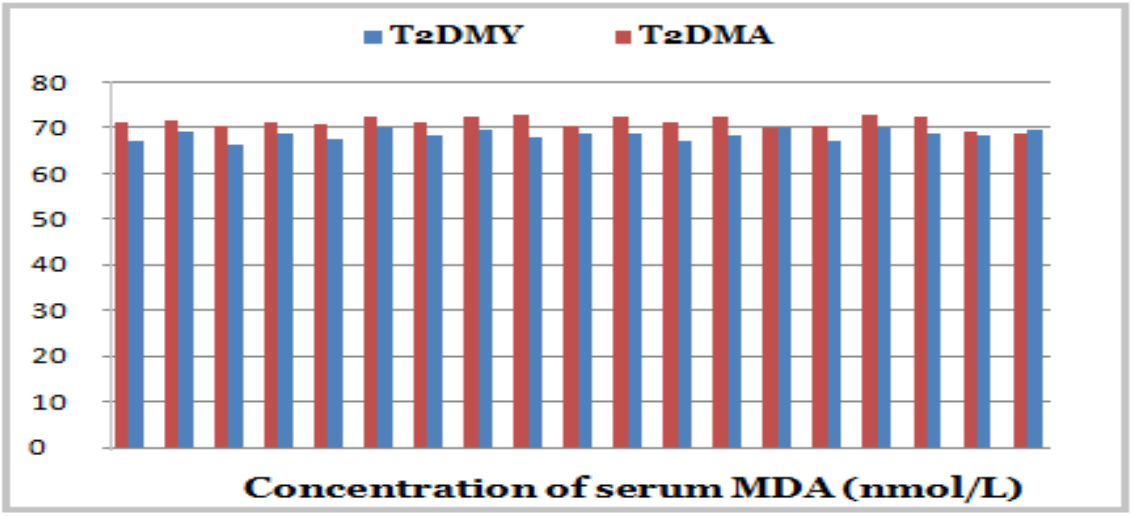


Fig. 7. Comparison of serum MDA levels in T2DMA and T2DMY groups

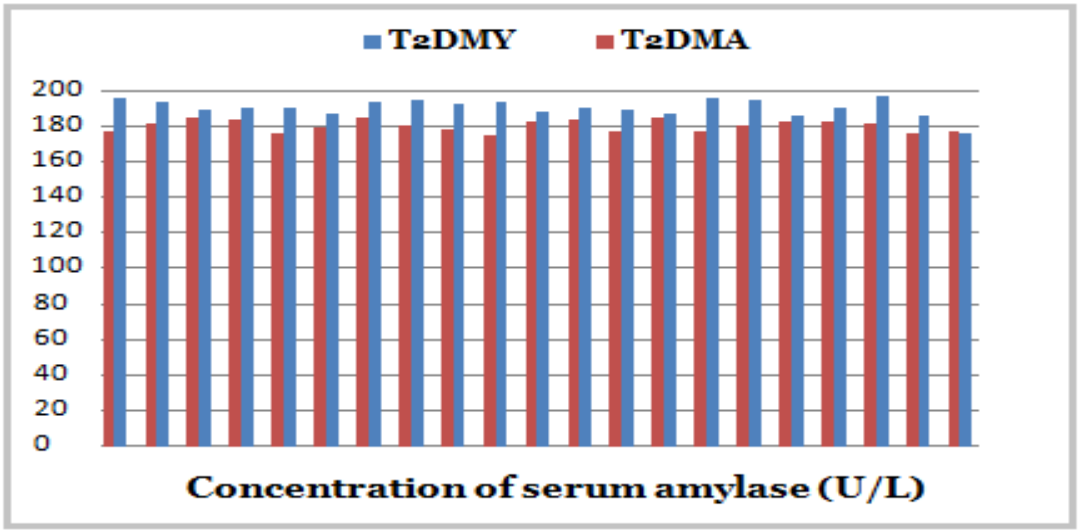


Fig. 8. Comparison of serum amylase levels in T2DMA and T2DMY groups

The results of present study indicates that fasting glucose levels in T2DMA increased in comparison T2DMY groups were statistically significant ($p<0.05$).The reason of this state is that type 2 diabetes mellitus appears after age 40 and the increasing in glucose concentration in this type and diabetes mellitus is due to the weakness of β-cell , modicums of insulin production as well as responding and increasing of its resistance. Where all this appears by aging so glucose levels increase with this type(16)(17) as shown in table(2) and figure(4), also it may be result of the weakness of the work in pancreas and other organs by aging (25) .

In table(2) and figure(5) it can be observed that the level of serum MDA in T2DMY is decreased in comparison with T2DMA group because MDA play a role as cofactors in the pathogenesis and complications of type 2 DM and this role be Influential greatly by getting older and Advancing age(26).

Also we can Obviously seen in table (2) and figure(6) the increasing of serum amylase in T2DMY in comparison with T2DMA . Our results suggest that the low serum amylase levels in diabetes are associated with an impaired insulin action due to insulin resistance and/or inadequate insulin secretion, as was indicated by the raised blood glucose levels in our study and this may be caused by the insulin deficiency in diabetes affect the normal milieu of the pancreas, thereby decreasing the total volume, the amylase secretions(27).

REFERENCES

[1] Kannel WB, McGee D. Diabetes and cardiovascular risk factors: the Framingham study. Circulation 1979;59:8–12.
[2] Kim A, Miller K, Jo J, Kilimnik G, Wojcik P, Hara M. Islet architecture: a comparative study. Islets 2009; 1(2): 129–136.
[3] Danaei G, Finucane MM, Lu Y, et al. National, regional, and global trends in fasting plasma glucose and diabetes prevalence since 1980: Systematic analysis of health examination surveys and epidemiological studies with 370 country-years and 2.7 million participants. Lancet. 2011;378(9785):31-40.
[4] Alberti KGMM, Zimmet PZ. WHO Consultation. Definition, diagnosis and classification of diabetes mellitus and its complications. Part 1: Diagnosis and classification of diabetes mellitus - provisional report of a WHO consultation. Diabetic Med. 1998;15(7):539-53.
[5] Holman RR, Paul SK, Bethel MA et al. 10-year follow-up of intensive glucose control in type 2 diabetes. N Engl J Med. 2008;359(15):1577-89.
[6] Tundis R, Loizzo MR, Menichini F. Natural products as alpha-amylase and alpha-glucosidase inhibitors and their hypoglycaemic potential in the treatment of diabetes: An update. Mini-Rev Med Chem. 2010;10(4):315-31. [PMID:20470247].**A recent review on natural plant extracts with alpha- glucosidase and alpha- amylase inhibitory activity.
[7] Griesmacher A, Kindhauser M, Andert SE, Schreiner W, Toma C, Knoebl P, et al . Enhanced serum levels of thiobarbituric-acid-reactive substances in diabetes mellitus. Am J Med 1995;98:469-75.
[8] Jennings PE, McLaren M, Scott NA, Saniabadi AR, Belch JJ. The relationship of oxidative stress to thrombotic tendency in type 1 diabetic patients with retinopathy. Diabet Med 1991;8:860-5.

[9] Velazquez E, Winocour PH, Kesteven P, Alberti KG, Laker MF. Relation of lipid peroxides to macrovascular disease in type 2 diabetes. Diabet Med 1991;8:752-8.
[10] Greiling, H., Gressner, A.M., Lehrbuch, D., Klinischen, 1995. Chemie und Pathobiochemie , 3rd , Stuttgart/ New York ;Schattauer Verlag.
[11] Trinder, P., Ann. 1989. Clin Biochem. 6:24-33.
[12] Fong, K.L. , McCay, P.B. , and Poyer, J.L. ; 1973. J. Biol. Chem. , 248: 7792 .
[13] Gullbault, GG and Rietz, E.B. (1976). Enzymatic, Fluorometric Assay of a-Amylase in Serum. Clin. Chem. 22(10): 1702:1704.
[14] Giugliano, D., Ceriello, A., Paolisso G.;"Diabetes mellitus, hypertension, and cardiovascular disease: which role of oxidative stress?"; Metabolism. 44:363-368;1995.
[15] Emanuele, N., Klein, R., Moritz, M., et al;"Comparison of dilated fundus examinations with seven-field stereo fundus photographs in the Veterans Affairs Diabetes Trial"; 2008
[16] Tan, CE., Chew, LS., Chio, LF.;"Cardiovascular risk factors and LDL sub fraction profile in type 2diabetes mellitus subjects with good glycemic control";Diabetes Res Clin Pract. 51:107-14;2001
[17] Annette, M., Chang and Jeffrey, B., Halter;"Aging and insulin secretion";AJP-Endocrinology and Metabolism;2003
[18] Sinha, R., Fisch, G., Teague, B., Tamborlane, WV., Banyas, B., Allen, K., Savoye, M., Rieger, V., Taksali, S., Barbetta, G., Sherwin, RS., Caprio ,S.;"Prevalence of impaired glucose tolerance among children and adolescents with marked obesity" N Engl J Med. 346: 802-810,2004
[19] Bonnefont-Rousselot, D., Bastard, J. P., Jaudon, M. C., Delattre, J. ;"Consequences of the diabetic status on the oxidant/antioxidant balance"; Diabetes Metab. 26:163-176;2000.
[20] Jain, SK., McVie, R., Jackson, R., Levine, S. N. & Lim G;"Effect of Hyperketonemia on Plasma Lipid Peroxidation Levels in Diabetic Patients"; Diabetes Care . 22:1171-75;1999
[21] West, I. C;"Radicals and oxidative stress in diabetes";Diabet Med .17:171–180;2000
[22] Dierckx, N., Horvath, G., Van, C., Vertommen, J., Van De Vliet ,J., De Leeuw, I., Manuel-YKeenoy ,B.;"Oxidative stress status in patients with diabetes mellitus: relationship to diet"; Eur JClin Nutr . 57(8):999-1008;2003
[23] Sandberg AA, Hardt PD. Giessen International Workshop on Interactions of Exocrine and Endocrine Pancretic Diseases: Workshop Report. *J Pancreas.* 2005;6(4):382-405.
[24] Vantyghem MC, Haye S, Balduyck M, Hober C, Degand PM, Lefevre J. Changes in serum amylase, lipase and leukocyte elastase during diabetic ketoacidosis and poorly controlled diabetes. *Acta Diabetologica* 1999;36(1-2):39-44.
[25] Wilson PW, Meigs JB, Sullivan L, Fox CS, Nathan DM, D'Agostino RB Sr. Prediction of incident diabetes mellitus in middle aged adults: the Framingham Off spring Study. Arch Intern Med 2007;167:1068–1074.
[26] Mahreen R, Mohsin M, Nasreen Z, Siraj M, Ishaq M. Significantly increased levels of serum malonaldehyde in type 2 diabetics. *Int J Diabetes Dev Ctries* 2010, 30:49−51.
[27] Hayden MR, et al. Attenuation of endocrine-exocrine pancreatic communication in type 2 diabetes: pancreatic extracellular matrix ultrastructural abnormalities. J Cardiometab Syndr. 2008;3:234–43.