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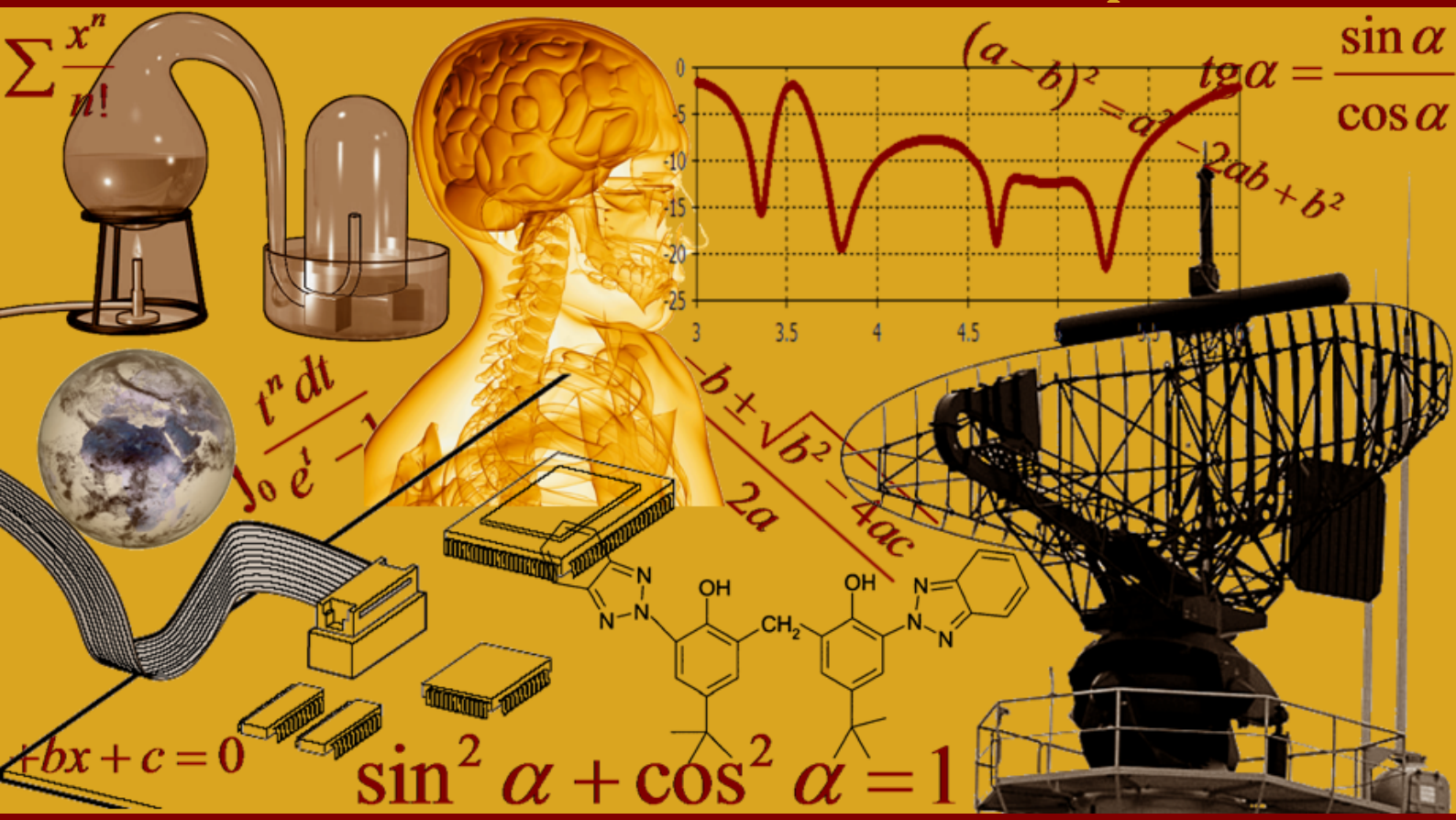


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# Relationship between quality of care for people living with HIV/AIDS and socio-economic variables: A case of Morogoro Municipality, Tanzania

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**ABSTRACT:** Assessment of the relationship between quality of care provided to people living with HIV/AIDS (PLWHA) and socio-economic variables was undertaken in Morogoro Municipality whereby a cross-sectional survey approach was adopted. Ninety PLWHA from two NGOs that are well known to support PLWHA in Morogoro Municipality were involved. Data were collected through face to face interviews. Descriptive and inferential methods of data analysis were used. Six variables were tested to determine their relationship with the quality of care in three components of care. Results showed that counseling and testing was significantly influenced by only the duration of living with the virus while medical care was affected by age and education level of respondents. The communication and behaviour change component was affected by respondents' age and marital status. It is therefore recommended that education be strengthened to PLWHA and even the care providers that high quality of care is essential to all PLWHA regardless of their socio-economic backgrounds so as to improve the quality of and prolong their lives.

**KEYWORDS:** HIV/AIDS, PLWHA, counseling, opportunistic infection, behaviour change.

## 1 BACKGROUND INFORMATION

HIV/AIDS stands for Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome whereas; AIDS is the fatal clinical condition that results from long-term infection with HIV. History shows that AIDS came into public consciousness in the early 1980s as a disease that was primarily affecting white male homosexuals in the Bay area of San Francisco (Almond, 1990). Currently, HIV/AIDS is a world's greatest threat causing deaths largely among the productive young adults (UNAIDS, 2006). However, the Sub-Saharan Africa, Tanzania inclusive, remains the hardest hit region by HIV/AIDS. Almost 70% of the world's people living with HIV/AIDS (PLWHA) live in this region (Amfar, 2014). In 2011, Tanzania was estimated to have 1.6 million PLWHA (Avert, 2014). Currently, the overall prevalence rate in the country is 5.1% whereby, it is 6.2% and 3.8% in females and males respectively (TACAIDS, 2012).

The relationship between HIV and AIDS and socio-economic development is complex. On one hand, HIV and AIDS negatively affect economic growth and on the other hand, the weak economy makes it difficult for nations and individuals to mount adequate and comprehensive responses to the epidemic. In addition, poverty is a co-factor to the spread of HIV and AIDS. Deaths due to AIDS have reduced agricultural labour force, productivity and disposable incomes in many families in rural areas. HIV/AIDS also leads to reduced capacity to deliver social responsibilities because of illness (RCQHS, 2003). Socially, death of a young adult means loss of a father or/and a mother who are the main family income earners, leaving the care burden to the old (grandparents). This tends to increase poverty and food insecurity within the family whereby, orphans not only get deprived of material, social and emotional priviledge, but also lack the opportunity for education and health care. Widows and orphans are deprived of their inheritance rights by relatives through the application of oppressive traditional practices and customary laws. The widows are often blamed for the premature deaths of their husbands and

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spread of the disease to their infants (NACP, 2005). Adequate and quality care for PLWHA is therefore crucial if development is to be achieved.

### 1.1 COUNSELING AND TESTING

HIV testing is the first step in the comprehensive care for PLWHA (other care components include medical care, communication and behavior change, home based care and prevention of mother to child transmission (PMTCT) – the latter two not dealt with in this paper). Despite having HIV testing programmes in sub-Saharan Africa, many people still do not get tested and they get health care only when they are already severely compromised (Phaladze, 2005). Testing in Tanzania is done either at voluntary bases or when a sick person needs treatment that involves blood examination or transfusion, and this is done only where such services are provided. Once and individual has tested and found to be HIV-positive, then she or he becomes eligible for enrollment in home based care organization if she or he wishes and eligible for Anti-retroviral drugs (ARVs) if CD4 count is below 200 (NACP, 2005). HIV infection affects all dimensions of a person's life: physically, psychologically, socially and spiritually. Counseling should consider both the physical and mental well-being of a person. Voluntary counseling and testing (VCT) for HIV, plays the key part in HIV-related prevention and care. It is particularly important as a starting point for the access of other HIV/AIDS-related services (WHO, 2001). If a person does not know she or he is affected, she or he can't get any treatment or care. It is widely recognized that knowledge of HIV infection can help a person to stay healthy for longer as well as preventing new infection.

VCT also provides benefit for those who test negative because it may result in change of behavoiour (WHO, 2001).) Ideally, care for PLWHA should start with voluntary counseling and HIV testing. Counseling should inform people about the facts of HIV infection. Correct information helps to dispel myths about HIV and AIDS. Counseling is also crucial to the success of any medical treatment. It is important that the person understands why and how illnesses related to HIV should be treated. The person should also be informed what treatment and care services are available locally and how they can be accessed. Even in very resource poor settings with minimum infrastructure, some treatment can be made available (NACP, 2005). Counseling is done with information on basic technical aspects of screening and the possible personal, medical, social, psychological and legal implications of being diagnosed either positive or negative (MOH, 2005). It is worth noting that quality of counseling is very important as from this point, is when the person living with HIV/AIDS can live positively and get assisted to work through particular problems she/he faces (SAT, 2003).

### 1.2 MEDICAL CARE

Although hospitalizations and deaths have decreased since the implementation of ART, opportunistic infections remain a leading cause of morbidity and mortality in HIV- infected persons (Buchecz *et al*., 2008). There are different conditions that typically occur at different stages if HIV infection. In early HIV disease, people can develop tuberculosis, malaria, bacterial pneumonia, herpes zoster, staphylococcal skin infections and septicaemia (Avert 2014). These are diseases that people with normal immune systems can also get, but with HIV they occur at a much higher rate. It also takes longer for a person with HIV to recover than it takes for someone with a healthy immune system. When the immune system is very weak due to advanced HIV disease or AIDS, opportunistic infections such as toxoplasmosis and cryptococcusis develop. Some infections can spread to a number of different organs, which is known as 'disseminated' or 'systemic' disease. Many of the opportunistic infections that occur at this late stage can be fatal. Providing prevention and treatment of opportunistic infections not only helps HIV-positive people to live longer healthier lives, but can also help prevent TB and other transmissible opportunistic infections from spreading to others (Avert, 2014).

Patients with HIV also have typical health care needs beyond conditions related to HIV (Aberg, 2004). These include the need for routine, age-appropriate health-maintenance screening for cardiovascular health and for cancer (breast, prostate, colorectal). This means PLWHA need baseline evaluation in health maintenance interventions, opportunistic infection prophylaxis and antiretroviral therapy (Khalsa, 2006). One component of health maintenance in patients with HIV is routine vaccinations such as for tetanus and diphtheria. The overall goal of antiretroviral therapy is to convert HIV infection into a chronic disease by suppressing viral replication to arrest or revert immunodeficiency progression and preventing opportunistic complications.

### 1.3 COMMUNICATION AND BEHAVIOUR CHANGE

Behaviour change is one of the services provided to PLWHA. There are two aspects to behaviour change counseling: one is to encourage persons who have tested HIV negative to adopt behaviours and lifestyle patterns that may be less risky than

those practiced before the test. The other one is to encourage those who have tested positive to adopt behaviours and lifestyle patterns that enhance their own health status and that prevent further transmission of HIV (RCQHC, 2003). In Asian countries, HIV infection is attributable primarily to various high- risk behaviours such as unprotected sexual intercourse with sex workers, and injection-drug use (UNADS, 2006). The most important prevention approach is education and behavior modification (Gallant, 2004)) whereby emphasis should be on behavioural intervention strategies that focus on interpersonal prevention skills rather than just patient knowledge. Positively reinforcing incremental changes toward safer behavior and addressing how to disclose HIV-seropositive status to a sex or drug partner is also important (CDC, 2003). However, other studies (Goldschmidt, 2004, Bryson, 1996) have documented the safest sexual practices for PLWHA to be abstinence followed by monogamy. For patients who are neither abstinent nor monogamous, the physician should convey the following infection prevention messages: consistent and correct condom use, sex only while they are sober, reduced number of sex partners and less mucosal trauma. For patients who use intravenous drugs, physician should recommend cessation of illicit drug use or, if this is unlikely, using sterilized or new needles and not sharing needles.

## 2 PROBLEM STATEMENT

However, some studies have shown variations in health care for PLWHA. In a study by Opiyo *et al*. (2008) in Western Kenya, it was found that about 90% of afflicted men received hospitalized care before their death compared to only 64% of women. The reasons given were; lack of someone to remain with children at home, even where the husbands were alive and well and that it is easy to replace a wife as men can be polygamous. Also more affluent families seek medical care from different hospitals and clinics as well as herbalists, willing to spend considerable amounts of money on medical care, which they believe might prolong their lives (UNIFEM, 2009). Further, religious-based stigma can also have negative influence on uptake and adherence to HIV care. Watt *et al*. (2009) observed high perceptions of stigma in religious communities usually related to associations between HIV infection and “sinful” sexual behaviour. This therefore shows that care for PLWHA depends on some social, economic factors as well as the gender of a person. It is from this point of view that the current study was aimed at finding out the relationship between quality of care provided to PLWHA and various socio-economic and demographic variables in Morogoro Municipality.

## 3 METHODOLOGY

As explained earlier the study was conducted in Morogoro municipal and the respondents were drawn from two non-governmental organizations (NGOs) namely Faraja Trust Fund (FTF) and Wanaoishi na Virusi vya Ukimwi Morogoro (WAVUMO), meaning people living with HIV in Morogoro. A total sample of 90 (40 from FTF and 50 from WAVUMO) PLWHA were purposively selected from the total population of PLWHA from the two organizations for interview. Care was taken to ensure desired representation of specific subgroups of males and females, different age groups and marital status and different education levels and occupations. Also two informants who were members of the management team from each organization were interviewed. Other stakeholders such as collaborating NGOs, Morogoro Regional and District Medical Officers, and Morogoro Regional and District AIDS Coordinators were consulted. In order to assess the quality of care provided to PLWHA, score indexes were developed with respect to three caring parameters which were counseling and testing (index A), medical care (index B) and communication and behavior change (index C). A panel of relevant experienced experts and practitioners from the Sokoine University of Agriculture and Tanzania Commission for AIDS (TACAIDS) were consulted to suggest the parameters to be included. A draft was complied and given to the experts for comment before the indexes were used to collect data. Ruel and Purmima (2002) used a similar approach of scoring system to quantify child feeding practices and used the scores to examine associations between child feeding practices and nutrition.

**A). Variable and scoring system for counseling and testing**

| **Variable** | **Coding** |
|---|---|
| Availability of pre-test counseling | Yes= 2, No = 0 |
| Quality of pre-test counseling<br>Waiting time before consulting the counselor<br>Duration of consultation with the counselor<br>Clarity of information received from the counselor<br>Quality/depth of information received from the counselor<br>Usefulness of information received from the counselor<br>An opportunity to ask questions during the consultation | For each parameter:<br>Poor = 0, Fair = 1, Good = 2, Very good = 3, Excellent = 4 |
| Availability of post- test counseling | Yes = 2, No = 0 |
| Quality of post-test counseling<br>Emotional support given by counselor<br>Easiness of making new appointments<br>Overall quality of counseling session | For each parameter:<br>Poor = 0, Fair = 1Good = 2, Very good = 3, Excellent = 4 |
| **Maximum/Minimum** | **40/0** |

**B). Variable and scoring system for medical care for PLWHA**

| **Variable** | **Coding** |
|---|---|
| Quality of services received from health facility | Poor = 0, Fair = 1, Good = 2, Very good = 3, Excellent = 4 |
| Paying for health facility services | Yes = 2, No = 0 |
| Cost paid at the health facility | High = 1, Fair = 2, Low = 3, Don't know = 0 |
| Failed to get health services at least once | Yes = 2, No = 0 |
| Frequency of missing health services | None = 4, Once = 3, Twice = 2, Thrice = 1, >4times =0 |
| **Maximum/Minimum** | **15/0** |

**C). Variable and scoring system for communication and behaviour change care for PLWHA**

| **Variable** | **Coding** |
|---|---|
| Awareness of importance of behaviour change | Yes = 1, No = 0 |
| Have you opted changing your sexual behaviour?<br>Yes, already, Have started, I don't think I will,<br>Have no plan for that | Yes, already = 3, Have started = 2<br>I don't think I will / have no plans for that = 0 |
| Perceived level of information on HIV/AIDS:<br>I have received enough information<br>I have not received enough information<br>Not at all | Enough information = 2<br>Not enough information = 1<br>Not at all = 0 |
| Sources of services obtained on behaviour change:<br>Training, Meeting, IEC, Media, PMTCT | For each parameter;<br>Yes = 1, No = 0 |
| **Maximum/Minimum** | **11/0** |

Quantitative data analysis was conducted using computer program Statistical Package for Social Sciences (SPSS) version 16.0. Descriptive statistics were computed to determine the quality of care provided to PLWHA. Inferential statistics were computed to show relationship between dependent and independent variables. This involved cross-tabulations with t-test statistics. Qualitative data were analyzed using content analysis.

## 4 ETHICAL CONSIDERATION

Ethical considerations were abided to throughout this study. Consent was obtained orally after a participant was given all the information about the project. Confidentiality of the information provided by the respondent and the organization was ensured.

## 5 RESULTS AND DISCUSSION

In order to allow for comparisons, the scores in each of the care score indexes (A, B and C) were converted to percentages of the maximum possible score. Therefore each parameter had 100 as the maximum score and 0 as the minimum score. Scores were categorized as very low quality of care (0-20), low quality of care (21-40), moderately high quality of care (41-60), high quality if care (61-80) and very high quality of care (81-100). T-tests for mean values of various variables were conducted to determine the relationship between the extent of care in the selected care components namely counseling and testing, medical care and communication and behaviour change. The variables tested included duration of living with HIV, age, gender, occupation, marital status and level of education.

### 5.1 COUNSELING AND TESTING

Findings revealed that there was significant difference at $p \leq 0.05$ in quality of counseling between the respondents who have lived with HIV for 0-2 years and those of 3-4 years whereby the former scored higher than the latter as shown in Table 1 below. The possible reason could be that the PLWHA who have lived for a shorter time with their positive serology tend to attend and adhere more to counseling than those who have lived longer with their positive serology. It can further be explained that perhaps messages that are provided during the counseling are the same so much that PLWHA are not motivated to continue receiving the service. The other duration categories as well as the other variables showed no significant difference in their mean values.

**Table 1: Quality of counseling and duration of living with HIV/AIDS**

| Duration category | Mean score | t | Significance (2 tailed) |
|---|---|---|---|
| 0-2 year | 51.7614 | 2.251 | 0.028* |
| 3-4 years | 35.4348 | | |
| 0-2 years | 51.7614 | -0.003 | 0.997 |
| 5-18 years | 51.7857 | | |
| 3-4 years | 35.4348 | -1.798 | 0.079 |
| 5-18 years | 51.7857 | | |

Key: * indicates $p \leq 0.05$

### 5.2 MEDICAL CARE

Results in this care component revealed no significant difference in the mean values of care quality in the four variables that is gender, marital status, occupation and duration of staying with the disease. As far as age is concerned, respondents in various age groups were found to score significantly different values of quality of medical care (Table 2). Old adults scored the lowest quality of medical care and this may be due to the fact that the most young people and adults are more economic independent and thus tend to have more access to medical care. Adults who scored the highest were probably more responsible to themselves and to their families and hence tend to seek whatever medical care they could obtain.

**Table 2: Quality of medical care and age**

| Age group | Mean score | t | Significance (2 tailed) |
|---|---|---|---|
| Young (16-30years) | 35.4545 | -0.823 | 0.414 |
| Adults (31-45 years) | 37.5362 | | |
| Young (16-30 years) | 35.4545 | 2.154 | 0.037* |
| Old adults (≥46 years) | 28.7879 | | |
| Adults (31-45 year) | 37.5362 | 3.482 | 0.001*** |
| Old adults (≥46 years) | 28.7879 | | |

Key: * indicates $p \leq 0.05$ and *** indicates $p \leq .001$

Further, findings showed significant difference at $p \leq 0.05$ in the mean scores among various categories of education. As indicated in Table 3 below, primary/adult education level scored higher in quality of medical care than those with secondary education and above. It is likely that most of the educated individuals living with HIV/AIDS tend to shy away to be seen that they are infected. They therefore tend to miss some of the very important services including medical services. Free medical services for PLWHA were only provided to individuals who have declared their status and who were willing to attend in person.

**Table 3: Quality of medical care and education level of respondent**

| Education category | Mean score | t | Significance (2 tailed) |
|---|---|---|---|
| Primary and adult education | 35.9259 | 2.157 | 0.034* |
| Secondary education and above | 29.2308 | | |
| Primary and adult education | 35.9259 | 0.276 | 0.783 |
| No formal education | 34.6667 | | |
| Secondary education and above | 29.2308 | -0.896 | 0.384 |
| No formal education | 34.6667 | | |

Key: * denotes $p \leq 0.05$

### 5.3 COMMUNICATION AND BEHAVIOUR CHANGE

Among the test variables that were considered, only those categories of age and marital status were significantly different in the way in which they were related with communication and behaviour change care component at $P \leq 0.05$.

**Table 4: Quality of communication and behaviour change care and age**

| Age group | Mean score | t | Significance (2 tailed) |
|---|---|---|---|
| Young (16-30years) | 56.6116 | -1.744 | 0.086 |
| Adults (31-45 years) | 63.2410 | | |
| Young (16-30 years) | 56.116 | -2.140 | 0.038* |
| Old adults (≥46 years) | 66.1157 | | |
| Adults (31-45 year) | 63.2410 | -0.819 | 0.416 |
| Old adults (≥46 years) | 66.1157 | | |

Key: * denotes $p \leq 0.05$

The study results revealed that old adults (46 years and above) scored the highest and this was particularly so as compared to young respondents at $p \leq 0.05$ (Table 4). This could be that the old adults are a group that is having a lot of responsibilities on matters concerning their lives and possibly their marriages and also is an age group that cares for a number of people (dependants). Therefore, this age group is likely to seek for more information and be willing to change behaviour than the young age group. With marital status, the findings showed significant difference in the mean scores between the single and the married/cohabiting couples at $p \leq 0.01$ as can be seen in Table 5 below, whereby the latter group scored higher than the former group.

**Table 5: Communication and behaviour change care and marital status**

| Marital status | Mean score | t | Significance (2 tailed) |
|---|---|---|---|
| Single | 54.0670 | -2.838 | 0.007** |
| Married/cohabiting | 66.4334 | | |
| Single | 54.0670 | -0.936 | 0.357 |
| Divorced/separated | 59.5041 | | |
| Single | 54.0670 | -2.704 | 0.009** |
| Widow | 64.7059 | | |
| Married/cohabiting | 66.4334 | 1.350 | 0.186 |
| Divorced/separated | 59.5041 | | |
| Married/cohabiting | 66.4334 | 0.501 | 0.618 |
| Widow | 64.7059 | | |
| Divorced/separated | 59.5041 | -1.114 | 0.271 |
| Widow | 64.7059 | | |

Key: ** indicates $p \leq 0.01$

The possible reason could be that, the married/cohabiting respondents tend to support each other and hence give each other some useful information regarding their care. Likewise, being a couple, they might be having some responsibilities to their children or relatives hence could be trying to search for more information with regard to their care so as to stay healthy for longer. Significant difference was also noted between the single and widowed respondents at $p \leq 0.01$, with widows showing higher scores. Having lost heir spouses, the widows are more likely to accept behaviour change than the singles.

## 6 LIMITATIONS OF THE STUDY

The findings of this study are limited to people living with HIV/AIDS from Faraja Trust Fund and Wanaoishi na Virusi vya Ukimwi Morogoro NGOs in Morogoro. They therefore should not be generalized.

## 7 CONCLUSION AND RECOMMENDATIONS

There are still some socio-economic and demographic variables which influence various aspects of quality of care for HIV/AIDS infected people. These include age, marital status, education level and the duration one has been living with the virus. There is a need therefore, to educate PLWHA on the importance of quality care for all so as to improve and prolong their lives. Further, PLWHA should be enabled to improve their economic situation by providing them with low interest loans, training and support for expanding their businesses. Also, counseling should be strengthened as a support for other services provided to PLWHA since it is a cross-cutting type of service involving all other care components.

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# Recession of Satopanth and Bagirath Kharak Glacier, Using Multi Temporal Set of Data

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**ABSTRACT:** The changes in climate variability have led to a rapid retreat of mountain glacier systems which are considered the lifeline of river basins and ecosystems. Scientific studies have shown that 67 % of glaciers are retreating at a startling rate in the Himalayas as a result of various factors including climate change. Glaciers and small ice caps in temperate environments are sensitive indicators of the change in climate. Satopanth and Bhagirath Kharak glaciers are located at the head of the Alaknanda valley in Chamoli District. Retreat of the snouts and area vacated by recession of the glaciers were estimated for 51 years by way of superimposing the Survey of India Toposheets of 1962 on the map .Snouts of the Satopanth and Bhagirath Kharak glaciers recorded continuous recession for the past five decades, with decline in recession of both cases. The retreat rate of Satopanth glacier is 2.88 m/year while Bagirathi Kharak retreat at a rate of 1.21 m/year which is much more less in comparison to Satopanth glacier. Retreat in the length of Satopanth and Bagirathi Kharak glacier was 2.28km and 0.66 km respectively from the period (1962-2013). The total area vacated by the Satopanth and Bhagirath Kharak glaciers during 51years was (0.354 sq. km) and (0.14 sq. km) respectively. This paper presents the results obtained from the analysis from the set of multitemporal satellite data, SOI Toposheets 1962, Satellite data of Landsat 1976, 1990, LISSIII 2000,2010 and CARTOSAT-1& LISS IV 2013 are used in the study.

**KEYWORDS:** Satopanth, Bhagirath Kharak Glaciers Glacier Retreat, Satellite Data.

## INTRODUCTION

Impacts on high mountain systems including glacial retreat are amongst the most directly visible signals of global warming. One of the most important and visible indicators of climate change is the recession of glaciers in many parts of the World including Himalayan glaciers. On a time scale recent glaciations occurred around 20,000 years ago as part of the earth's pale climatic history. Although the recession of glaciers has been suggested by some scientists as a natural phenomena, in the latter half of 20th century. Warmer climate in the future may cause increased melting of glaciers, which will lead to a rise in sea level.. Monitoring of glaciers actuates scientific interest for two main reasons. First, Glaciers change monitoring has been used for climatic change investigation. The surface area and volume of individual glaciers are monitored to estimate future water availability. Second, glaciers in Indian Himalayas, have been recognized as important water storage systems for municipal, industrial and hydroelectric power generation purposes. The present study deals mainly with climatic change and its impact on the Himalayan glaciers. Glaciers all over the world have been shrinking since the last ice age, and they experience melting every year. The increasing temperatures of climate change are speeding up the shrinking process – a concern usually captured in the terms "glacier melt" and "glacier retreat" (S. Swaroop and S. P. Shukla. Changes in glacier melt amounts and patterns, along with other changes in high-altitude hydrology, will affect agricultural production across the region. In the Himalaya, glacier and snow-melt form an important source of water into the North Indian rivers. However, this source of water is not permanent as glacial dimensions change with climate. Along with glacier melt changes, increased temperatures will reduce snow cover throughout the winter but especially in spring, and monsoon patterns will likely change as well. The natural environment, ecosystems with high biodiversity, and human populations that live in these watersheds may experience severe impacts. Although the pace of glacier retreat is slower than was thought at the time of the project's initiation, the phenomenon is occurring.. The river basins are important for Indian economy, as numerous power projects are

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under operation and construction here. Therefore, changes in glacial extent and their influence on river run-off are important to plan future strategies of power generation.

## STUDY AREA

The glaciers are situated at the head of the Alaknanda valley in Chamoli District, Uttarakhand. The major portion of the glaciers falls in the Survey of India topographic map N/6 , 53 N/5, and N/1. The glaciers are located between lat. 30°43'47"–30°43'28"N and long. 79°11'53"–79°29'30"E. The Satopanth and Bhagirath Kharak glaciers are approximately 14.29 and 19.17 km long with an average width of 767–872 m, covering an area of 23.17 and 31.17 sq. km respectively. The Upper Alaknanda watershed covers an area of 234.35 sq. km, out of which 70.70 and 107.22 sq. km are covered by the Satopanth and Bhagirath Kharak sub-watersheds respectively. It lies on the northwest side of Nilkanth, a major peak of the Garhwal division of the Himalayas. It sits below a 2,500 m (8,200 ft) face of the peak. Originating at a height of 7000 meters from the peaks of the Chaukhamba (7068m) and the Badrinath (6974m) mountains, this glacier melts into water at an altitude of 3810 meters. The Narayan Parvat and the foot of Balkun peak, touches the glacier.

## DATA USED AND METHODOLOGY

Monitoring of Himalayan glaciers, using conventional methods, is normally a difficult exercise due to the rugged and inaccessible nature of the terrain with the application of remote sensing techniques in mid-seventies now monitoring and mapping of glacier became easier . Extensive work, based on spectral reflectance characteristic of snow and glacier, was done with Multi temporal satellite data .

***Table 1: Satellite and topographic data used in the study***

| Satellite Name | Resolution | Date Of Acquisition |
|---|---|---|
| LISS IV data | 5.8m | 2013 |
| LISS IV & Cartosat Merged data | 2.5m | 2011 |
| LISS III data | 23.5m | 2006 |
| AWIFS data | 64 m | 2012 |
| Landsat MSS data | 30 m | 1976 |
| Landsat TM data | | 1990 |
| SOI Toposheets maps at 1:50,000 | | 1962 |

This investigation has been carried out using data from a number of Indian Remote Sensing satellites. In this study LISS IV (5.8m) Cartosat Merged data(2.5m) , LISS III(23.5m) , Landsat TM (30m) are used for finding retreat and mapping. The oldest information about glacial extent is available on Survey of India topographic maps, surveyed in 1962, using vertical air photographs and limited field investigations. Mapping of glacial extent in 2006,2013 was carried out using LISS-IV images, in the year 2000 LISS-III images are used, for 1976 and 1990 Landsat images were used. Images covering July–September period were selected, because during this period snow cover is at its minimum and glaciers are fully exposed. Glacier boundary was delineated using topographic maps and digitized using Geographic Information System. On satellite images glacial boundary was mapped using standard combinations of bands. Image enhancement technique was used to enhance the difference between glacial and non glacial areas. Ancillary data like basin boundaries, river, Glacier boundary, drainage and spatial frame work parameters (1:50, 000 scale) Survey of India topographic map frames were taken from NRDB database. Elevation values were derived from aster-DEM given in meter.

The present study involves mainly delineation of the terminus portion of the glacier. Hence satellite data devoid of fresh snow at lower altitudes of the glacier were selected. The steps include geo-rectification of maps, Orthorectification, co-registration, interpretation and digitizing the glacier outlines. Subsequently, the Satopanth and Bagirathi Kharak Glacier terminus position was digitized from satellite imageries of 1976, 1990, 1999 and 2010, and 2013. Delineation of the Glacier boundary and terminus from satellite imagery was carried out using standard false color composite (FCC) band combination of SWIR, NIR and green bands for red, green and blue channels respectively. Reflectance of debris/rock in SWIR band was higher than that of ice; therefore, debris cover on the glacier gives a red tone in the aforementioned FCC image. Snow is characterized by a high reflectance in visible spectral region and a rather strong absorption in the SWIR region. Therefore, ratio of visible band/SWIR band can differentiate the snow and non snow covered surfaces. To estimate change in glacial area, the glacier boundaries of two time frame data of glacier extent are overlaid on each other. The two time frame

data/glacier boundaries are brought to common scale. While matching the boundary, the scale of the map and image is kept at 1:50,000 because the mapping depends on the scale. Increase or decrease in the evacuated area from glaciers can be measured.

IRS-P6 LISS-III satellite data has been used for preparing geomorphologic map of the study area. The major landforms exposed in this area are of glacial origin. Some landforms of structural, denudation land fluvial origin are also exposed in this area. Under the geomorphic units of glacial origin, the area has glacial terrain and valley glacier. The landforms here include medial moraine and lateral moraine. The geomorphic units of structural origin have highly dissected structural Hills and valleys. The landform of denudation origin has piedmont slope. The landform of fluvial origin has piedmont alluvial plain.Biotite Granite & Tourmaline Granite of Gangotri formation and Vaikrita Group rocks are exposed in this area. The Vaikrita Group mostly composed of migmatites Gneiss and Granite. Change in snout position was ascertain by mapping Satopanth and Bhagirath Kharak glacier from 1962-2013 .The snout of the glacier represent the total health of glacier, the snout is a vital part for the interpretation of glacial extracts . The terminus is identified on satellite data using multiple feature the snout is the originating point of river and river can be easily identified in the image. The peri-glacier area downstream of the snout has distinct geomorphologic set up then the glacier surface. The area vacated was estimated by taking the snout position marked in the Survey of India topographic map (53N/5) of 1962 and comparing it with the present position using set of satellite data. The position of snouts in 1962 was observed at the height of 3726mt with the help of aster DEM, in 1962 the Satopanth and Bagraitah Kharak glacier snout was single but at the steady rate the fragmentation of these two glaciers was started after 1976 .In 1962 the length of Satopanth and Bhagirath Kharak glacier was 14.29 km and 19.17 km respectively. Total decline in the length of Satopanth glacier and Bagirath Kharak glacier 2.28 km and 0.66 km respectively. Rate of Satopanth glacier recession was higher than Bhagirath Kharak glacier.

***Table 2: Length of Satopanth Glacier from 1962-2013***

| Period | Length of Satopanth glacier (km) | Vacated area |
|---|---|---|
| 1962 | 14.29 | - |
| 1976 | 13.94 | 0.35km |
| 1990 | 12.67 | 1.27km |
| 2010 | 12.36 | 0.31km |
| 2013 | 12.01 | 0.35km |

***Table 3: Length of Bhagirath Kharak Glacier from 1962-2013***

| Period | Length of Bhagirath Kharak glacier (km) | Vacated area |
|---|---|---|
| 1962 | 19.17 | |
| 1976 | 19.00 | 0.17km |
| 1990 | 18.81 | 0.19 km |
| 2010 | 18.67 | 0.14 km |
| 2013 | 18.51 | 0.16 km |

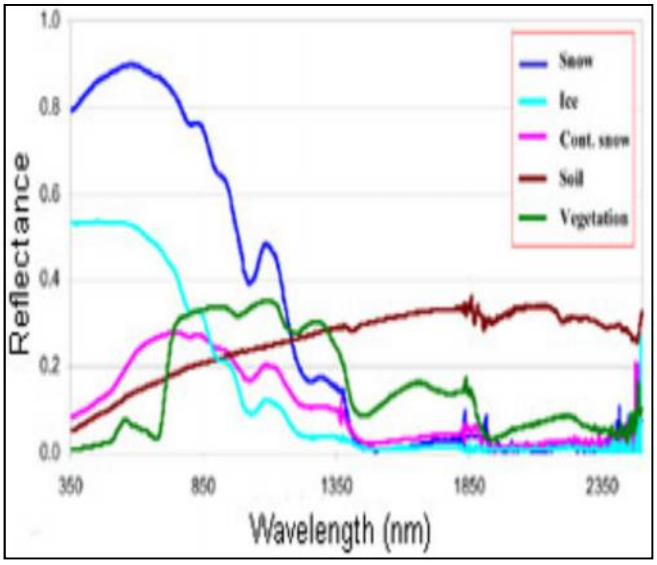


*Fig 1: Spectral reflectance of snow, ice contaminated snow, vegetation and soil.*

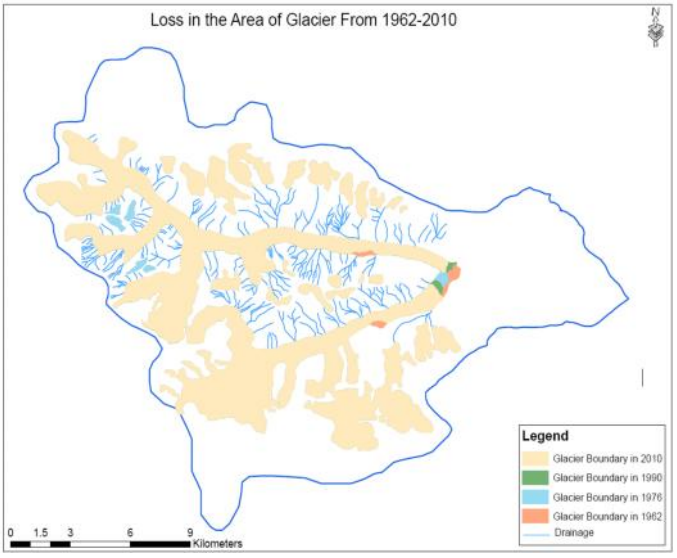


*Fig 2:Glacier Boundary of Satopanth and Bagitahi Kharak Glacier from 1962-2010*

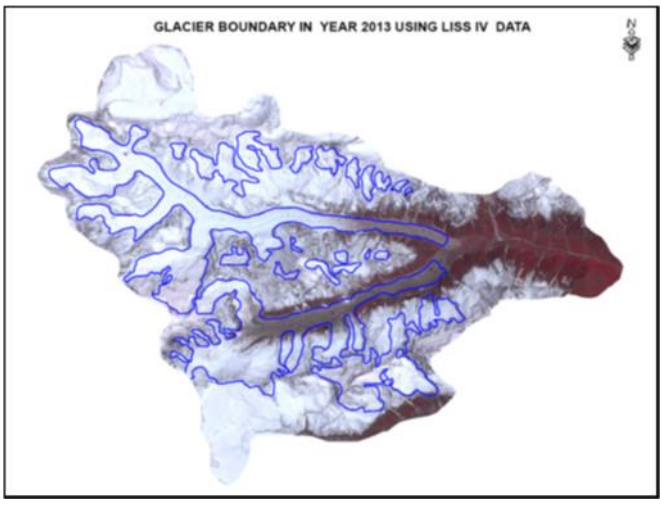


*Fig 3:Glacier Boundary of Satopanth and Bagitahi Kharak for the year 2013using LISS IV data*

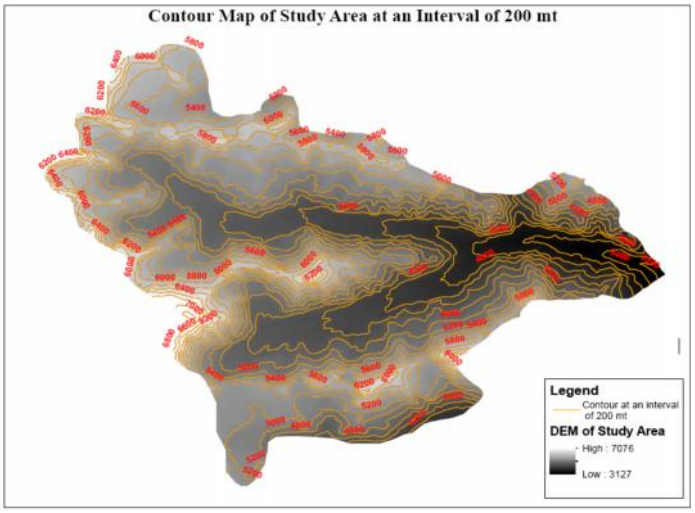


*Fig4:Contour Map at an Interval of 200 mt using ASTER DEM*

*Table 4: Snout Recession of Satopanth and Bagirathi Kharak Glacier Between 1962 And 2013*

| Period | Snout Position of Satopanth Glacier (using aster DEM) | Snout Position of Bhagirathi Kharak Glacier (using aster DEM) | Retreat of Satopanth glacier | Retreat of Bhagirathi Kharak glacier |
|---|---|---|---|---|
| 1962 | 3726mt | 3726mt | - | - |
| 1976 | 3827mt | 3774mt | 101mt | 48mt |
| 1990 | 3836mt | 3771mt | 9mt | 3mt |
| 2006 | 3872mt | 3761mt | 36mt | 10mt |
| 2013 | 3873mt | 3762mt | 1mt | 1mt |

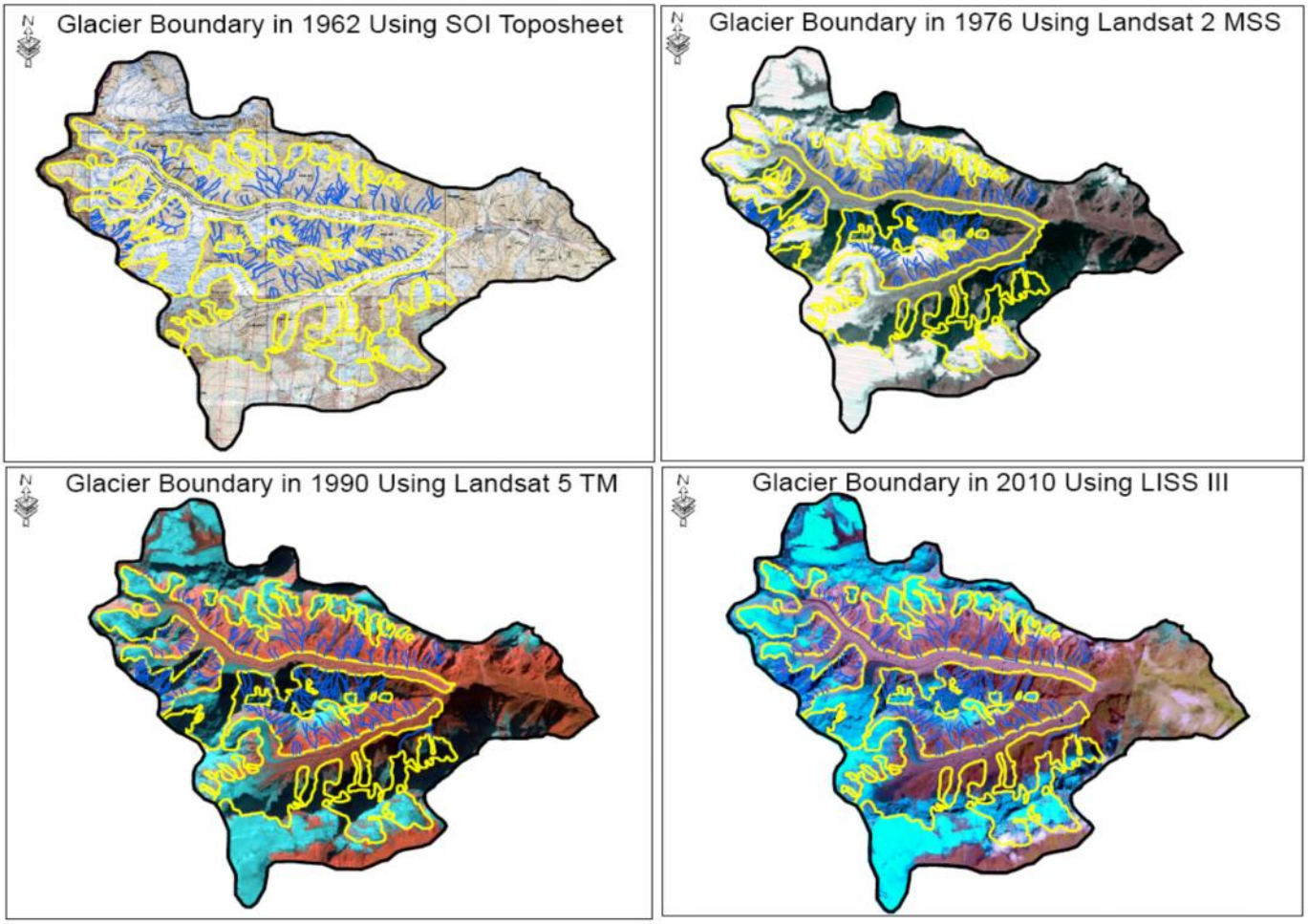


*Fig 5: Glacier Retreat of satopanth and bagirath kharak Glacier from 1962 to 2010*

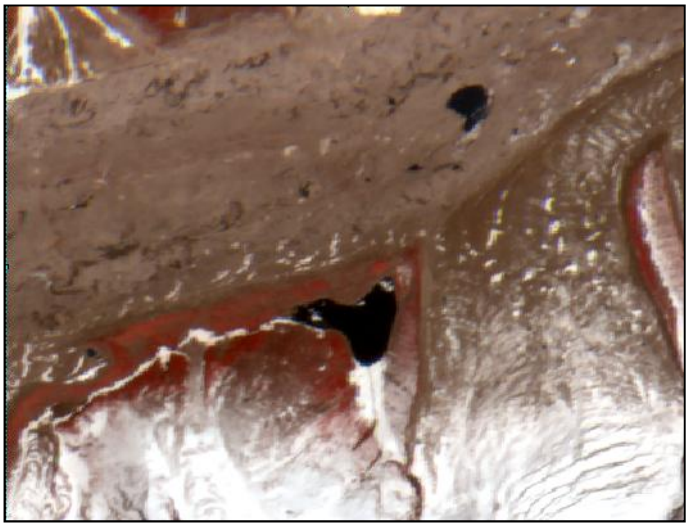

*Fig 6 :Satellite imagery LISS-IV sensor showing Satopanth lake near Satopanth galacier*

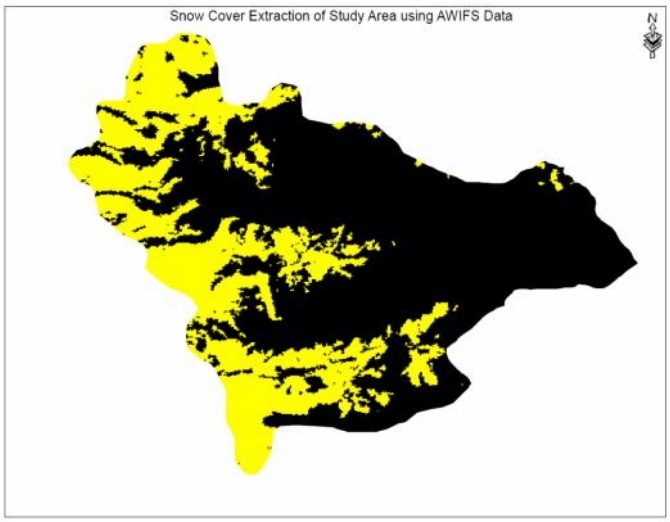


*Fig7: Snow Cover Extraction of Study Area using NDSI*

*Figure 8 :Field Photograph Showing Satopanth Lake Near the Snout of Satopanth Glacier.*

*Figure 9: Field photograph of terminus region of Satopanth Glacier in year 2011.*

Identification and mapping of glacier boundary and terminus is one of the important aspects of estimation of retreat. If glaciers are not covered by debris, identification of snow, ice and rock on satellite images is possible due to substantial difference in spectral reflectance. A satellite imagery of LISS-IV sensor showing glacial boundary of 1962 and 2013 is given in Figure 10. Identification and mapping of glacial terminus in a satellite imagery is normally difficult if glaciers are covered by debris Sometimes a glacial terminus is characterized by a steep ice wall. Depending upon relative positions of the sun and the wall, it can form shadow in downstream, which can be used as a marker for terminus delineation.

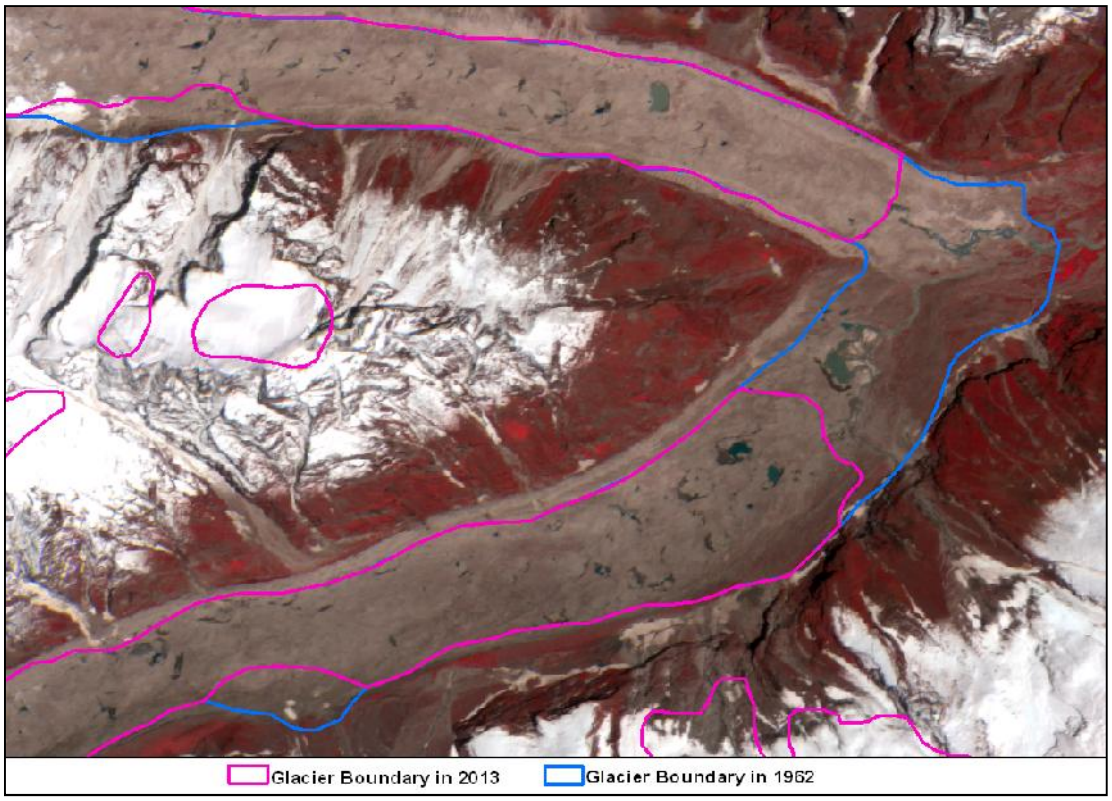


*Figure 10. Resourcesat imagery of LISS-IV sensor dated June 2013 showing Glacier Boundary in 1962 and 2013*

## CONCLUSION

Globally, glaciers are considered to be the sensors of climate change. Any small disparity in the climate will affect the accumulation and ablation rate of glaciers, which in turn affects mass balance of the glaciers. Accurate determination of these glacier changes may be useful in assessing regional hydrological responses in Indian rivers. The retreat of glaciers in the Himalaya has significant impact on the environment, including freshwater supply, diminishing wetlands and unstable stream runoff. Remote sensing offers promise for glacier monitoring in areas lacking traditional glaciological methods. In the study it is observed that Snouts of the Satopanth and Bhagirath Kharak glaciers record continuous recession from 1962 to 2013 which decreased in the year from 1976-1990, recession in the Satopanth glacier is much more higher then Bhagirath Kharak glacier. The retreat rate of Satopanth glacier is 2.88 m/year while Bagirathi Kharak retreat at a rate of 1.21 m/year. Processes of individual glacier also play a pivotal role, in the fluctuation of the rate of glacial melting. The study shows that repetitive space-borne optical data can be used to obtain glacier dynamics of inaccessible terrains of the Indian Himalaya. The lack of in situ meteorological data in many parts of the Indian Himalayan terrain limits better understanding of such environmental changes measured from space. the , larger glaciers are being fragmented into smaller glaciers. In future, if additional global warming takes place, the processes of glacial fragmentation and retreat will increase, which will have a profound effect on availability of water resources in the Himalayan region.

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# Rapid Synthesis of Silver Nano Particles Capped In Starch and its Anti - Mold Activity

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**ABSTRACT:** A rapid preparation of nanomaterial of noble metal (Silver) via chemical reduction is presented. Silver nitrate (oxidizing), glucose (reducing) and corn starch was the capping agents.
Corn starch stabilized Silver Nanoparticles (AgNPs) synthesized rapidly in aqueous system via the assistance of microwave irradiation had its Surface Plasmon Resonance (SPR) monitored by a UV-Visible Spectrophotometer and peaked at 400nm. Further characterization was by FT-IR and TEM/ SAED. Self-assembly of starch-capped silver nanoparticles gave a mirror-like glassy film surface on drying. According to the FT-IR spectroscopy, AgNPs revealed the shifting of N-H and O-H of starch still exists. TEM gave average particle size of 7nm. Result also showed that AgNPs can inhibit the growth of mold (A*. niger*). Method is reliable, ecofriendly, cheap and evident by the properties of the nanoparticles obtained.

**KEYWORDS:** Starch, Silver nanoparticles, Microwave, SPR and anti-mold.

## 1 INTRODUCTION

The many properties of silver is well known and the synthesis of its nanoparticles (usually ranging in size from 1 to 100 nm), has become prevalent because its nanoparticles is being used for numerous applications, physically, medically/ pharmaceutically and biologically. They have been reported to have a larger surface area than macro-sized materials as well as presenting new properties which has earned them the several applications. A number of synthetic methods have been

employed for the synthesis of silver-based nanoparticles involving physical, chemical and biochemical techniques [1]. Silver Nanoparticles (AgNps) has found application in the purification and quality management of air, biosensing, imaging, drug and pesticide delivery systems as well as in coatings for solar energy absorption, as optical receptors, as catalysts in chemical reactions and as antimicrobials. With increasing focus on green chemistry, natural compounds like glucose, chitosan, starch, have attracted considerable research interest as safer alternatives, reducing and stabilizing agents to synthesize the silver nanospher [2], [3], [4]. The most popular preparation of silver colloids is chemical reduction of silver salt which may appear simple, but great care must be exercised to make stable and reproducible colloid. Starch has been shown as a good capping agent for many work on inorganic nanoparticles such as gold and silver to form inclusion complexes [1]. Starch is one of the most abundant materials on earth due to its cheapness, it is widely-used in stabilizing and controlling size and shape of metal nanoparticles [5]. The possibility of Preparing nano-sized metals and metal oxides, mainly silver (Ag), titanium dioxide (TiO2), zinc oxide (ZnO) and cooper II oxide (CuO), has brought about the development of novel ranges of biocides.

AgNps biocidal action against microbial has been proposed to be that Ag interacts with the -SH groups of proteins on the cell walls, thereby blocking respiration and causing death [6]. Other reports have that "pits"are formed in the cell wall of bacteria, thereby causing permeability and resulting in death [7]. Yet another explains silver ions form metal-organic complexes and insoluble compounds with the sulphhydryl groups in cell walls of bacteria and fungi, inhibiting metabolism and electron transport by making essential enzymes dysfunctional [8].

Silver is safe and non-toxic to animal cells and highly toxic to bacteria such as *Escherchia coli* (*E. coli*) and *Staphylococcus aureas* as well as fungi [9]. Nano silver in the form of powders as well as suspensions, due to the high surface to volume ratios, has been used as anti-bacterial because it enables the loading of small quantities of silver and thus makes the product cost effective [10],[11]. Molds live everywhere—on logs and on fallen leaves, in the soil/dust and in moist places like bathrooms and kitchens

Spoilage by mold is a serious and costly problem for many industries, be it food processing, wood, pharmaceutical, building, textiles and agricultural. The use of preservatives has become an attractive means to diminish the spoilage due to mold and other microbes. It has been reported that losses due to mold spoilage in the bakery industry averages about 200 million pounds per year in certain countries [12]. The commonest molds found in most tropical environment are: *Rhizopus sp., Aspergillus sp., Penicillium sp., Monilia sp., Mucor sp. and Eurotium sp*. This is due to the climate (seasons), warm and wet. In developing countries, mold growth on products are a serious problem that results in economic losses and made worse by incessant power outage making refrigeration a difficult preservative method. Recently, several means of preservation has been reported for instance, bio-preservation where Lactic acid bacteria (LAB) has been used in the food industry [13]. Also the study on the potentiality of LAB strains to inhibit mold growth and found that only four strains out of 95 tested had anti -fungal activity, while the growth rate of mycelia of several strains of *Penicillium* (*P.chrysogenum, P.corylophilum) and Aspergillus flavus* to temperature and water activity (aW) on sponge cake and observed a dependence on the two parameters [14], [15]. The review [12] of the microbial spoilage of bakery products and their control by preservatives concluded that mold spoilage is still a major problem limiting the shelf life of many high and intermediate moisture bakery products. Generally speaking, losses due to mold spoilage have been resulting in lost revenue to the food (packaging, baking and processing) as well as other industries. This work set out to find the possibility to inhibit and control mold growth in typical tropical climate (Nigeria) so as to extend the shelf life of many products of great economic importance. Molds not only cause food spoilage, it has been implicated in some diseases in man and animals mainly due to allergy sensitivity to their spores. Food-handling workers are particularly at risk if they are allergic to mold [16] and [17]. Therefore this study focused on a rapid synthesis of AgNps stabilized by starch and evaluated the anti-mold effect of AgNps on food spoiling mold.

## 2 EXPERIMENTAL

### 2.1 MATERIALS

The Corn (CO) seeds were purchased from Dutse market in Abuja.

### 2.2 REAGENTS

Silver nitrate and glucose were purchased from Finlab Scientific Company Abuja Nigeria**.** All reagents were of analytical grade and used without further purification. Also solutions were prepared using distilled water. The mold strains were obtained from a 4days mold culture in the laboratory.

### 2.3 STARCH ISOLATION

A method [18] was adopted with modification (as there was no bleaching) during the starch extraction. The starch was then defatted before use. This is termed "native starch" and had no modification whatsoever.

### 2.4 SYNTHESIS OF CORN STARCH SILVER NANOPARTICLES (CO-AGNPS)

All materials in our experiments are biocompatible and environmental-friendly. According to a slightly modified methods of [19]&[20], 1ml of 1% solution of $AgNO_3$ was added was mixed for 10mins, with 4ml of 0.5M glucose solution, stirring carried out to make sure both oxidant and reductant were in contact, to this, 1% dispersion of the Corn starch (CO) in distilled water was added and the complex was micro waved(Samsung 123 HCE, TDS) for 5 minutes at 100% power, 800W at 250MHZ working condition. The Oxidant ratio to reductant was 1:4. The setting of the microwave timer for a longer period and then stopping it after 5 minutes enhanced the heating and the solution was quite hot. The complex was allowed to cool and was centrifuged at 11,000rpm for 20minutes using Eppendorf 5417R micro-Centrifuge. The resultant nanoparticle was oven-dried, ground to powder, stored in a closed dark container devoid of sunlight.

### 2.5 DETERMINATION OF THE FORMATION OF SILVER NANOPARTICLES COLOUR

The colour of the sample after synthesis was checked with naked eyes to examine the formation of Corn starch Silver NanoParticles (COAgNPs).

**Possible equation for the reaction during the synthesis:**

$Ag_2O + CH_2OH\text{-}[CHOH]_4\text{-}CHO + 2(starch) \rightarrow CH_2OH\text{-}[CHOH]_4\text{-}COOH + 2Ag(starch)ppt$

Glucose, as an aldehyde, was able to reduce $Ag^+$ ions to $Ag^0$, and through this reaction, glucose can be oxidized to gluconic acid.

### 2.6 ANTI-MOLD ACTIVITY OF AGNPS

The anti-mold activity of silver nanoparticles was evaluated using the plate spore and spot disappearance method. In duplicate, AgNps was prepared (A) and as well, the control (B) was prepared in the same way but without silver nitrate and glucose solutions just 1% starch dispersion in distilled water was heated in the microwave for 5mins this gave a colloid. Aliquots (50ml) of both A and B colloidal gels were poured into sterile plates and according to the method of [14], conidial suspension of natural food spoiling mold strains *A. niger* ($10^4$ conidial/ml per 50ml of colloidal gel) was surface –sprayed and plates covered with polythene bags and kept isolated in the laboratory at $30^oC$. The plates were observed daily for the manifestation of mold growth so that stability and susceptibility of both AgNps and control gels will be defined as the number of days mold spots appeared on the gels. In another set up, plates A2 and B2 containing 50ml of AgNps and the control were covered with polythene bags at $30^oC$ and left for days to monitor for their susceptibility to food spoiling mold strains to grow naturally on the starch gels for days. Plates A2 and B2 were also observed daily for the manifestation natural mold growth.

Finally, the susceptible plates were surface –smeared with 5ml of AgNps suspension and monitored for lethal activity of mold strains based on spores and spot disappearance on the plate's surface. This was also monitored for days for possibility of re-manifestation.

### 2.7 CHARACTERIZATION METHODS

UV-Vis Spectroscopy**:** The prepared colloidal Ag nanoparticles were characterized by 7000 series, CECIL CE 7500 UV-VIS - spectrophotometer. The scanning range was 200-700 nm and the correction of the spectrophotometer was carried out by using distilled water as blank reference. The wavelength corresponding to maximum absorption spectra of the sample was recorded.

Transmission Electron Microscope (TEM) was employed in determining the morphology and size of the particles synthesized.

Fourier Transform Infra-Red (FTIR) Analysis.

The obtained silver nanoparticles (dried samples) were grinded with KBr pellets and used for FTIR measurements. The spectrum was recorded in the range of 4000 - 400 cm-1 using Horizon, Model: MB 3000 spectrometer in the diffuse reflectance mode operating at resolution of 4 cm-1.

## 3 RESULTS AND DISCUSSION

Initially, a colourless clear solution appeared at room temperature even with the rigorous stirring. This then turned yellowish brown on heating for 5minutes in the microwave. The change in colour may be due to excitation of surface Plasmon vibrations of silver nanoparticles. The step-wise formation of the AgNps is shown in figure 1. These colour changes indicates the formation of colloidal Silver (Ag) nanoparticle. Interestingly, microwave heating was able to initiate a reduction of $Ag^{+}$ to $Ag^{0}$ when glucose was employed as a reductant. Meaning that as temperature increases, the Surface Plasmon Resonance (SPR) typical of silver nanoparticles appears [19].

### 3.1 UV-VIS ANALYSIS (KINETICS OF FORMATION OF AGNPS)

UV-VIS absorption spectra have proved to be quite sensitive to the formation of silver colloids because silver nanoparticles exhibit an intense absorption peak due to the surface plasmon (it describes the collective excitation of conduction electrons in a metal) excitation [21]. The Uv-vis absorption spectra of corn starch AgNps is presented in Fig.2. Formation of strong absorption band centered at 400nm clearly suggests formation of Ag nanoparticles embedded in the starch matrix. For the broadening observed, according to literature broad peaks in the beginning of formation of AgNps, is attributed to very small particles (seeds) [21]. This is in agreement with [6], that employing microwave assistance in synthesis yields relatively small nanoparticles in a short reaction time. This observation is further confirmed by TEM analysis. A microwave synthesis of silver nanoparticles involves the reduction of silver nanoparticles using variable frequency microwave radiation as against the conventional heating method. The method yields a faster reaction and gives a higher concentration of silver nanoparticles with the same temperature and exposure [20].

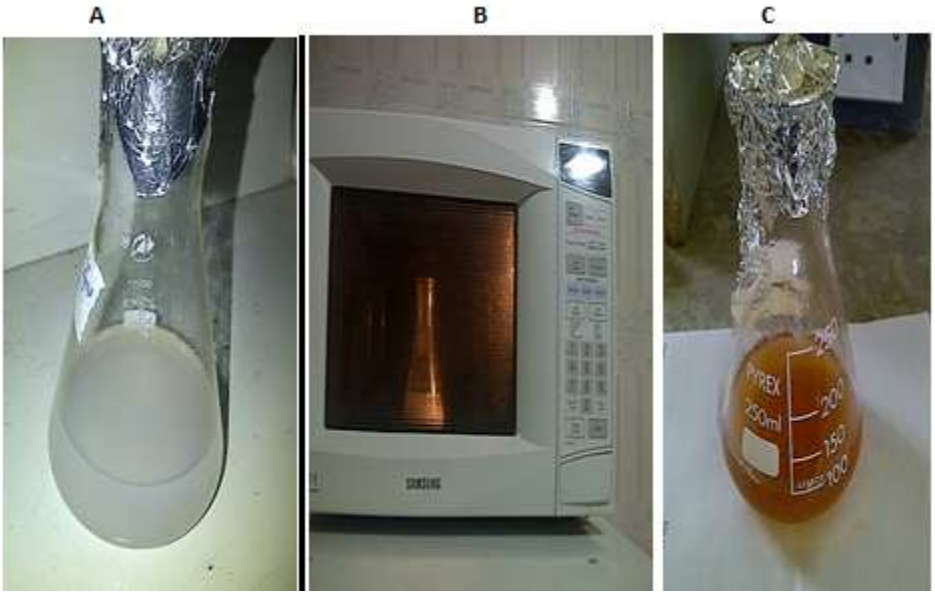


***Fig. 1: Stepwise preparation of CO-AgNPs. The Color changes of reaction complexes containing colloidal AgNPs in a microwave assisted method (A) at the beginning, (B) during microwave irradiation, (C) and the resultant complex after 5minutes of microwave heating.***

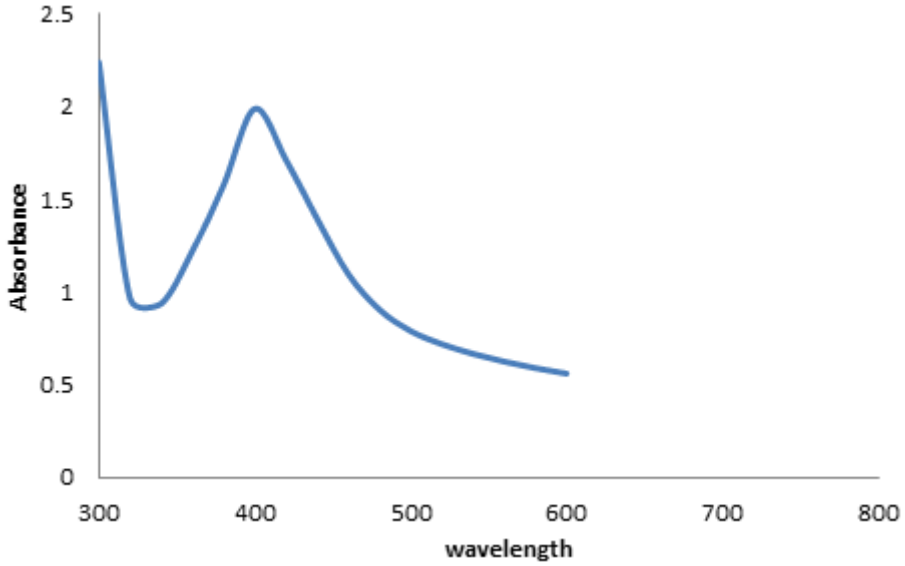


*Fig. 2 showing the UV-Vis spectra of the starch-AgNPs*

### 3.2 MORPHOLOGIES

The Transmission Electron Microscopy (TEM) images of silver nanoparticles embedded in the corn starch Ag/CO/NPs is presented in Figure 3. The image reveals spherical particles of average size range 7-15nm, majority of the spheres are in the size range of 7-15nm with a few above 25-30nm.. With the average particle size obtained from these micrographs being about7.6nm ± it is obvious that these nanoparticles are polydisperse, aggregated, and the Selected-Area Electron Diffraction (SAED) patterns depicted in Figures 3b shows bright dots, indicating that these nanoparticles may have crystalline in nature. Usually, the arranged rings can be attributed to the diffraction from the (111), (200), (220), and (311) planes of Face-Centered Cubic (FCC) silver [22]. TEM micrographs are the best method of determining morphology of nanoparticles and the obtained spheres are in agreement with the report of [19], [6], that microwave assisted synthesis yield small particle size nanoparticles.

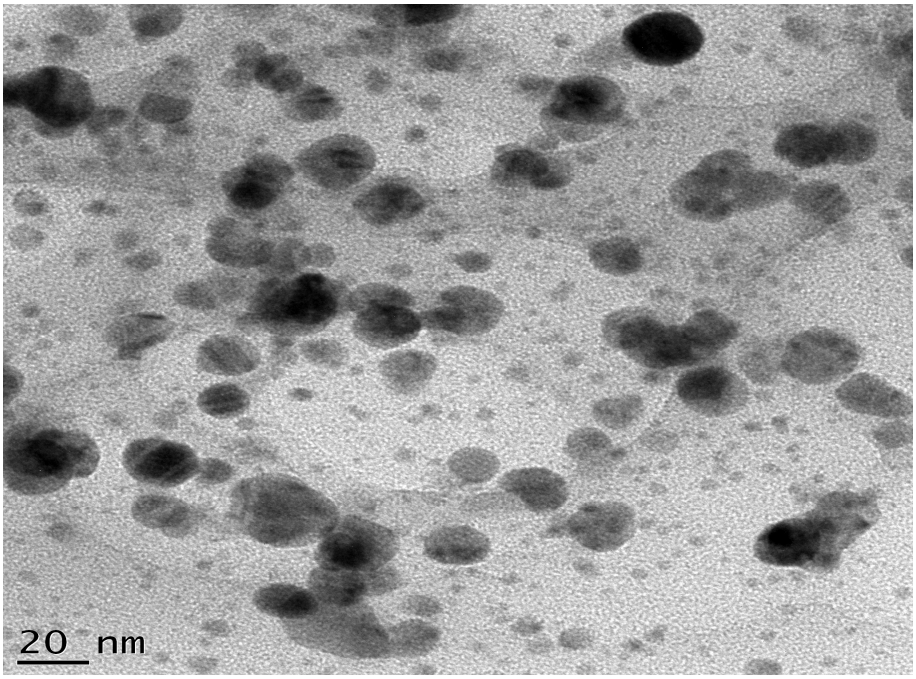


*Figure 3 Showing Transmission electron micrograph images of AgNPs synthesized.*

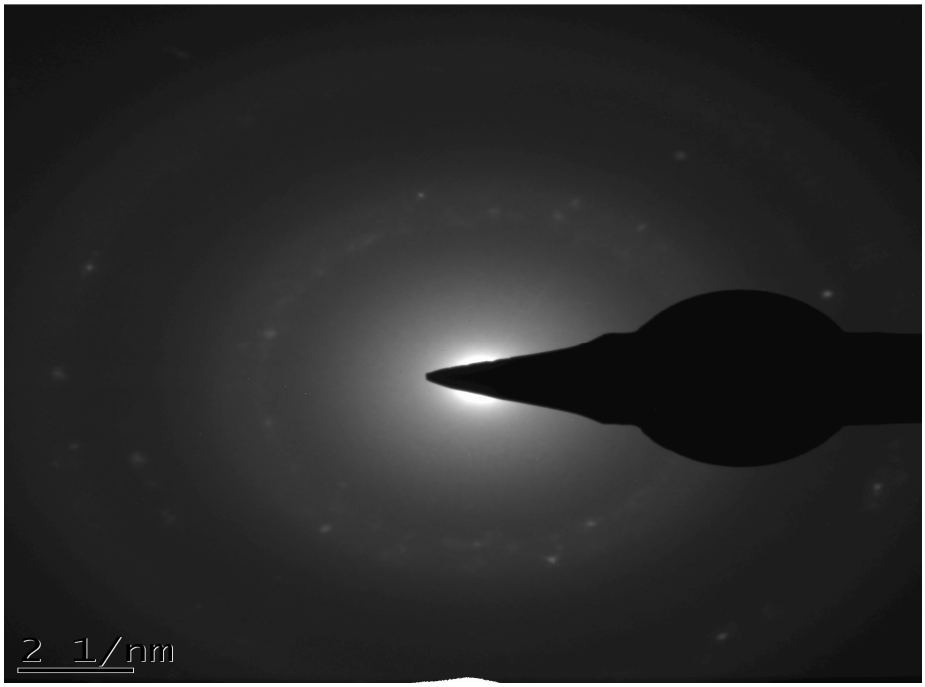


*Figure 3b showing the bright dots of the silver nanoparticles in the SAED.*

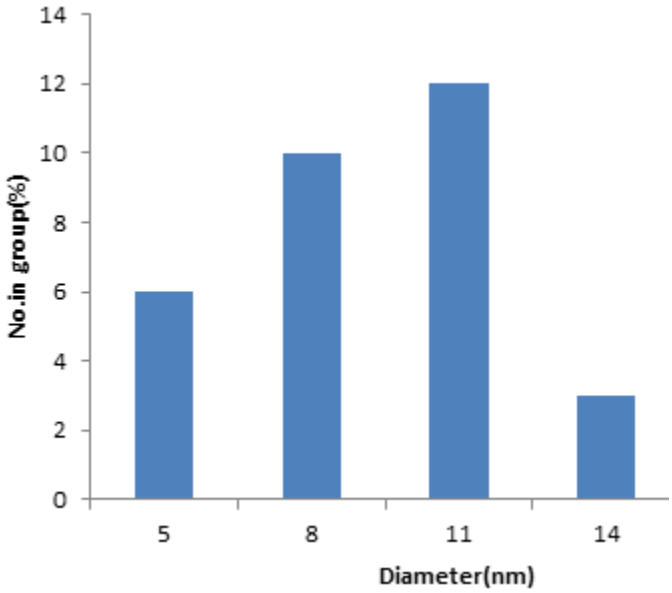


*Fig.3c Particle size distribution plot for silver nanoparticles prepared by microwave heating.*

### 3.3 FOURIER TRANSFORM INFRARED (FTIR) CHARACTERIZATION

The FTIR spectra of the starch silver nanoparticles were recorded in order to identify the functional groups of glucose and starch involved in the reduction and capping/stabilization of the synthesized nanoparticles. Figure 4 shows the Fourier transform infrared spectrum for the synthesized Silver nanoparticle revealing vibrations of ether and alcoholic groups as major absorbance bands respectively. It has been reported [23] that 3600–2800-$cm^{-1}$ region, strong hydrogen-bonded (O–H) stretching absorptions and weak C–H stretching absorptions are usually observed. That played out as our spectrum had characteristic broad and strong absorbance bands at 3404.47$cm^{-1}$, 1643$cm^{-1}$ and 2926 $cm^{-1}$ which could be assigned to the hydroxyl ( O-H) group and C-H stretching vibrations respectively. A shift from 3385 $cm^{-1}$ to 3404 $cm^{-1}$ is observed for

stabilized AgNPs; this may be due to the inter and intra molecular interactions of $Ag^0$ with –OH group. There are peaks at 1155 $cm^{-1}$ , 1230 $cm^{-1}$ , 1022 $cm^{-1}$ , and 875 cm-1. They maybe gluconic acid peaks [24].

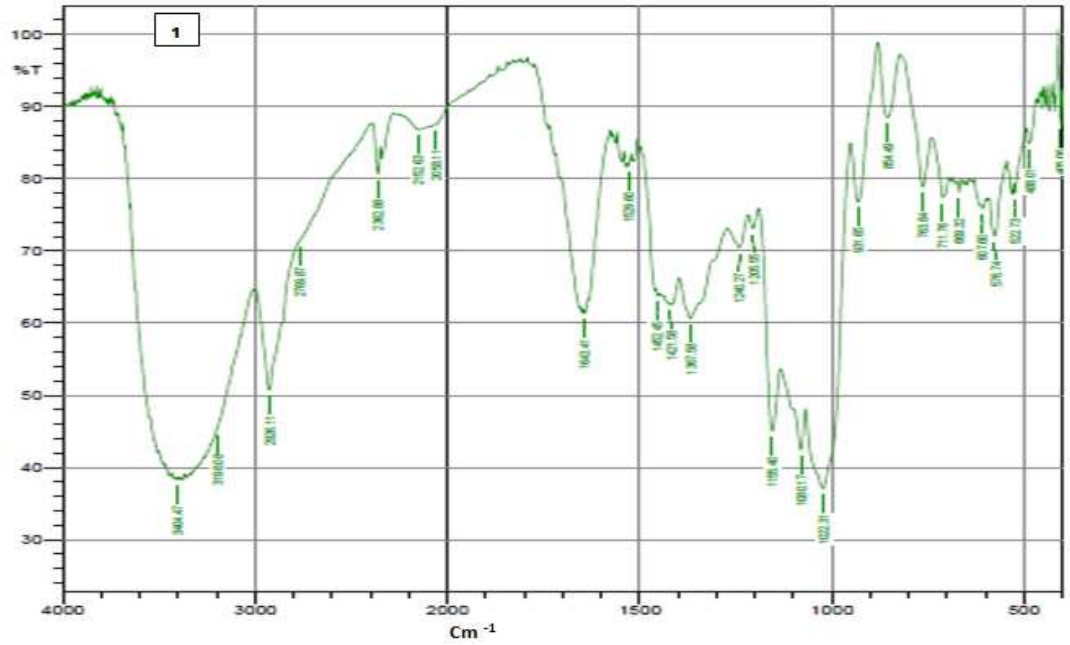


*Fig. 4(1) showing the FTIR spectral of silver nanoparticle synthesized via microwave heating.*

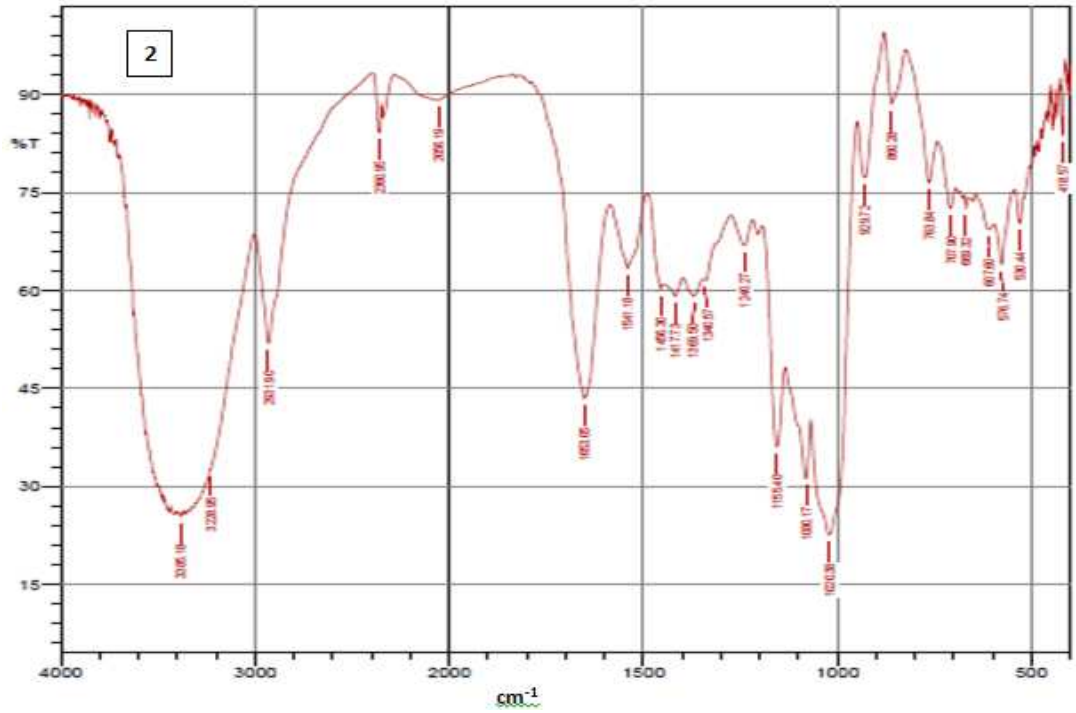


*Fig. 4(2) showing the FTIR spectral of native starch*

### 3.4 ANTI- MOLD ACTIVITY

Figure 7; shows plates to which AgNPs and the control colloidal suspensions (50ml each) was applied (plates A&B). In the plates with AgNPs, presence of silver nanoparticles inhibited modal growth by 100%. As the control was found to be

susceptible to different strains of the *A. niger* which was visible in coloured spots (blue, grey, whitish) on the plate (C). The measure of inhibition zones is the entire circumference of the plates (90mm). Anti mold activity was also assessed by smearing the surface of the mold infested plates with AgNPs colloids (5ml) which revealed a 24hour lethal action as mold spots were found to be disappearing daily and no new manifestation observed for months. The grown strains of A*. niger* in plate C, were eliminated and further growth inhibited in the plate (D). The test was repeated at least twice, for each treated sample. AgNPs samples presented good Anti- mold activity. Plate E depicts the end product AgNPs films as obtained on drying.

**MODE OF ACTION**

Though there are many mechanisms attributed to the antimicrobial activity shown by silver nanoparticles, the actual and most reliable mechanism is not fully understood or cannot be generalized as the nanoparticles are found to act on different organisms in different ways. Silver has always been an excellent antimicrobial and has been used for the purpose for ages. The unique physical and chemical properties of silver nanoparticles only increase the efficacy of silver [25]. The mode of antimicrobial action of silver ions is presently limited to the effect on their structure and morphology. A study summarized it to be linked to the DNA state at a time. During relaxation, replication occurs while replication is lost when DNA is condensed. Hence, when the silver ions penetrate inside the microbial cell the DNA molecule turns into condensed form and loses its replication ability leading to cell death [10].

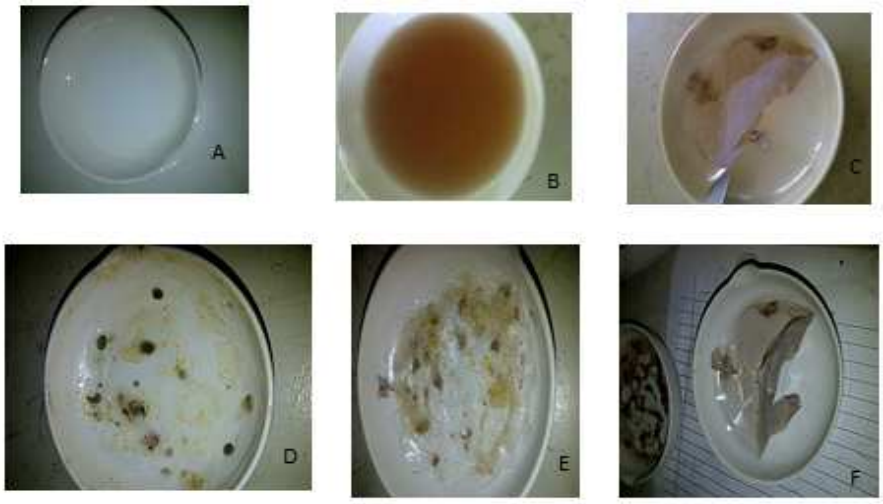


***Figure 7. (a-f) Representative photographs of fungicidal activity against bread mold (A. niger), where: a and b are the resultant colloids, c is the dired product of B (AgNPs). While D is the mold infested plate, E the AgNPs smeared plate undergoing inhibitory Mode fungal growth after 24 hours and F the dried plate d after all mold appearances has been eliminated.***


***Figure 8: A comparison of the untreated and treated surfaces of mold infested plates. Plate 2 is undergoing lethal and inhibitory action by the smeared AgNPs.***

## 4 CONCLUSIONS

A critical need in the field of nanotechnology is the development of reliable, fast and eco-friendly processes for synthesis of metallic nanoparticles. Here, we have report a simple rapid, chemical and low-cost approach for preparation of stable silver nanoparticles by reduction of silver nitrate solution with glucose under microwave irradiation. Starch was employed as a stabilizing agent. The characteristics of the obtained silver nanoparticles were studied using UV-Vis, FTIR, and TEM techniques. The results confirmed the reduction of silver nitrate to silver nanoparticles with high stability and without any impurity. The silver nanoparticles had mean diameters of 7nm.

Additionally, results reveal that AgNPs synthesized has considerable anti-mold activity, a fact that can be related to size of colloidal silver particles. Also, the antimicrobial susceptibility of silver nanoparticles synthesized was investigated. The smeared spore and spot disappearance method was used as antimicrobial inhibitory and susceptibility testing method. Areas of inhibition were measured after 24 hours of surface –smearing. The comparison of treated and untreated plates showed an almost magical clearance of the mold on plate 2 in figure 8. We have been able to show in this present study, obtained results of antimold activity reveal that the growth of A*. niger* was inhibited at colloidal volume of 5ml/90mm plate size.

This study shows that, Ag-NPs synthesize from a cheap, non-toxic, and renewable and generally compatible natural polymer (starch) could considerably be used in industries without placing pressure economically.

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# ESTIMATION OF TECHNICAL EFFICIENCY OF ENVIRONMENTALLY CONTROLLED SHED BROILER PRODUCERS IN PUNJAB, PAKISTAN

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**ABSTRACT:** This study estimated the level of technical efficiency of environmentally controlled (EC) shed broiler farmers in Punjab, Pakistan. Multistage random sampling technique was used for selection of 60 EC broiler producers. Data was collected from sampled producers during the months of January-February, 2014. The analysis of data was done applying stochastic frontier Cobb-Douglas production function. Maximum likelihood estimation technique was utilized for estimation. Results showed that the mean technical efficiency of sampled farmers was 0.999 ranging from 0.934 to 1.00. This implies that, on average, EC shed broiler producers were operating at full technical efficiency level. Based upon these findings it is suggested that government should motivate open shed broiler producers to switch over to EC shed broiler production and also motivate investors to invest in EC shed broiler farming. This will result in higher production of poultry meat and the problem of insufficiency of protein and other nutrients can be easily eradicated. This will also provide employment opportunities to the labor force of the country.

**KEYWORDS:** Environmentally Controlled Shed Broiler Farms, Technical Efficiency, Cobb-Douglas Production Function, Punjab, Pakistan.

## 1 INTRODUCTION

Poultry is a sub-sector in the livestock industry constituting a major component in agriculture of developing countries. Poultry sector is one of the sparkling segments of Agriculture Industry in Pakistan.

Although there are a several types of poultry raised and consumed chicken is the most important. There are three main types of chicken in Pakistan; broiler, layer, and breeder.This sector generates income and employment for about 1.5 million people. Its contribution in agriculture growth is 4.81% and in livestock growth 9.84%. Poultry meat contributes 19% of the total meat production in the country. The daily availability of protein quantity per capita in Pakistan amounts to 13.6 gram, deriving from animal source including beef, mutton, poultry and fish. Poultry sector has shown a vigorous growth rate of 7 to 8 percent per annum, which is mirror of its intrinsic potential. Value addition of poultry has increased from Rs. 113465 million in 2011-12 to Rs. 121726 million in 2012-13; illustrate a boost of 7.3 percent than last year [1]. For poultry industrial to express their full potential, some basic rations must be provided; these are like good management, environment, balanced provisions of resources and adequate housing. According to the World Health Organization standards the required daily dietary protein allowance from animal source is 27 grams whereas we have much less than this. Animal protein is crucial for normal physical and mental development of the human being. An adequate consumption of meat is the indication of economic and social welfare. Demand for animal protein is usually elevated in cities than in villages because of the difference in level of education its availability and in income [2]. In Pakistan the consumption of white meat has gradually increased in recent years due to growing health awareness in masses. The cheapest source of animal protein available in Pakistan is broiler meat. Broiler birds are reared in lesser time than any other source of animal protein. The increasing demand of the white meat in the market and short Production has made it a profitable business enterprise. The production of commercial poultry for the last three years is given in Table 1.

**Corresponding Author:** Salamat Ali 

*Table 1 Production of commercial poultry in Pakistan*

| Commercial Poultry | Units | 2010 | 2011 | 2012 |
|---|---|---|---|---|
| **Broilers** | Million No | 542.74 | 34.82 | 37.25 |
| **Layers** | Million No | 32.54 | 44.10 | 47.00 |
| **Breeders** | Million No | 8.81 | 597.02 | 652.72 |
| **Day old chicks** | Million No | 566.89 | 9.25 | 9.71 |
| **Eggs** | Million No | 8690.00 | 623.58 | 685.94 |
| **Chicken meat (Broilers + Layers)** | 000 tones | 662.18 | 7281.00 | 9912.00 |

Source: GoP, 2013.

Poultry Farming in Controlled Environment has brought a great change in poultry industry of Pakistan and is rapidly becoming popular among broiler producers due to its many significant advantages. According to Industry sources there is capacity of 5,000 environmental control houses in Pakistan and currently 2,500 houses are working out of which 75% (1,875) are in Punjab and remaining 25% (625) are in other provinces [3]. In controlled environment farm, inputs including farm equipments like drinkers, feed trays, brooders, and feeders and other items like feed, vaccines & medicines, rice-husk or saw-dust, water, electricity and evaporative cooling system etc are required and they make environment quite conducive for poultry production by getting continuous production. The society expects the livestock sector, poultry included, to continue to meet rising world demand for animal products cheaply, quickly and safely [4]

The concept of efficiency in the use of farm resources, which goes back to the pioneering work of Farell [5] is concerned with the relative performance of the processes used in transforming given inputs into outputs. There are basically three major types of efficiency, viz, technical, allocative and economic efficiency. Technical efficiency in production is the physical ratio of product output to the factor input, the greater the ratio, the greater the magnitude of technical efficiency. It refers to the ability of firms to employ the best practice in the production process so that not more than the necessary amount of a given set of inputs is used in producing the "best" level of output [6] and it is expressed as the ratio of farmer's actual output to the technically maximum possible/frontier output, at given level of resources; Technical Efficieny (TE) = $Q_i / Q_i^*$ , Where Qi is the observed output and $Qi^*$ is the frontier output. Allocative efficiency is concerned with choosing optimal sets of inputs. Allocative efficiency refers to the choice of optimum combination of inputs consistent with the relative factor prices. It is expressed as the ratio of the technically maximum output, at the farmer's level of resources to the output obtainable at the optimum level of resources. On the other hand, Economic efficiency is the ability of a farm to maximize profit or it is obtained in the presence of both the technical and allocative efficiency.

The crucial role of efficiency in increasing agricultural output has been widely recognized by researchers and policy makers alike. Efficiency is an important factor of productivity growth especially in developing agriculture where resources are meager [7]. Technical efficiency is a a mean of fostering production in agriculture [8]. Analysis of technical efficiency in agriculture has received particular attention in developing countries because of the importance of productivity growth in agriculture for overall economic development. For example in Nigeria considerable effort has been devoted to analysis of farm level efficiency by both academician and policy analysts in the country for more than a decade [9].Technical efficiency is the main ingredient for enhanced performance of the agricultural industry [10]. Ellis suggested that the producers' performance should be estimated only in terms of technical efficiency. This according to him is because measures of technical efficiency rely less heavily on assumptions of perfect knowledge, perfectly competitive markets and the profit maximization objective [11].

The core problem in agriculture in developing countries is how to increase output per unit input. One way of addressing the problem of increasing production is to analyze how efficiently farmers are utilizing their available resources and existing technology. If resources are not efficiently utilized, output can be increased by optimal and efficient adjustment factors of production. In case resources are efficiently utilized, then output can be increased by innovation and adoption of inputs technology of production[12].

Previously no research work has been carried out to estimate technical efficiency of EC shed broiler farmers in Pakistan. Therefore, this study is an attempt to estimate technical efficiency of EC shed broiler farmers in the study. The findings of this study will be helpful for EC shed broiler farmers to identify factors that affect wheat farmer's technical efficiency and determining the opportunity for increasing output. Similarly policy makers will also benefited from these findings to form sound programs or legislations related to expand national food production potential more effectively.

## 2 DATA AND METHODOLOGY

### 2.1 UNIVERSE, SAMPLING TECHNIQUE AND SAMPLE SIZE OF THE STUDY

This study was designed to examine technical efficiency of EC shed broiler farms in Rawalpindi Division of Punjab, Pakistan. Multistage sampling technique was employed for selection of sample size. Rawalpindi Division was purposively selected, in first stage. In second stage, four districts were randomly selected through simple random sampling technique. In stage third, eight villages were randomly selected, from each district. In stage four 60 EC shed broiler farms were randomly selected using proportional allocation sampling technique [13]

$N_i = n^{*} (N_i/N)$ (1)

Where;

$n_i$ = Number of sampled broiler farms in ith district.
n = Total sample size.
$N_i$ = Total number of broiler farms in ith district.
N = Total number of broiler farms in the study area.

### 2.2 DATA COLLECTION

For collection of required data from EC shed broiler farmers a comprehensive interview schedule was prepared and pretested in the field. Interview schedule was corrected according to the feedback from the field survey. Sampled farmers were interviewed either at their farms. Farmers were first taken in to confidence that the required was needed purely for research purpose, to get correct and accurate data for reliable estimates. For collection of secondary data different government and official sources e.g. Punjab Poultry Research Institute (PPRI) Rawalpindi, Economic Survey of Pakistan and Agriculture Statistics of Pakistan were used [14].

### 2.3 ANALYTICAL FRAMEWORK

#### 2.3.1 CONCEPTUAL MODEL

Efficiency concepts were first introduced Koopmans [15] and Debreu [16]. Technical efficiency was defined by Koopmans [15] while Debreu [16] introduced its measurement as the 'coefficient of resource utilization'. Based upon the work done by Koopmans [15] and Debreu [16], Farrell [5] was the first to measure economic efficiency. He decomposed economic efficiency in to technical and allocative efficiency. According to Farrell [5] technical efficiency is the ability of a firm/farm to produce maximum possible level of output from available inputs. Allocative efficiency is the allocation of inputs in best optimal proportions, given their relative prices and available technology. Economic efficiency is measured as the product of technical efficiency and allocative efficiency. The most efficient farmer/s operates on the frontier/isoquant.

Literature unveils that efficiency of firms/farms were estimated by different studies using i) nonparametric and ii) parametric approaches. Nonparametric approach makes use of linear programming (LP) which is known as Data Envelopment Approach (DEA) and free disposal hull (FDH) [17]. DEA method was initiated by Farrell [5] and transformed into estimation techniques by Charnes [18] while FDH approach was developed by Deprins, *et al*. [19]. DEA approach makes no assumption about the distribution of error term and no functional form. This method is limited because; i) it has no proper statistical procedure for testing of hypothesis, ii) error term is not incorporated; this means that every variation in output from the frontier erect firm's inefficiency and iii) measurement is very sensitive to outliers [17].

Parametric approach is based on econometric theories in which error terms are taken in to account. Error term is further decomposed in to natural error term ($v_i$) and farm and/or farmer specific error term ($u_i$). $v_i$ is symmetric; its value ranges between - ∞ and ∞ and accounts for variations in $Q_i$ in response to statistical errors in measurements, breakdowns, weather conditions and natural disasters etc. $v_i$ is beyond the control of farmers and is assumed to be independently and identically distributed as iid $N \sim (0, \sigma^2_{vi})$ [18][19]. $u_i$ is a non negative random variable; related to farm and/or farmer specific factors which can be controlled by farmers. $u_i$ is associated with technical inefficiency of the EC shed broiler farm; independently and identically distributed as iid $N \sim (0, \sigma^2_u)$ i.e. half normal distribution having value between 0 and 1. $v_i$ and $u_i$ are assumed to be independent of each other [18]. The stochastic frontier function was independently proposed by Aigner *et al*. [18] and Meeusen and van den Broeck [20].

Stochastic frontier approach makes it possible to estimate a frontier function that simultaneously takes into account the random error and inefficiency factors specific to every farm/farmer as follows:

$\ln Q_i = \quad Xi\ \beta_i + \epsilon_i \qquad (2)$

Where $Q_i$ is production obtained by ith farmer, $X_i$ are inputs applied by ith farmer, $\beta_i$ are unknown parameters to be estimated and $\epsilon_i$ is composite error term consisting of $v_i$ and $u_i$

### 2.3.2 EMPIRICAL MODEL FOR ESTIMATION OF TECHNICAL EFFICIENCY OF EC SHED BROILER FARMERS

The farm specific technical efficiency is ratio of observed output ($Q_i$) to the corresponding frontier output ($Q_i^*$) using the available resource and technology. Hence technical efficiency of EC shed broiler farmers is given as follows:

$TE_i = \exp(-\mu_i)$

$= Q_i / Q_i^* \qquad (3)$

$= [f(X_i, \beta_i) + v_i + u_i] / [f(X_i, \beta_i) + v_i; u_i = 0]$

Where;

$Q_i$ = Observed output of ith farm.

$Q_i^*$ = Highest predicted/frontier output for ith farm.

$TE_i$ = Technical efficiency of ith farm that ranges between 0 and 1.

Technical efficiency takes values ranging from zero to one, where 1 stands for fully efficient farm and 0 indicates for inefficient.Production technology of EC shed farmers is assumed to be specified by stochastic production function representing Cobb-Douglas production technology [21]:

$\ln Q_i = \beta_0 + \beta_1 \ln X_{1i} + \beta_2 \ln X_{2i} + \beta_3 \ln X_{3i} + \beta_4 \ln X_{4i} + \beta_5 \ln X_{5i} + \epsilon_i \qquad (4)$

Where;

$Q_i$ = Production of broilers obtained by ith broiler farmer in kilograms per EC shed.

$X_{1i}$ = No of day old chicks per shed

$X_{2i}$ = Feed intake in kilograms per shed

$X_{3i}$ = Number of labors in man days per shed $X_{4i}$ = Number of vaccinations per shed

$X_{5i}$ = Capacity of shed (Number of broilers)

$\beta_0$ = Intercept

$\beta_i$ = Unknown parameters to be estimated.

$\epsilon_i$ = Composite error term.

$\epsilon_i$ = $v_i + u_i$

$v_i$ = Natural error term.

$u_i$ = Farm and/or farmer specific error term.

Ln = Natural logarithm.

i = 1, 2, 3, ……, n.

$Q_i$ = Production of broilers obtained by ith broiler farmer in kilograms per EC shed.

$X_{1i}$ = No of day old chicks per EC shed.

$X_{2i}$ = Feed intake in kilograms per EC shed.

$X_{3i}$ = Number of labors employed in man days per EC shed.

$X_{4i}$ = Number of vaccinations per EC shed.

$X_{5i}$ = Capacity of EC shed (Number of broilers).

$B_0$ = Intercept.

$\beta_i$ = Unknown parameters to be estimated.

$\epsilon_i$ = Composite error term.

$\epsilon_i$ = $v_i + u_i$

$v_i$ = Natural error term.

$u_i$ = Farm and/or farmer specific error term.

ln = Natural logarithm.

i = 1, 2, 3, ……, n.

$\beta_0$ and $\beta_i$ are the parameters to be estimated.

### 2.3.3 DETERMINATION OF TECHNICAL INEFFICIENCY OF BROILER FARMERS

In order to determine factors contributing to the observed technical inefficiency, the following model was formulated and estimated jointly with the stochastic frontier model in a single stage maximum likelihood estimation procedure [22]. The model is given as fallows:

$\mu_i = g(Z_i : \delta_i)$ (5)

$\mu = \delta_o + \delta_1 Z_{1i} + \delta_2 Z_{2i} + \delta_3 Z_{3i} + \delta_4 D_{1i} + \delta_5 D_{2i} + \omega_i$ (6)

Where;

$\mu_i$ = Technical inefficiency.
$Z_{2i}$ = Age of the poultry farmers in years.
$Z_{2i}$ = Farming experience of the poultry farmers in years.
$Z_{3i}$ = Education of the poultry farmers in years.
$D_{1i}$ = Dummy variable for access to credit; $D_{1i}$ =1, if farmers have access to credit, $D_{1i}$ = otherwise.
$D_{2i}$ = Dummy variable for membership with poultry association/cooperatives,
$D_{2i}$ = 1, if farmers have membership with poultry association/cooperatives, $D_{2i}$ = 1, otherwise.
$\omega_i$ = Stochastic error term.
$\delta_o$ = Intercept.
$\delta_i$ = Parameters to be estimated.

## 2.4 DIAGNOSTICS TESTS

Following diagnostic tests were applied to test the robustness of the estimates of the stochastic frontier Cobb-Douglass production model.

### 2.4.1 NORMALITY TESTS

For testing normality of residuals/error terms the following tests were performed.

**I. Jarque Bera (JB) test**

The estimated p-value (0.8387) for JB statistic was found to be statistically insignificant; implies that we accept the null hypothesis of normal distribution of residuals/error terms.

**II. p-p plot test**

p-p plot shows departure of residuals from regression line. Residuals obtained from our data depicts that residuals are not far from regression line, suggesting normal distribution of residuals.

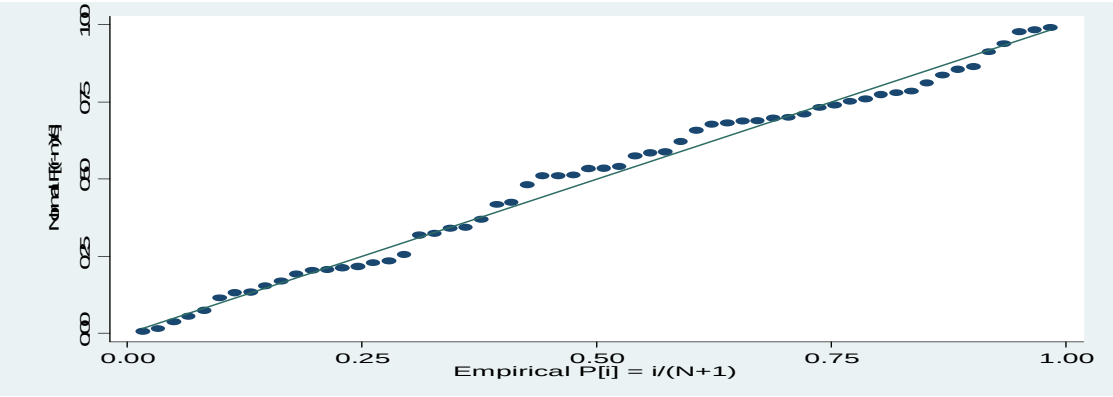


**Figure 1** p-p plot

#### 2.4.2 HETEROSCEDASTICITY TESTS

When the assumption of homoscedasticity (equal variances) is violated then we face the problem of heteroscedasticity (unequal variances). In presence of heteroscedasticity problem still we have unbiased estimates but no longer efficient. The results of the variances which may be small or large, leading to type I or type II error in the presence of heteroscedasticity which means that OLS is no not BLUE (Best Linear Unbiased Estimator). Heteroscedasticity is mainly present in cross sectional data as ours, than time series data [19].

The assumption of the homoscedasticity of the classical linear regression model is that the variance of each disturbance term $\mu i$ for the chosen values of the dependent variables is a constant number equal to $\sigma^2$. Symbolically it can be written as:

$$E(\mu_i^2) = \sigma^2 \qquad i = 1,2,.....,n$$

If the aforementioned assumption is violated then it will lead to a problem of heteroscedasticity, which means that variance of the error term will no more remain constant. The consequence of heteroscedasticity is an unbiased but inefficient estimate of the coefficients. The results of the variances which may be small or large, leading to type I or type II error in the presence of heteroscedasticity which means that OLS is no not BLUE (Best Linear Unbiased Estimator). Heteroscedasticity is mainly present in cross sectional data as ours, than time series data (Gujarati and Porter, 2009).

**i. Breusch-Pagan test**

Breusch-Pagan test for heteroscedasticity also follows $\chi^2$ distributions. The estimated value of Breusch-Pagan statistic was statistically insignificant (p-value = 0.2715) at all levels of significance. So we can not reject the null hypothesis of homoscedasticity.

**ii. White's general test**

White's general test proposed by White does not rely on normality assumption and is easy to implement. Heteroscedasticity follows $\chi^2$ distributions. The estimated value was found to be insignificant (p-value = 0.1371) at all levels of significance, suggesting that the model may not be plagued with problem of heteroscedasticity. This result reinforces our hypothesis of homoscedasticity.

#### 2.4.3 MODEL SPECIFICATION TESTS

When one or more relevant variables are excluded from the model or one or more irrelevant variables are incorporated in the model, then model specification error can occur. Estimates of regression are substantially affected by model specification errors [19]. Ramsey's RESET test was applied for detection of model specification errors as follows:

**i. Ramsey's RESET test**

Ramsey's RESET test performs a regression specification error test (RESET) for omitted variables. Ramsey RESET test follows F distribution [19].

As our F calculated (1.68) is less than F tabulated ($F_{0.05\ (5,\ 55)} = 2.53$), therefore, we can conclude that there is no specification error in the estimated model.

## 3 RESULTS AND DISCUSSION

### 3.1 MAXIMUM LIKELIHOOD ESTIMATES OF THE STOCHASTIC FRONTIER PRODUCTION FUNCTION OF EC SHED BROILER FARMERS

Table 2 shows estimates of stochastic frontier Cobb-Douglas production function for EC shed broiler farms. The estimated coefficient of day old chicks was found to be 1.4519 and statistically significant at 1 percent level of significance. This means a one increase in day old chicks brings about 1.4519 percent increases in broiler production of EC shed farms. These results are in conformity with the findings of Ohajaniya *et al*. [23] and Effiong [24] .

The estimated coefficient of feed was 0.0963 and statistically significant at 5 percent level of significance. This implies that a one percent increase in feed increases broiler output by 0.0963 percent. Similar results were found in earlier studies by Oleki and Islinka [25] while in contrast to the results of Alwris and Francis [26], Ike [27] and Areet *et al*.[28].

The estimated coefficient of labor was -0.060 and was statistically significant at 5 percent level of significance. This implies a one percent increase in labor decreases broiler production by 0.060 percent.

Source: Survey data, January-February, 2014.

The results is in accordance with the results of Ezeh, *et al*. [29] and Areet, *et al*. [28] while opposes the results of Ike [27]. One of the possible explanations of negative coefficient of labor is that broiler farmers of EC shed in the study area were either misallocating or over utilizing labor.

The estimated coefficient of vaccination cost was found to be negative and statistically insignificant. This means that vaccination has no significant effect on broiler production because all the broiler farmers in study area were applying approximately the same number of vaccination to their broilers. These results corroborate to the results of Oleke and Isinnika [26] and Ezeh *et al*. [29] while in contrast to the results of Ike [26] and Ohajaniya *et al*. [23].

The coefficient of capacity of shed was found to be - 0.0163 and statistically insignificant at 5 percent level of significance. This implies that capacity of shed has no significant effect on broiler production. This result opposes the findings of Ike [27] who found statistically significant effect of capacity of shed on broiler production.

***Table 2 Maximum likelihood estimates of the stochastic frontier production function of EC shed broiler farmers***

Dependent variable = log output of broilers

| **Variables** | **Parameters** | **Coefficients** | **Standard error** | **T- ratios** |
|---|---|---|---|---|
| **Constant** | $\beta_0$ | -4.9068 | 0.1760 | -27.88* |
| **Day old chicks** | $\beta_1$ | 1.4519 | 0.0734 | 19.76* |
| **Feed** | $\beta_2$ | 0.0963 | 0.0508 | 1.90** |
| **Labor** | $\beta_3$ | -0.0600 | 0.0286 | -2.10** |
| **Vaccin** | $\beta_4$ | -0.0179 | 0.0144 | -1.24 |
| **Capacity** | $\beta_5$ | -0.0163 | 0.0187 | -0.87 |
| ***Technical inefficiency effects model*** | | | | |
| **Constant** | $\delta_0$ | -43.1047 | 30.2251 | -1.43 |
| **Age** | $\delta_1$ | -1.0390 | 1.3821 | -0.75 |
| **Experience** | $\delta_2$ | 1.5302 | 1.6217 | 0.94 |
| **Education** | $\delta_3$ | 3.3174 | 2.8516 | 1.16 |
| **Credit access** | $\sigma_4$ | -0.2253 | 2.4177 | -0.09 |
| **Membership** | $\delta_5$ | -2.9315 | 3.3403 | -0.88 |
| **Sigma $u^2$** | $\sigma_u^2$ | 0.00199 | | |
| **Sigma $v^2$** | $\sigma_v^2$ | 0.00124 | | |
| **Sigma$^2$** | $\sigma^2$ | 0.00324 | | |
| **Gamma** | $\gamma$ | 0.61753 | | |
| **Mean TE** | $X_{mean}$ | 0.999 | | |
| **Minimum TE** | $X_{min}$ | 0.934 | | |
| **Maximum TE** | $X_{max}$ | 1.000 | | |

* and ** indicates significance at 0.01 and 0.05 probability, respectively.

Source: Estimated from survey data, 2014.

### 3.2 FREQUENCY DISTRIBUTION OF TECHNICAL EFFICIENCY OF OPEN SHED FARMS

Table 3 shows the estimated technical efficiency's frequency distribution of broiler farmer of open shed. The minimum and maximum values for estimated technical efficiencies are 0.440 and 0.985 with a mean efficiency of 0.880, which shows that majority of the farmers that is about 55 percent of the sample respondent in the study area, have technical efficiency of above 0.90.

***Table 3 Frequency distribution of technical efficiency of open shed farms***

| TE class interval | Frequency | % |
|---|---|---|
| 0.9–1.00 | 60 | 100 |
| Sample size | 60 | 100 |
| Minimum TE | 0.440 | - |
| Maximum TE | 0.985 | - |
| Mean TE | 0.880 | - |

Source: Estimated from survey data, 2014.

## 4 CONCLUSION AND RECOMMENDATIONS

This paper estimated the level of technical efficiency of EC shed broiler farmers in Rawalpindi division, Punjab. For selection of sampled respondents, multistage sampling technique was used. A total of 60 farmers of EC shed boilers farms were interviewed. An interview schedule was used for collection of required data. For the estimation of technical efficiency of broiler production, stochastic production frontier function was used. Data was analyzed using Stata (version 12) computer program.

Maximum likelihood estimates of the stochastic frontier Cobb-Douglas production function revealed that number of day old chicks and feed were statistically significant with positive coefficients and labor was significant with negative sign for EC shed farms. The average technical efficiency of EC shed farmers was found to be 0.999 ranging from 0.8392 to 1.00. This implies that EC shed farmers were efficiently utilizing their resources in broiler production. The estimated value of gamma was 0.40 but statistically insignificant.

Based upon these findings it is suggested that government should motivate open shed broiler producers to switch over to EC shed broiler production and also motivate investors to invest in EC shed broiler farming. This will result in higher production of poultry meat and the problem of insufficiency of protein and other nutrients can be easily eradicated. This will also provide employment opportunities to the labor force of the country.

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# SOCIO- ECONOMIC EFFECTS OF ALCOHOLISM ON FAMILIES IN MUKURU SLUM, NAIROBI COUNTY

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**ABSTRACT:** Drug abuse is one of the monster threatening family structures in Kenya. Consumption of alcohol is sometimes integrated into our culture through wide appeal and acceptance from an early age. The legality of alcohol makes it readily available, and there is now a recognition that relatively a high proportion of the population consumes quantities which are considered to be harmful to their health. Alcohol consumption has severe negative effects in the society including drop out from school, death of family members, perform poorly in academics, sexual risk and even suicide. Although governments are pre-occupied with increasing economic growth and consequently concentrating most of their resources in that direction, alcohol and drug abuse threaten to erode those gains. In low income areas in Kenya, for example, drug abuse is rampant a vice associated with peer influence, readily available drugs, among other factors. Therefore this study sought to establish the socio-economic effects of alcoholism in families the slum. The authors conclude that alcoholism has led to break-up of families and suffering of children due to lack of basic commodities of life. Alcohol dependence is also related health and psychological disorders. Therefore there is need for the government to formulate policies to curb alcoholism to promote a healthy and a prosperous nation. This paper recommends that counseling programs should be initiated to bring a change of attitude among alcoholics because guidance provided by social workers can greatly enhance the fight against alcoholism in the slum.

**KEYWORDS:** Drug Abuse, Alcoholism, Socio-economic, Mukuru slum, Nairobi County, Kenya.

## 1 INTRODUCTION

Alcohol abuse in families remains a prominent problem in the world. Alcohol abuse among people is associated with a broad risk which include drop out from school, death of family members, perform poorly in academics, sexual risk even suicide [1].Consumption of alcohol is common in many countries especially most developing countries like Kenya; in many ways it is integrated into our culture through wide appeal and acceptance from an early age. The legality of alcohol makes it readily available, and there is now recognition that a relatively high proportion of the population consumes quantities considered harmful to their health. Alcohol misuse can have damaging physical, psychological and social consequences for adults, parents who regularly consume large amounts of alcohol may be in an even more vulnerable position as they are responsible for the care and wellbeing of their children. It is important to understand the impact of parental alcohol misuse on children's development, family functioning, and parenting [2].

In different parts of the globe, the incidence rate of alcohol use among individuals in many families give room for great concern. The prevalence rate of alcohol use and abuse vary from one country to the other, for instance, in the United States of America, 52% of the eighth graders and 80% of the family members have used alcohol at sometime, while 25% of the eighth graders and 62% of the family members have been drunk [3]. In Nigeria, the situation shows there is high prevalence of alcohol use among family members and there is high probability that the frequency of alcohol drinking will continue to

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increase [3]. In Nigeria, many of the family members in higher institutions engage in various risky behaviors such as smoking, reckless driving, premarital and indiscriminate sexual activities, alcohol abuse (binge drinking) and drug abuse. The high rate of deaths in Nigeria, especially among the youths may not be unconnected with the unhealthy lifestyles. Alcohol use among students is characterized by a number of risky behaviors which in the long-run affect their well being and academic performance. As levels of alcohol intake increase, so also is the prevalence of a variety of risky behaviors [3]. Parental alcohol misuse can have a number of effects on children, depending on individual characteristics in combination with a range of family characteristics and dynamics. These effects may be transmitted directly. For example, there is some evidence of genetic and intergenerational transmission of alcohol use disorders as well as the known effects of excessive alcohol consumption during pregnancy [4], [5]. There is also strong evidence of the indirect effect of parental alcohol misuse on children through the impact of alcohol misuse on family functioning and parenting .Parental alcohol misuse is a significant concern in many child protection reports [6], [7].

Alcohol and drug abuse presents itself with many facets and varying degrees of complexity across regions. Abuse of hard drugs especially in the city of Mombasa and particularly among men is a major problem however, by far and large alcohol abuse is perhaps the most prevalent form of substance abuse in the country. In fact in several pockets of the country the problem had hit runaway proportions and as a consequence led to a myriad of socio economic problems being the loss of productivity and the deterioration of family and social life [7].

A person's substance use and abuse is influenced by a number of factors, among which are parental lifestyles, peer influence, parental attachment, and commitment to conventional activities among others [8]. Indeed, each of these factors exerts tremendous influence on an individual' frequency of substance use and abuse. Families in which children have a cordial relationship with their parents, parental control efforts are effective means in preventing children from involving in problem behaviours. Thus, the attachment relationship goes hand in hand with parenting [9]. Parents who adequately control and supervise their family members may prevent them from starting to drink early in life. Children are also highly attached to their parents; the attachment relationship might strengthen the impact of control on adolescents' alcohol use. Because of this, it is assumed that the expected association between parental control and an early development of drinking will be moderated by parental attachment [8], [9].

Several causes have been linked to the behavior and while credible, they vary in complexity depending on the region, hence, making the legislation and enforcement of laws to address the situation become more challenging especially across international borders thus making the problem and the actors involved difficult to apprehend or contain [9].

There is no single, simple explanation for why some individuals develop problems with alcohol. One of the central findings of the large body of research that has examined the psychosocial causes, or etiology, of alcohol use is that there are multiple pathways to behavior that involves alcohol consumption [10]. Multiple biological and psychosocial factors mutually influence each other in causing alcohol abuse; it would be incorrect to view psychosocial causes as either independent from or competing with, biological causes. Rather, alcohol use and alcoholism are best viewed as end products of a combination of bio-psychosocial influences. Researchers face the challenge of explaining diverse alcohol-related behavior ranging from simple alcohol experimentation to severe alcohol dependence. Clearly, different factors may influence different aspects of drinking, such as initial experimentation, later maintenance of regular drinking, and the decision to stop drinking [11].

Different people may drink for different reasons and at different times as celebration, social aspects in order to relieve tension, shyness, fear and escape from problems/pressures of life, conform to peer groups, feel good, reduce loneliness, to get drunk among other factors. Society under the legal aspects is divided into two, one legalizing the local brew or alcohol such as *chang'aa* and other the legalizing of conventional or industrially manufactured alcohol such as *whiskies, beer*, though both categories have some effect of dependency [7].

Heavy alcohol intake may lead to depression and liver damage [3]. In addition, alcohol affects many parts of the brain, but the most vulnerable cells are those associated with memory, co-ordination, and judgment. Short-term effect usually lasts up to 72 hours after heavy use [12]. Alcohol has several physiological and psychological effects, which may inhibit academic performance of an individual [13]. Cognitive abilities are affected by even small amounts of alcohol and can persist for a substantial period of time after the acute effects of alcohol impairment disappear. Students' poor academic performance is associated with alcohol consumption; this is because it contributes to students missing classes, failing tests, dropping out of school due to poor grades, and compromising the academic mission of colleges and universities [3]. One of the most common consequences of alcohol abuse by students is difficulty keeping up with academic responsibilities. Alcohol abuse in the context of this study connotes excessive consumption of alcohol which in order word is referred to as binge drinking [6], [7].

The effects of alcohol abuse are characteristically medical and socioeconomic and can be felt on many different levels: on the individual, on friends and family, on society, and on the entire nation. On the individual level, people who use alcohol experience a wide array of physical effects other than those expected like for example alcohol interferes with motor control and are factors in many automobile accidents [14].

Alcohol use also affect many families because drinks are often expensive, so uncontrolled use can lead to financial problems. It has been observed that tension and arguments within the family become frequent when income required for the support of the family is spent on drug related problems. Pronounced use of the drink, tend to rigidly define social groups it may limit one's circle of friends. Continual or large scale of use of alcohol also has a bad effect on most people's sex-life [14].

Alcohol definitely lowers people's ability to resist harming themselves when they have problems and can lower people's inhibitions against hurting others. Moreover, it greatly lessens people's ability to say no to unwanted sexual encounters which they would have definitely avoided had they had been sober. Many serious accidents are also alcohol drinking related and have serious impacts on the family income and also the national economy [14].

In Kenya alcohol beverages come in many forms as those prepared by fermentation i.e. traditional beers, *(busaa, mnazi, muratina* etc) and bottled beer. Those that are prepared by distillation i.e. wines and spirits ( *chang'aa, whisky, vodka, etc*).The traditional beer is mostly consumed among low income people especially those living in rural areas and slum dwellers.

While governments are preoccupied with increasing economic growth and consequently concentrating most of their resources in that direction, ironically, alcohol and drug abuse threaten to erode those gains. A case in point is the US where the costs of drug abuse were documented to have increased at an average of 5.3 percent per year from 1992 through 2002 a figure that was very slightly above the 5.1 percent annual at the time [3]. These costs mainly result from the use of resources to address health and crime consequences as well as the loss of potential productivity from disability, death and withdrawal from the legitimate workforce. [12]

Due to the severe effects associated with alcoholism as explained above a knowledge gap exists regarding the effects of alcoholism in families in low income areas in Kenya. The purpose of this study therefore was to determine the socio-economic effects of alcoholism on families in Mukuru slums.

## 2 Material and Methods

This paper is an outcome of the research that was conducted in Mukuru Slums Nairobi County, Kenya. The study utilized descriptive research design to yield both qualitative and quantitative data required to answer research questions. The design was be used because it is suitable for obtaining insights of a phenomenon like socio- economic effects of alcoholism on families. The authors' focus on Mukuru slum is based on the fact that drug abuse is rampant compared to other slums in Nairobi.

## 3 Results and Discussion

### 3.1 Major factor influencing alcohol consumption in Mukuru slums

The study established that gender, social, emotional and environmental factors are the most common causes of alcoholism in the slum. Gender as a cause of alcoholism stood at 21% this was due to reasons like socializing, relaxing and celebration among other factors which keeps on occurring and end up forming a habit hence leads to alcoholism and even further addictions.

With regards to social and emotional the research above found 49% of the population developed alcoholism as a result of frustration and hunger, social pressure and internal temptation, they further expressed that due to much work and low pay made some of the population turn to alcohol as a means of relieve from the pressure of work and high demand and need from their families which they were not able to meet or handle. They used alcohol as a means to forget and face the other day as it comes.

Environment factors stood at 30% whereby most of the population argued that the kind of place they were staying and easy accessible of alcohol at a lower price made it easy for them to drink at any time they felt like drinking. They can even cheaply purchase the alcohol they need and drink it with their friends in their houses.

### 3.2 ALCOHOL TESTING AMONG THE YOUTH

This research sought to analyze the factors that led to early tasting of alcohol among the youth and school age children. From the study findings, it's apparent that the male youth aged 20-26 years tasted alcohol at an early age at 60% unlike to their female counterparts who stood at 40% this was due to readily available alcohol, being introduced to alcohol by their parents, copying their parents behaviors and seeing the behavior as a good thing to try out, and also their peers challenging them to try and term it as a 'in thing' (fashionable, trending thing).The study also established that youth in the slum abuse drugs due to frustration.

### 3.3 VARIOUS TYPES OF ALCOHOL USED IN MUKURU SLUM

The study established that both industrially manufactured and local produced alcohols are abused in the slum. Industrially manufactured alcohol like beer, keg, whisky stand at 37% and its counterpart locally produced alcohol like chang'aa, busaa, mnazi, muratina standing at 63%. The consumption of locally produced alcohol stood relatively at a high percentage people giving excuses as it's affordable and that they can easily access it.

### 3.4 STRATEGIES TO SUPPORT CHILDREN AND FAMILIES AFFECTED BY PARENTAL ALCOHOL ABUSE

The major strategy to support children and families affected by parental alcohol misuse was proper parenting campaigns (58%) and this was about setting clear and consistent goals and boundaries between the parents and children. Not over disciplining or under disciplining the children when growing up but guiding them through the right choices and letting them know each choice has a consequence. Setting alcohol consumption rules stood at 31% like parents not overdrinking and staggering home drunk, coming up with specific times to drink like the 'muthuto' laws not carrying alcohol home since this makes the children have the anxiety to taste or start drinking. Also identified was working with families to prevent and minimize harm at 11%, this can be done through education in schools where teachers should work hand in hand with the parents in guiding and monitoring a child's behavior, involving both parents and children in welfare societies where they get to come together and share various experiences in life.

### 3.5 THE SOCIO- ECONOMIC EFFECTS OF ALCOHOL CONSUMPTION WITHIN MUKURU FAMILIES

The study established various effects of alcoholism on families in mukuru slum and the major one was family break ups at ( 42%) where by the respondents said that alcoholism had made most of the families to separate or even break due to one partner drinking a lot and not wanting to change the habit making the other to leave and try life as a single parent to protect the children. There was also domestic violence which was at 21% whereby they said alcoholism led to domestic violence where most cases reported when investigated were found out were as a result of alcohol and this is affecting most families within mukuru slum. Lack of education for children within the families was also an effect raised by the respondents where they argued that in cases where both parents are drinking less consideration is taken to the children's education and this leads to a high number of dropouts and children loitering around the streets which on the other hand increased child labor because now the children have to fend and look for ways of survival. Loss of jobs also was at 11% where most alcoholics would easily lose their jobs due to either going to work drunk, leaving work early to go drink, or even drink within working hours due to the strong urge they have of alcohol. Others lose their jobs due to not reporting to work for many days after they have received their salary reason being they are drinking from one den to the other because they have the money and do not care of what tomorrow holds. This posed as a challenge to the families involved because most of them depend on both partners working for them to be able to meet their daily needs and if one partner looses work due to alcoholism you find that it becomes challenging given the present economic times of our country and the globe at large. There was increased crime at 9%, where by people affected with drinking or those with drinking problems sometimes involve in theft, pick pocketing in order to get money to drink. Most of this was reported by the respondents that it comes as a result of the people who lose their jobs become jobless and idlers and there urge to drink is still in them and they are forced to indulge in crime so as to service there need that is alcoholism. Spread of diseases also was the lowest at 6% where most people when drunk they lose their sense of judgment and in most cases end up indulging in sex with their drinking partners without protection and spread diseases like HIV/AIDs which is also spread to their partners. Others also engage in sex especially the female in exchange for alcohol which is a risky behavior especially to the youth of mukuru slum.

## 4 CONCLUSION

Currently, drug abuse in Kenya is a major concern. The government and most non-governmental organizations have struggled to root out this vice from society since many people have died of drugs related illness and crimes are mostly committed across the country as a result of drug abuse. Subsistence abuse in most cases is influenced by the readily availability of the drugs and government authorities ought to carry out crack down of drug traffickers if Kenya is to attain its vision 2030.Alcoholism has led to breaks ups of families and suffering children due to lack of basic commodities of life. Alcohol dependence is a substance related disorder in which an individual is addicted to alcohol either physically or psychologically. Alcohol dependence syndrome is an illness that is characterized by a variety of elements which include craving to drink which is the inability to control the desire to drink even when a decision has been made to stop drinking. A stop in alcohol consumption varies with individual levels of commitment, discipline and a will to discontinue the habit. Counseling programs initiated to bring change of attitude among alcoholics and guidance provided through social workers has greatly enhanced the fight against alcoholism. Therefore the government and other stakeholders in development need to initiate programs to sensitize citizens on severity of drug consumption if development is to be achieved in the country.

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# Les écoulements superficiels dans le plateau de Settat-Ban Ahmed et la plaine de Berrechid : Hydrographie Endoréique

# [ Surface flows in the plate of Settat-Ben Ahmed and the plain of Berrechid: Endoreic hydrography ]

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**ABSTRACT:** The plate of phosphate is a geographical zone distributed between three basins slopes: The catchment area of Oum Rbia, the catchment area of Mallah Wadi and the basins slopes of Chaouia. These basins slopes are located in Morocco power station. They are thus exposed to disturbed oceanic flows coming from North and of Western North. The basins slopes of Chaouia and particularly those of the plate of Settat-Ben Ahmed are characterized by a little developed hydrographic network. It is hardly made up by the ends down streams of the wad is going down from the plate. These water ways, not having a discharge system towards the sea, they cross the plain of Berrechid on about ten kilometers before atrophying itself there. They are with temporary flow, their water arrive on the plain, they are then evaporated or percolate towards the tablecloth, therefore one speaks about a endoreic hydrography.

**KEYWORDS:** flash floods, Semi-arid, Watershed area,

**RÉSUMÉ:** Le plateau du phosphate est une zone répartie géographiquement sur trois bassins versants : le bassin versant d'Oum Rbia, le bassin versant d'Oued Mallah et les bassins versants de Chaouia. Ces bassins versants sont situés dans le Maroc centrale. Ils sont donc exposés aux flux océaniques perturbés en provenance du Nord et du Nord Ouest. Les bassins versants de Chaouia et particulièrement ceux du plateau de Settat-Ben Ahmed sont caractérisés par un réseau hydrographique peu développé. Il est à peine constitué des bouts avals des oueds descendants du plateau. Ces cours d'eau, n'ayant pas d'exutoire vers la mer, ils traversent la plaine de Berrechid sur une dizaine de kilomètres avant de s'y atrophier. Ils sont à écoulement temporaire, leurs eaux arrivent sur la plaine, ils sont ensuite évaporés ou percolent vers la nappe. D'où le fonctionnement endoréique de ce réseau dont la gestion peut contribuer à la recharge du bassin hydrogéologique de la plaine de Berrechid et également limiter les inondations qui touchent de temps en temps la zone situé à l'aval de ce réseau.

**MOTS-CLEFS:** crues, semi-aride, bassin versant.

## 1 INTRODUCTION

Les bassins versants du plateau de Settat-Ben Ahmed sont des entités hydrologiques et hydrographiques bien individualisées. Ils sont disposés côte à côte sur une bande orientée SW- NE, d'une dizaine de kilomètres de largeur et d'une trentaine de kilomètres de longueur. Ces bassins s'étendent de l'Est à l'Ouest. Les cours d'eau les plus importants: Boumoussa, El Himmer, Mazer et Tamdrost (Fig.1). Leur intérêt réside dans le fait qu'ils contribuent à l'alimentation de la

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nappe de Berrechid. Leurs apports à la nappe sont d'autant plus importants en période de crues. Ces bassins appartiennent au bassin du Chaouia, ils font parie de l'Agence de bassin hydraulique de Bouregreg et le Chaouia.

Le régime d'écoulement de ces cours d'eau est formé de longues périodes de débits faibles ou inexistants et de quelques crues parfois violentes mais de courte durée et d'occurrence pendant les moins de novembre, décembre et février.

Le climat qui règne dans la région est de type aride à semi-aride, la température moyenne annuelle est d'environ 18°C. La population est très inégalement répartie entre des centres ruraux et urbains. La principale activité socio-économique est l'élevage et la culture des céréales en bour.

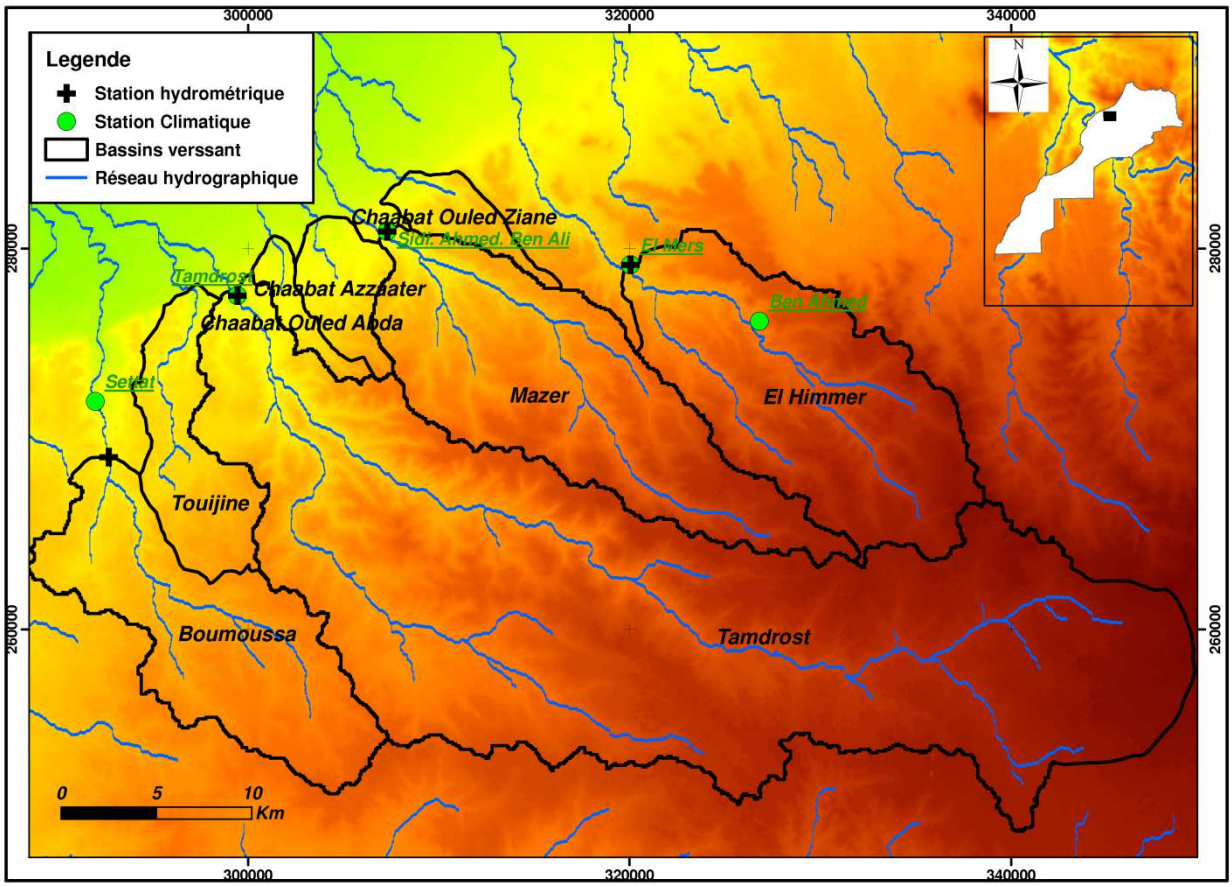



***Fig. 1. Plan de situation des bassins versants***

## 2 MORPHOMETRIE ET GEOLOGIE GENERALE

### 2.1 CONTEXTE GÉOLOGIQUE ET LITHOLOGIQUE

La série lithologique dans le plateau de Settat-Ben Ahmed débute par les formations d'âge paléozoïques, essentiellement les quartzites plissées et faillées. Le Trias est formé d'argiles rouges affleurent largement dans la région [1]. Après une lacune du Jurassique, le Crétacé est représenté par des calcaires de l'Infra Cénomanien et du Cénomaniens [2]. Le Tertiaire est représenté par une série d'âge pliocène caractérisée par des variations importantes de faciès et d'épaisseur. Cette formation est absente sur le plateau de Settat Ben Ahmed. Mais dans la plaine elle est gréseuse et constituée par une succession de conglomérats, de sables calcaires, de calcaires détritiques, renfermant des débris de coquillés [3]. Les formations quaternaires sont généralement couvertes dans la plaine de Berrechid par des limons subactuels à actuel.

Le Bassin de Berrechid et le plateau de Settat ont subi les effets de la compression alpine [4], dont les conséquences sont l'existence quasi permanente d'une légère flexion dans le secteur. Une phase compressive plus tardive de direction NNE-SSW à ENE-WSW entraine un léger soulèvement du bassin accompagné par quelques déformations tardives sur les bordures [1]. Les failles les plus importantes du secteur sont, en partie ou en totalité, des failles de sub-surface. Les failles de direction NNE-SSW à NE-SW (Faille de Mediouna ) qui borde à l'ouest le bassin de Berrechid, la flexure limitant le plateau des phosphates et passant par El Gara. Cette faille a manifestement contrôle la limite sud-est du bassin de Berrechid [5]. La faille

de Settat cartographie par Gigout [6], l'accident de Béni Sekten de direction NW-SE, elle mise en évidence par l'interprétation structurale des logs de forage, et.une famille de failles d'orientation NW-SE caractérisées par une grande continuité sans décalage apparent, avec un rejeu marqué par un déplacement à forte composante horizontale [7], ces failles jouent un très grand rôle dans l'orientation de l'écoulement des oueds du plateau de Settat Ben Ahmed.

### 2.2 CARACTÉRISTIQUES DES BASSINS VERSANTS

Le plateau de Settat-Ben Ahmed constitue la terminaison occidentale du plateau des phosphates, ce plateau s'incline doucement depuis le SE, où son altitude atteint 700m, vers la plaine de Berrechid en direction du NW, suivant une pente générale d'environ 1,3 %. Les différents compartiments du paysage dans la région se sont élaborés aux dépens d'une structure simple faisant partie-intégrante du domaine mesétien [8].

Les bassins versant des cours d'eau du plateau de Settat-Ben Ahmed sont relativement allongés avec des indices de compacité compris entre 1,8 et 2,4. Les superficies drainées oscillent entre 134 km2 pour le bassin d'oued Boumoussa et 631 km2 pour le bassin versant d'oued Tamdrost (tableau 1).

Il s'agit, en fait de petits bassins de forme allongée mais qui ensemble, présentent une superficie totale de 1153 km². Leur pente moyenne est modérée, et est inférieure à 1,2 %.Ces bassins versants reposent sur des terrains peu perméables composés de marnes et de marno-calcaires d'âge crétacé.

***Table 1. Caractéristiques géométriques des bassins versants***

| Caractéristiques géométriques | Tamdrost | Mazer | El Himmer | Boumoussa |
|---|---|---|---|---|
| **Surfaces (km2)** | 631 | 183 | 173 | 166 |
| **Périmètres (km)** | 215 | 99 | 83 | 82 |
| **Longueur (km)** | 54 | 32 | 27 | 24.7 |
| **Indices de compacité** | 2.4 | 2.1 | 1.8 | 1.8 |
| **Altitudes minimums (m)** | 306 | 324 | 448 | 360 |
| **Altitudes maximums (m)** | 774 | 689 | 771 | 603 |
| **Pentes moyennes (%)** | 0.87% | 1.14% | 1.20% | 0.98% |
| **Longueurs du rectangle équivalent (km)** | 54.0 | 32.0 | 27.0 | 24.7 |
| **Largeurs du rectangle équivalent (km)** | 11.7 | 5.7 | 6.4 | 6.7 |
| **Exutoire** | St Tamdrost | St S.Ahmed Ben Ali | St El Mers | Entrée canal enterré |

Ces bassins versants sont quasiment tous exposés vers le Nord-Ouest. Ceci leur permet de faire face aux perturbations pluvieuses en provenance de l'Océan atlantique. Par ailleurs, le réseau hydrographique de ces bassins est particulièrement caractérisé par une faible densité. Le niveau de ramification est caractérisé par la classification de Strahler.

***Table 2. Caractéristiques des oueds du secteur étudié [9].***

| Bassin | Surface (km²) | Module moyen (70-02) | Débit spécifique (l/s/km²) | Niveau de ramification |
|---|---|---|---|---|
| **Tamdrost** | 631 | 65.1 | 0.1 | 5 |
| **El Himmer** | 173 | 60 | 0.34 | 3 |
| **Mazer** | 183 | 71.8 | 0.39 | 3 |
| **Boumoussa** | 166 | 63.7 | 0.38 | 3 |

## 3 PLUVIOMETRIE ET REGIME DES COURS D'EAU

L'étude des séries chronologiques des précipitations fournies par l'Agence de Bassin Hydraulique de Bouregreg (ABHBC), qui couvre une période de 40 ans (1968 à 2010), nous a permis de constater que les bassins versants du plateau de Settat jouissent dans l'ensemble d'une pluviométrie moyenne pour des latitudes semi aride. De l'Ouest à l'Est, les exutoires de ces bassins reçoivent annuellement en moyenne 328 mm sur les sept stations (Fig. 1).

*Table 3. Situation des stations Pluviométriques*

| Station | X | Y | Z | Période d'observation |
|---|---|---|---|---|
| **El Gara** | 329000 | 299000 | 360 | 1968-2002 |
| **Ben Ahmed** | 326800 | 276200 | 600 | 1969-2002 |
| **El Mers** | 320050 | 279150 | 448 | 1975-2002 |
| **S. A. Ben Ali** | 307300 | 280900 | 324 | 1973-2002 |
| **Tamdrost** | 299450 | 277540 | 306 | 1975-2002 |
| **Settat** | 292000 | 272000 | 330 | 1973-2010 |
| **Khouribga** | 358750 | 257180 | 802 | 1972-2010 |

### 3.1 PRÉCIPITATIONS MENSUELLES

L'observation des histogrammes des pluies moyennes mensuelles (Tab. 4) et (Fig. 2) indique que :

Les précipitations connaissent une grande variabilité selon les saisons. La période pluvieuse s'étend de Novembre à Avril. Durant cette période, les précipitations connaissent une répartition irrégulière avec prédominance dans le mois de janvier ou décembre ou même du mois de mars dans certaines années.

A partir de Mai, les pluies deviennent de plus en plus rares, et en juillet août, les précipitations sont quasi inexistantes.

Le tableau et le graphe suivants présentent la pluviométrie mensuelle moyenne calculée sur l'ensemble des stations traitées sur la période (1972-2005).

*Table 4. Pluviométrie moyenne mensuelle sur les 7 stations*

| Station \ Mois | Sep | Oct | Nov | Déc | Jan | Fév | Mars | Avr | Mai | Juin | Juil | Août |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Khouribga** | 9.16 | 25.02 | 43.11 | 57.17 | 52.21 | 49.45 | 41.91 | 35.20 | 15.05 | 6.17 | 1.80 | 1.82 |
| **S. Ahmed Ben Ali** | 2.91 | 21.51 | 31.69 | 63.60 | 51.15 | 46.35 | 35.99 | 33.60 | 8.06 | 0.94 | 0.13 | 0.49 |
| **El Mers** | 4.80 | 23.30 | 44.23 | 58.19 | 52.11 | 42.26 | 36.18 | 30.42 | 13.13 | 2.07 | 0.16 | 0.18 |
| **Tamdrost** | 4.35 | 21.61 | 36.53 | 55.16 | 48.58 | 42.12 | 33.08 | 32.08 | 9.27 | 1.10 | 0.47 | 0.28 |
| **Settat** | 6.35 | 28.80 | 42.91 | 61.89 | 52.32 | 48.61 | 36.85 | 29.70 | 11.87 | 2.42 | 0.63 | 0.28 |
| **El Gara** | 7.37 | 31.08 | 49.37 | 69.99 | 56.59 | 50.33 | 43.63 | 38.82 | 16.48 | 4.00 | 2.41 | 2.45 |
| **Ben Ahmed** | 7.11 | 27.62 | 52.87 | 56.90 | 56.12 | 44.67 | 45.64 | 39.89 | 16.64 | 4.55 | 2.31 | 3.38 |
| **Moyenne** | 6.01 | 25.56 | 42.96 | 60.42 | 52.73 | 46.26 | 39.04 | 34.24 | 12.93 | 3.04 | 1.13 | 1.27 |

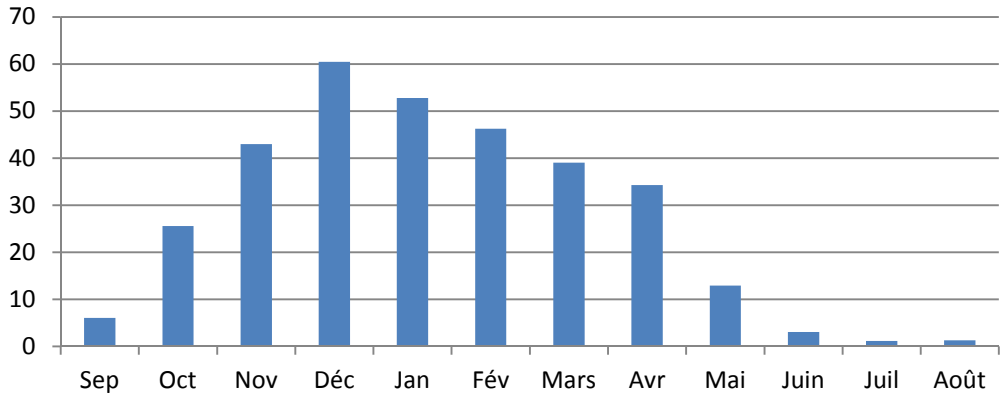



*Fig. 2. Pluviométrie moyenne mensuelle calculée sur les 7 stations en (mm)*

### 3.2 PRÉCIPITATIONS ANNUELLES

L'examen des données, année par année, révèle que certaines années s'annoncent sèches très tôt ; normalement, les premières pluies font leur apparition au mois de Septembre, mais il n'est, cependant, pas rare qu'aucune précipitation n'ait lieu jusqu'au mois d'Octobre ou même jusqu'au mois de Novembre.

La figure ci-après représente l'évolution de la pluviométrie annuelle. Elle fait apparaître la grande variabilité d'une année à l'autre des précipitations comme l'illustrent les importantes fluctuations que l'on observe. Ce schéma qui permet de mettre en évidence les années à fort déficit pluviométrique par rapport à celles excédentaires indique des périodes sèches entre les années 1979 et 1988, 1992 et 1994 et 1998 et 2000. Ces périodes sont entrecoupées d'épisodes plus pluvieux de cycles plus courts en général (2 à 4 ans).

La pluviométrie annuelle moyenne sur l'ensemble des stations oscille entre 150 mm et 550 mm, suivant que l'on se situe en année sèche ou en année humide.

L'analyse comparative des données annuelles de chaque station met en évidence une variabilité spatiale des pluies. En effet, alors que la moyenne annuelle des précipitations à Tamdrost est la plus faible de la zone d'étude, El Gara et Ben Ahmed sont relativement bien arrosés. D'après les données de ces stations, les précipitations diminuent nettement en allant de l'Ouest vers l'Est. Une diminution s'observe également en partant vers le Sud. Très logiquement la hauteur de précipitation augmente en fonction de la proximité de l'Océan et aussi de l'altitude et des reliefs rencontrés.

Les moyennes annuelles de précipitation sur le plateau de Settat s'établissent dans une fourchette de 285 à 373 mm/an.

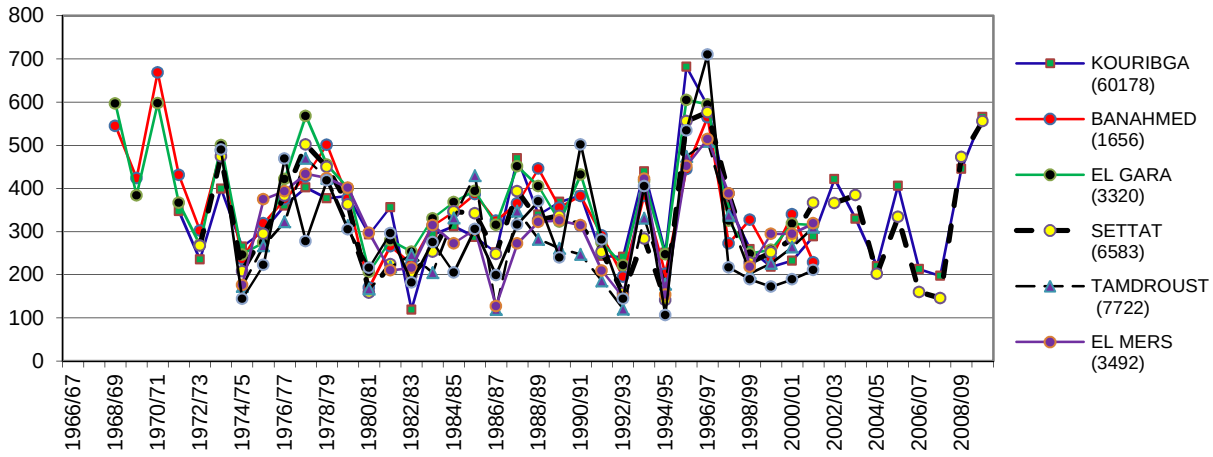



***Fig. 3. Pluviométrie annuelles pour les 7 stations en (mm)***

## 4 ANALYSE DES DÉBITS

Pour le régime des écoulements superficiels, le débit est assez irrégulier pour tous les bassins versants, avec une grande variation inter-annuelle et aussi une variation intra-annuelle.

### 4.1 DÉBITS MENSUELS

Les débits sont généralement faibles avec un régime très irrégulier au cours de l'année, les cours d'eau coulent pendant un nombre de mois restreints. Ces écoulement ne se fait pas pendant tous les jours du mois. A partir de l'analyse des données hydrométriques , nous avons relevé que le maximum hydrologique mensuel est enregistré sur les quatre bassins aux mois de décembre, janvier, février, mars, et Avril (Fig 4), on peut conclure que dans cette région du Maroc central, c'est l'écoulement hivernal qui prime . Au cours des mois d'été, les débits diminuent brutalement (période d'étiage) et les oueds sont pratiquement à sec.

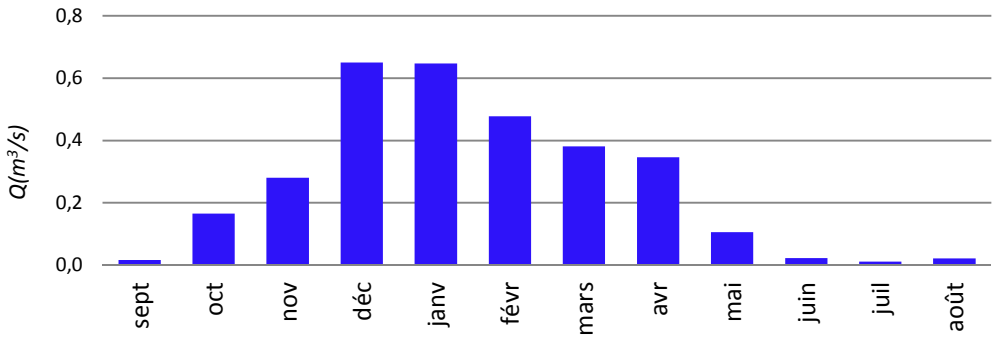



*Fig. 4. Débit moyen mensuel Sept 1970 - Aout 2002 pour les quatre Oueds*

En comparant les débits mensuels des quatre stations, on constate que les stations de Tamdrost et Mazer présentent des valeurs supérieures à celles des autres stations, mais en générale les quatre Oueds se caractérisent des débits faibles qui ne dépassent pas 0.5 m3/s.

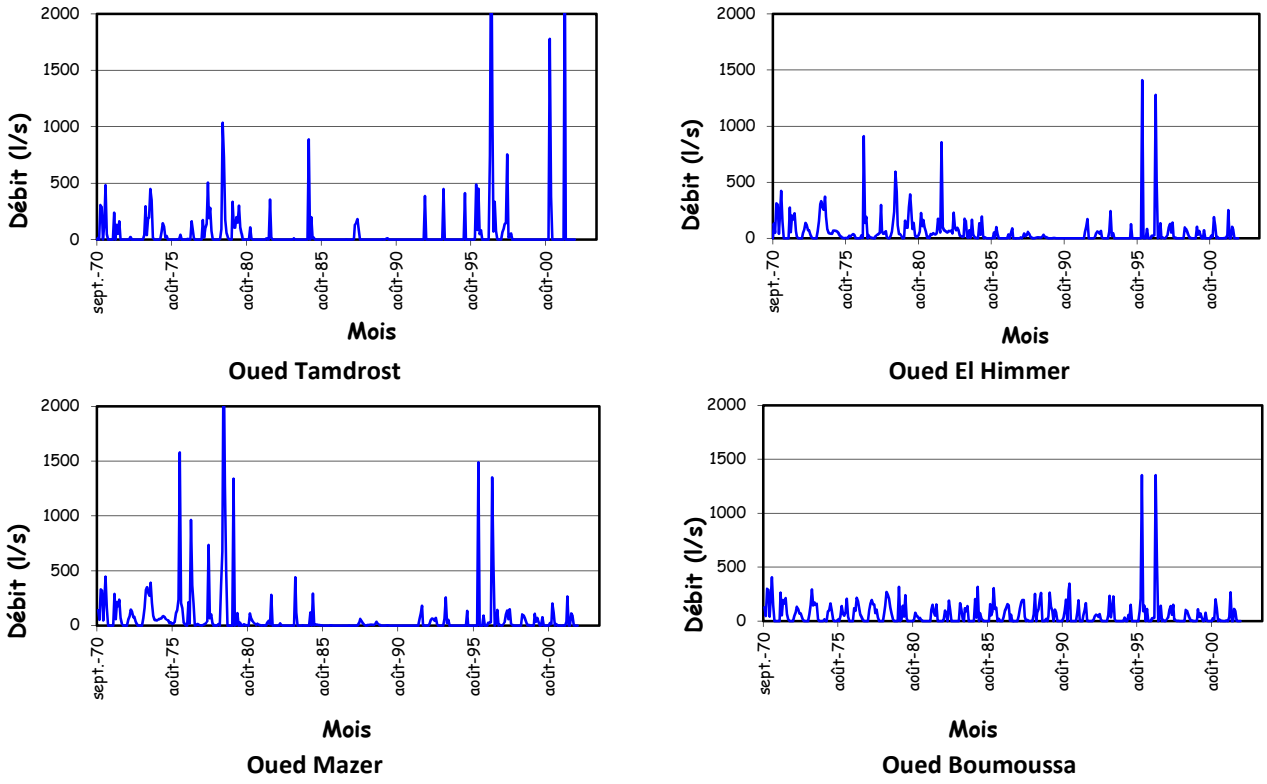



*Fig. 5. Débits moyens mensuels des oueds Tamdrost, El Himmer, Mazer et Boumoussa [5].*

Pour s'assurer de l'homogénéité des débits et la cohérence de l'information qu'ils présentent, on a eu recours à des essais de corrélation linéaire entre débits/débits des différentes stations hydrométriques afin de mieux juger les relations qui lient ces différentes stations. Ces essais consistent à examiner la tendance d'un nuage de points à s'aligner selon une droite oblique. Les corrélations moyennes mensuelles débits/débits (Tableau 5), sont fortes, et supérieur à 0.85 pour toutes les couples, ceci peut être expliqué par une forte liaison saisonnière entre les stations.

*Table 5. Coefficients de corrélations des débits mensuelles (l/s) des oueds étudiés*

| Station débit en l/s | Oued Tamdrost | Oued El Himmer | Oued Mazer | Oued Boumoussa |
|---|---|---|---|---|
| **Oued Tamdrost** | 1 | | | |
| **Oued El Himmer** | 0.96 | 1 | | |
| **Oued Mazer** | 0.85 | 0.85 | 1 | |
| **Oued Boumoussa** | 0.90 | 0.94 | 0.87 | 1 |

Un autre essai de corrélation linéaire entre les débits et la pluviométrie (Tableau 6), qui permet de déduire la relation linéaire mensuelle avec des coefficients de corrélation supérieurs à 0,80 pour toutes les stations témoignant d'une étroite dépendance saisonnière.

*Table 6. Coefficients de corrélations des débits mensuelles des oueds et les précipitations moyennes mensuelles*

| | Oued Tamdrost | Oued El Himmer | Oued Mazer | Oued Boumoussa |
|---|---|---|---|---|
| **Khouribga** | 0.83 | 0.87 | 0.89 | 0.95 |
| **S. Ahmed Ben Ali** | 0.92 | 0.92 | 0.92 | 0.96 |
| **El Mers** | 0.83 | 0.88 | 0.85 | 0.97 |
| **Tamdrost** | 0.87 | 0.90 | 0.89 | 0.97 |
| **Settat** | 0.83 | 0.85 | 0.87 | 0.94 |
| **El Gara** | 0.83 | 0.86 | 0.85 | 0.95 |
| **Ben Ahmed** | 0.75 | 0.82 | 0.82 | 0.94 |

La variation des débits mensuelle est donc semblable à celle des précipitations, montrant une bonne corrélation entre les deux variables, les coefficients de corrélation R sont supérieurs à 0,80 pour toutes les couples sauf entre les précipitations de Ben Ahmed et le débit de Tamdrost où le coefficient de corrélation R=0.75, certaines stations montrent un décalage au niveau des mois de l'été a cause des averses, le temps de réponse peut être évalué à quelques heures seulement.

### 4.2 DÉBITS ANNUELS

Le régime annuel est très irrégulier d'une année à l'autre, l'observation de l'évolution annuelle du module d'écoulement des oueds indique la succession d'années où le régime est très bas (période 80-94) et d'années de modules un peu plus significatifs (période 70-80).

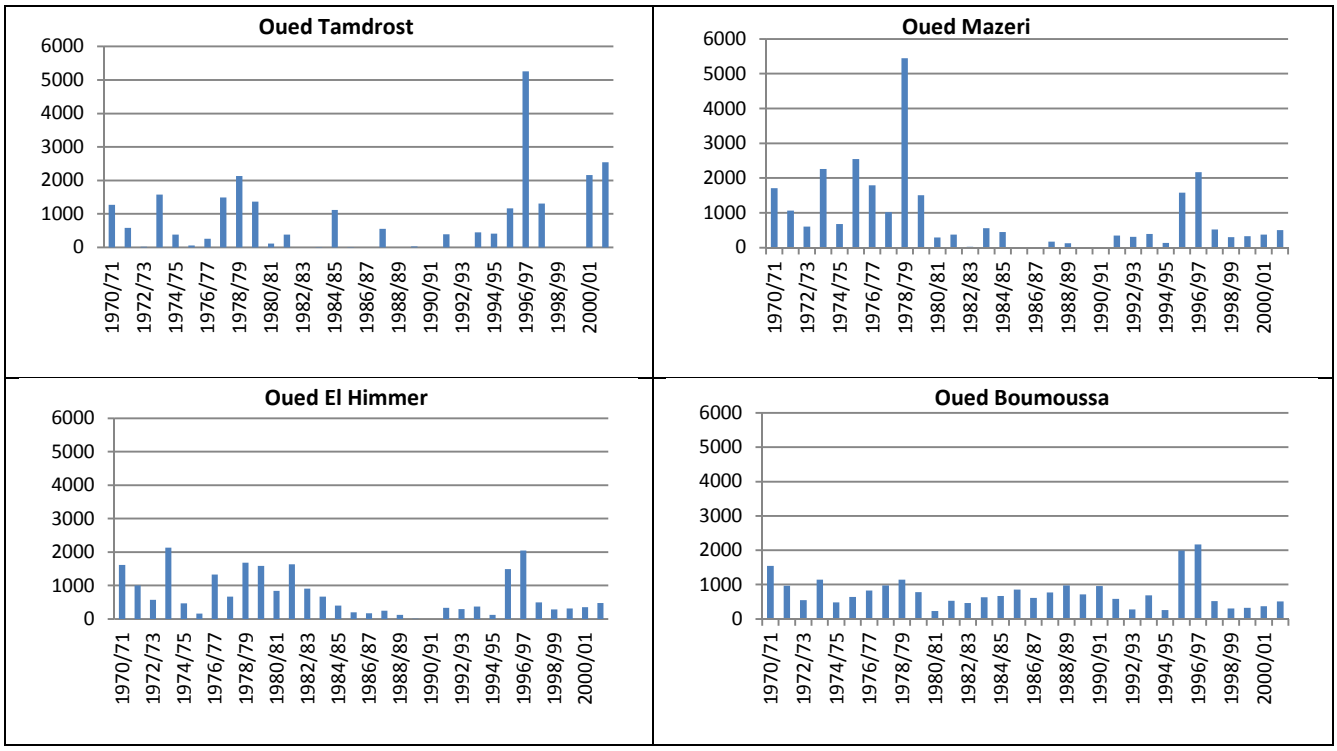



***Fig. 6. Histogrammes des débits moyens annuels en l/s [5].***

Au cours des années soixante dix, les débits sont plus significatifs (période 70-80) et représentent une période humide.

Pour les années quatre vingt, les débits sont faibles, les oueds sont plutôt secs correspondant généralement aux périodes de sécheresses qui ont sévi dans la région. D'ailleurs durant ces dernières années, ces oueds sont pratiquement à sec, sauf pour oued Boumoussa dont le débit est soutenue par les rejetés des eaux usées de la ville de Settat.

En comparant les débits annuels des quatre stations, on constate que les débits sont irréguliers d'une année à l'autre. Mais en générale les quatre Oueds se caractérisent des débits faibles qui ne dépassent pas 1 m3/s annuellement.

Pour déterminer la relation entre les précipitations annuelles et les moyennes annuelles des débits des oueds, la figure 7 montre une bonne relation linéaire pour la station de Settat et oued Boumoussa avec un coefficient de corrélation linéaire r = 0,74.

Pour les autres stations, la liaison linéaire est moins marquée, avec des coefficients plus faibles, ceci peut être expliqué probablement par la faible part des ruissellements de la précipitation totale, qui laisse cette corrélation moins significative, les débits moyennes annuelles sont généralement faibles voire même nulles, avec un régime très irrégulier au cours de l'année.

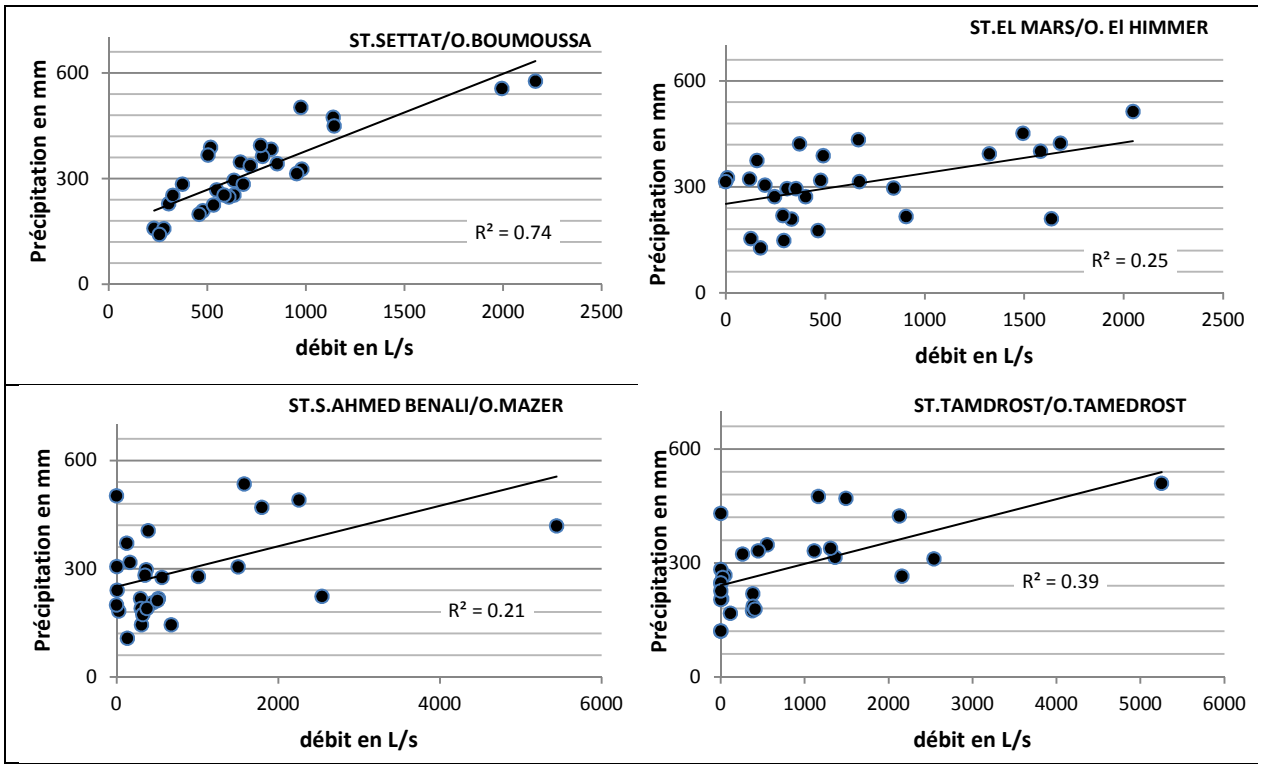



*Fig. 7. Corrélation linéaire entre les pluies moyennes annuelles et les débits moyens annuels des stations étudiées.*

En général, on peut dire qu'il existe une liaison saisonnière et annuelle étroite entre les précipitations et les régimes des oueds, puisque les précipitations sont évidemment le facteur essentiel qui conditionne les régimes hydrologiques et qu'elles constituent la matière première des débits du cours d'eau. Le calcul des rapports des débits extrêmes sur le débit moyen (Tableau 7), permet d'indiquer une très grande irrégularité des régimes des oueds.

*Table 7. Rapport des débits extrêmes sur le débit moyen*

| Stations | Tamdrost | El Mars | S. Ahmed Bni Ali | Boumoussa |
|---|---|---|---|---|
| Oueds | Tamdrost | El Himmer | Mazer | Boumoussa |
| Qmax/Qmoy | 6.7 | 3.0 | 6.3 | 2.8 |
| Qmin/Qmoy | 0.0 | 0.0 | 0.0 | 0.3 |

Les rapports ont des coefficients important ceci indique une grande irrégularité des débits annuels des oueds, ainsi l'oued Boumoussa présentent une stabilité relative avec 0,3 < r < 2,8 en le comparant aux autres oueds.

## 5 AJUSTEMENT STATISTIQUE DES DÉBITS

Nous disposons au départ, d'une série de crues observées à chaque station de mesure (fournie par l'Agence de Bassin Hydraulique de Bouregreg et de la Chaouia, et nous avons soumis cet échantillon à un traitement statistique qui aboutit à la probabilité d'occurrence d'un événement donné ou à sa durée de retour.

L'ajustement de la loi de Gumbel aux crues des Oueds du Plateau a montré une adéquation satisfaisante, ce qui nous autorise à utiliser cette loi pour estimer les probabilités d'occurrence des crues et leurs périodes de retour (Tableau. 8).

Dans le cas d'un ajustement selon la loi de Gumbel, la méthode graphique repose sur le fait que l'expression d'un quantile correspond à l'équation d'une droite. En conséquence, un échantillon de n points (xi, i =1 à n) d'une variable X susceptible de suivre une loi de Gumbel. On peut procéder:

- en traçant les fréquences empiriques des xi en fonction de xi sur un graphique de Gumbel, si les points sont alignés si on affaire à une variable de Gumbel ; on en déduit les paramètres.

- on calcule les paramètres de la loi théoriques :

Soit par la méthode des moments soit par la méthode du maximum de vraisemblance ; on trace la droite théorique ainsi obtenue et les points expérimentaux (couple (xi, Femp (xi)), un bon alignement des fréquences empiriques sur la droite théorique signifie que X suit bien une loi de Gumbel.

Soit T la période de retour d'une valeur x ≥ X, exprimée en année. F(x) désigne la fonction de répartition de Gumbel.

Si X représente la valeur maximum annuelle d'un phénomène (débit instantanée, intensité horaire de pluie, etc…) on a la relation suivante entre T et F(x) :

$$T = \frac{1}{1 - F(x)}$$

En remplaçant F(x) dans l'expression suivante on en tire :

$$x = -s.Ln\left[-Ln\left(1-\frac{1}{T}\right)\right] + x_0$$

Ce test statistique a permis de constater que les crues des oueds sont assez puissantes pour la superficie drainée et pour un milieu semi aride.

Une pointe de 11 m3/s par exemple, et qui correspond à 154 fois le module moyen, se produirait tous les cinq ans et même une pointe de 13 m3/s reviendrait tous les 10 ans (Tableau. 8).

Les crues des oueds du plateau de Settat sont toujours provoquées par de fortes pluies, principalement d'automne et d'hiver. Elles sont exclusivement d'origine pluviale. Ces pluies intenses sont couplées à une morphologie générale et une lithologie propices au développement de fortes crues, notamment des substratums peu perméables et un couvert végétal clairsemé et très peu développé.

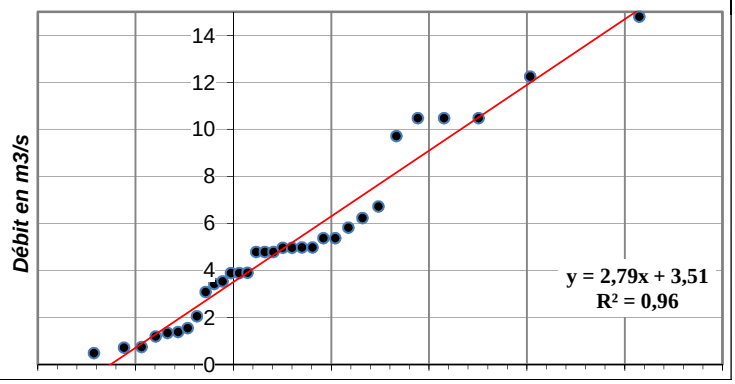
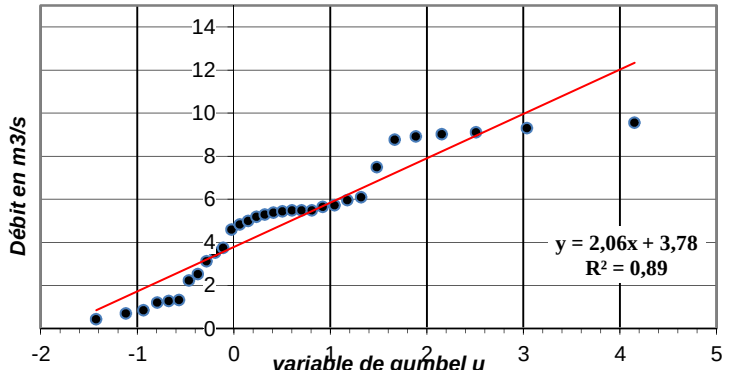
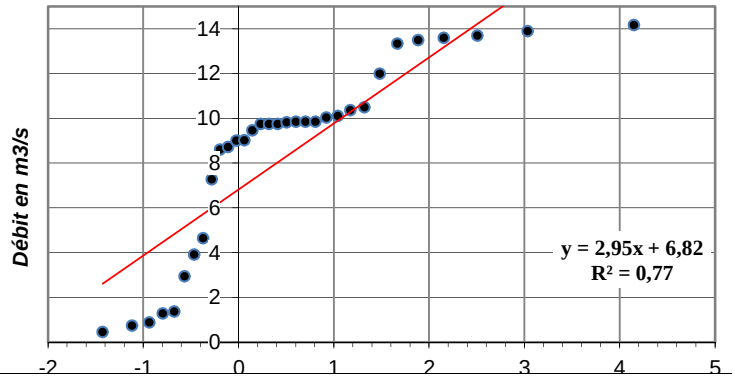
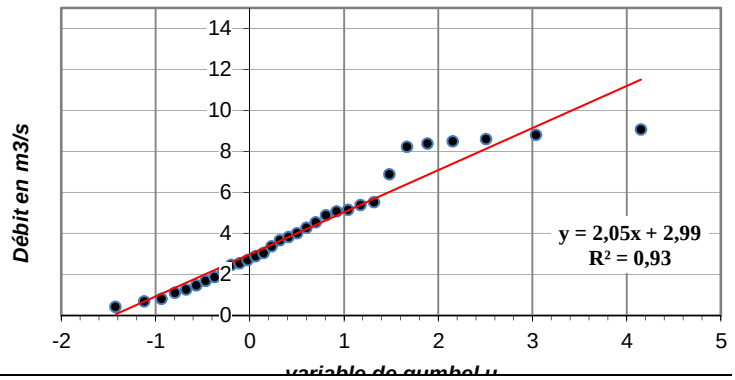
| *Oued* | *période de retour T* | *probabilité de non dépassement de Qp* | *variable réduite de Gumbel* | *Qp pour période de retour T* | **Diagramme de Gumbel** |
|---|---|---|---|---|---|
| Tamdrost | **2** | 50% | 0.4 | **5** |   |
| | **5** | 80% | 1.5 | **8** | |
| | **10** | 90% | 2.3 | **10** | |
| | **20** | 95% | 3.0 | **12** | |
| | **50** | 98% | 3.9 | **14** | |
| El Himmer | **2** | 50% | 0.4 | **5** |   |
| | **5** | 80% | 1.5 | **7** | |
| | **10** | 90% | 2.3 | **8** | |
| | **20** | 95% | 3.0 | **10** | |
| | **50** | 98% | 3.9 | **12** | |
| Mazer | **2** | 50% | 0.4 | **8** |   |
| | **5** | 80% | 1.5 | **11** | |
| | **10** | 90% | 2.3 | **13** | |
| | **20** | 95% | 3.0 | **16** | |
| | **50** | 98% | 3.9 | **18** | |
| Boumoussa | **2** | 50% | 0.4 | **4** |   |
| | **5** | 80% | 1.5 | **6** | |
| | **10** | 90% | 2.3 | **8** | |
| | **20** | 95% | 3.0 | **9** | |
| | **50** | 98% | 3.9 | **11** | |

***Table 8.*** ***Estimation des débits de crues et leurs périodes de retour des oueds***

## 6 SYNTHESE ET DISCUSSION

La zone d'étude est soumise, comme le restant du territoire marocain, à des crues importantes qui peuvent être très dommageables aussi bien pour les infrastructures publiques ou privées que pour l'agriculture, et causer de nombreuses victimes parmi la population.

Le risque d'inondation est ressenti plus fortement aujourd'hui en raison du fort développement démographique, économique, urbain, agricole, industriel et touristique.

En clair, le risque d'inondation est le résultat de la présence à la fois d'un cours d'eau susceptible de déborder après de fortes précipitations aléatoire et présence des biens vulnérables exposés à ces aléas. Il est à souligner que la vulnérabilité augmente fortement avec le développement urbain et que des situations de risque peuvent être crées là où il n'y en avait pas auparavant, d'où la nécessité d'une maîtrise de l'occupation des sols en zone inondable.

Il est possible d'avoir une idée sur le potentiel global des ressources en eau dans la zone d'étude en utilisant l'information disponible au niveau des bassins versants jaugés. Les apports annuels moyens de la zone d'étude s´élèvent à 9.1 Mm3 (1972/05) avec une forte irrégularité interannuelle.

***Table 9. Estimation des Apports globaux annuels moyens (1972-2005) en Mm3 [10].***

| Bassins | Surfaces (km2) | Périmètres (km) | Longueur (km) | Apports annuels moyens (1972-2005) en Mm3 |
|---|---|---|---|---|
| **Boumoussa** | 166 | 82 | 24.7 | 2.1 |
| **Touijjine** | 61 | 55 | 18 | 0.9 |
| **Tamdrost** | 631 | 215 | 54 | 2.3 |
| **Mazer** | 183 | 99 | 32 | 2.2 |
| **EL Himmer** | 173 | 83 | 27 | 1.6 |

L'infiltration des apports le long des cours d'eau ou par épandage des crues, d'une partie des eaux de ruissellement provenant des Cinq oueds

***Table 10. Estimation des Apports mensuels moyens (1972-2005) en Mm3 [10].***

| Station \Mois | Sep | Oct | Nov | Déc | Jan | Fév | Mars | Avr | Mai | Juin | Juil | Août |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Boumoussa** | 0.0 | 0.2 | 0.3 | 0.5 | 0.4 | 0.3 | 0.3 | 0.2 | 0.1 | 0.0 | 0.0 | 0.0 |
| **Touijjine** | 0.0 | 0.1 | 0.1 | 0.2 | 0.2 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Tamdrost** | 0.0 | 0.0 | 0.9 | 0.4 | 0.3 | 0.3 | 0.3 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Mazer** | 0.0 | 0.2 | 0.3 | 0.5 | 0.4 | 0.3 | 0.3 | 0.2 | 0.1 | 0.0 | 0.0 | 0.0 |
| **EL Himmer** | 0.0 | 0.1 | 0.2 | 0.4 | 0.4 | 0.2 | 0.2 | 0.2 | 0.1 | 0.0 | 0.0 | 0.0 |

Les apports mensuels (Tableau. 10) sont généralement faibles avec un régime très irrégulier au cours de l'année, les apports sont relativement importants pendant un nombre de mois restreint, ces apports ne se fait pas pendant tous les mois. A partir de l'analyse des données de l'ABHBC, nous avons relevé que le maximum d'apport mensuel est enregistré sur les cinq bassins aux mois de décembre, janvier, et février (Fig 8), on peut conclure que les apports d'eau pour la plaine de Berrechid par les oueds du plateau de Settat Ben Ahmed sont liés à l'écoulement hivernal.

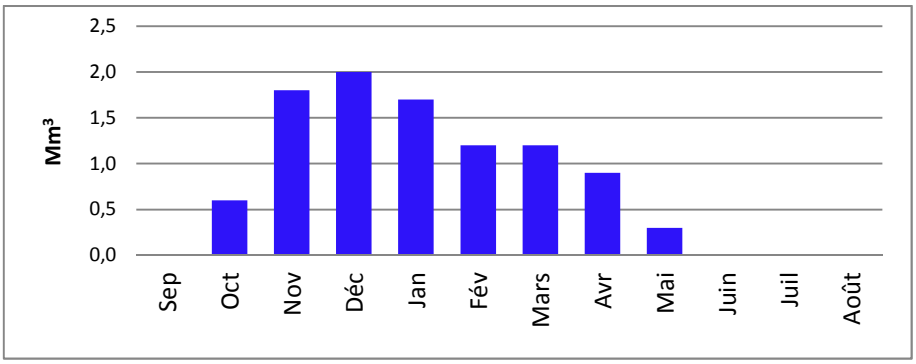



***Fig. 8. Apport moyenne mensuelle entre (1972-2005) en (Mm3) pour les quatre Oueds et Oued Touijjine [10].***

Bien qu'avec les débits moyens annuels très faibles (0,1 à 2 m3/s en général), les crues des oueds du plateau de Settat sont caractérisées par des débits de pointes très élevés. Ces crues sont aussi caractérisées par des temps de montées assez courts et des hydro-grammes pointus, ce qui indique la brièveté et la puissance des évènements.

Le régime des oueds est caractérisé par des tarissements fréquents et des crues rapides et violentes engendrées par des pluies intenses et localisées. Les écoulements sont globalement produits à hauteur de 65 à 90 % pendant la période allant de décembre à mars.

Ces oueds ont connu ces dernières années deux crues importantes, la première le 24 décembre 2001 et la deuxième le 25 novembre 2002. Les écoulements de ces oueds dans la plaine de Berrechid sont très complexes. Ils se font en nappe et les eaux des oueds divaguent à cause d'une topographie très plate de la zone.

Le volume ruisselé jusqu'à la plaine est de 9 Mm3. Dans la plaine, une partie sera reprise par évaporation dans les zones d'épandage et le reste joindra inévitablement la nappe. L'apport moyen au niveau de la plaine est de 5,5 Mm3 ; les valeurs extrêmes peuvent être particulièrement élevées : près de 23 Mm3 durant l'année 96/97; en années très déficitaires, ces valeurs sont quasi-nulles [10], ces volumes générées par ces oueds à régimes éphémères et saisonniers jouent un rôle très important dans la recharges de la nappe de Berrechid.

## 7 CONCLUSION

Les bassins versants des oueds du plateau de Settat ont un hydro-système relevant du domaine semi-aride marocain caractérisé par un régime pluvial océanique où seules les précipitations conditionnent l'écoulement superficiel. Ce régime est marqué par une saison pluvieuse en automne et en hiver suivi d'une longue période très peu pluvieuse d'avril à octobre.

Sur le plan hydrologique, le régime est caractérisé par une saison de hautes eaux calquée sur la saison pluvieuse. Les débits sont étroitement liés aux pluies aux échelles mensuelles et annuelles. Les coefficients de corrélation entre les deux paramètres son assez élevés. Ils témoignent de la bonne réponse hydrologique du bassin versant.

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# *In vitro* techniques to accelerate flavonoid synthesis in some Euphorbiaceae members

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**ABSTRACT:** In the present investigation, an attempt has been made to accelerate the flavonoid synthesis in *Baliospermum montanum* (Wild.) Muell-Arg., *Dryptes roxburghii* (Wall.) Huresawa and *Codiaeum variegatum* (L.) Bl, members of Euphorbiaceae family. Internodal explants were used to induce callus. Maximum growth of callus was observed in Baliospermum montanum and *Codiaeum variegatum* at 2mg/L and 3mg/L of 2,4-D respectively whereas *Dryptes roxburghii* showed maximum growth of callus at 3mg/L of BAP. Suspension culture was obtained from well developed callus. Three elicitors were used to induce flavonoid synthesis namely phenylalanine, copper sulphate and *Pseudomonas aeruginosa.* Among three, phenylalanine was found to be the best elicitor and maximum production of flavonoid was observed in *Baliospermum montanum*.

**KEYWORDS:** Baliospermum montanum, Dryptes roxburghii, Codiaeum variegatum, callus, suspension culture, Elicitor and flavonoid.

## 1 INTRODUCTION

The Euphorbiaceae is one of the largest family in dicotyledons, and has significant economic importance. The family has a cosmopolitan distribution with five subfamilies, 49 tribes, 317 genera and about 8,000 species. The family Euphorbiaceae is generally distinguished by the presence milky sap, the unisexual flowers, superior ovary and generally trilocular, axile placentation, collateral ovules, pendulous with ventral raphe and usually carunculate. Euphorbiaceae classification is difficult because of the variability in morphology, genetics and complexity in habitat. The family consists of species of great economic importance, the source of rubber and medicine (*Hevea*); staple starch source (*Manihot*) and fruits (*Phyllanthus emblica*); seed oils (*Ricinus, Vernicia*); insecticides, Waxes (*Euphorbia antisyphilitica*), edible seeds (*Caryoclendron orinocense*), leafy vegetable (*Cnidoscolous aconitifolius*).

Secondary metabolites are phytochemicals produced by plants which does not play any primary role in growth, photosynthesis and reproduction. Due to its diversity, Phytochemicals can be used as taxonomic characters in plant classification. Flavonoids are a specific class of phenolic plant phytochemicals represented by over 5000 compounds, subdivided Into 13 categories that include anthocyanidins, catechins, flavonols, and flavones [1]. Their activities are structure dependent. The chemical nature of flavonoids depends on their structural class, degree of hydroxylation, other substitutions and conjugations, and degree of polymerization [2]. Many have antiallergic, antiviral actions and some of them provide protection against cardiovascular mortality [3] & [4].

Dietary intake of phytochemicals may promote health benefits, protecting against chronic degenerative disorders, such as cancer, cardiovascular and neurodegenerative diseases. Majority of foods, such as whole grains, beans, fruits, vegetables and

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herbs contain phytochemicals. These phytochemicals, either alone or in combination, have tremendous therapeutic potential in curing various ailments [5]. Because of the wide spectrum of medicinal properties of phytochemicals, it is being commercially important to produce phytochemicals on large scale.

Study has revealed that phytochemicals plays important role in the immune system of plants, so by exposing plants to different environmental conditions, the phytochemicals production can be induced. There are different methods employed for phytochemical production, such as by adding precursor, using elicitor (biotic/ abiotic), metabolic engineering, biotransformation and mutagenesis. In this paper, flavonoid is induced by using its precursor (phenylalanine), by adding elicitor (biotic – dead cells of *Pseudomonas aeruginosa* and abiotic –copper sulphate).

## 2 MATERIALS AND METHODS

### 2.1 COLLECTION OF PLANT MATERIAL

*Baliospermum montanum* (Wild.) Muell-Arg,, *Dryptes roxburghii* (Wall.) Huresawa were collected from Sirsi, Western Ghats of Karnataka and *Codiaeum variegatum* (L.) Bl. was collected from Lal Bagh Botonical garden, Bangalore. Plants are being maintained in the Department of Molecular Biology, Bangalore University, Bangalore.

### 2.2 CALLUS INDUCTION

Internodal explants of *Baliospermum montanum*, *Dryptes roxburghii* and *Codiaeum variegatum* were inoculated on Murashige and Skoog basal media (MSBM) consisting of vitamins, 3% sucrose and 0.8% agar supplemented with 2,4-dichlorophenoxyacetic acid and 6-benzylaminopurine at the concentrations of 0.5, 1.0, 2.0, 3.0 and 4.0 mg/L were used for callus initiation and proliferation. MSBM without any plant growth regulators (2,4-dichlorophenoxyacetic acid and 6-benzylaminopurine) was used as control. These cultures were allowed to grow upto their maximum growth age (6 weeks). The pH of media was adjusted to 5.8 before autoclaving at 121ºC for 20 min. All cultures were maintained at 25 ± 2ºC in growth chamber with fluorescent light (1500 lux), 16 hrs light and 8 hrs dark photoperiod.

### 2.3 SUSPENSION CULTURE

Cell Suspension of *Baliospermum montanum*, *Dryptes roxburghii* and *Codiaeum variegatum* were obtained from callus tissue (6 weeks old) developed from internodal explants. One gram of friable callus was excised in Petri dish containing Whatman No.1 filter paper. Callus was slightly mashed and carefully transferred with sterilized forceps to each of 250ml Erlenmeyer flasks containing 50ml liquid MSBM, supplemented with 0.5ml/L of 2, 4-D alone. They were subcultured after every 14 days, the ratio innoculum to fresh medium was 1:6. The flasks were kept on a gyratory shaker at 100 rpm to a photoperiod of 16 hours, with fluorescent light (1200 lux) and a temperature of 25ºC.

### 2.4 VIABILITY TESTS

Viability was determined by the MTT assay. One ml sample of 6 week old cell suspensions was placed in micro-centrifuge tubes, centrifuged at 1000 rpm, and 100 µl of MTT was added to the sample. MTT protocol was based on Tisserat and Manthey method [6]. 1% MTT (3-(4,5-dimethythiazol-2-yl)-2,5-diphenyl tetrazolium bromide) solution was used to test the incubation conditions of 30min at room temperature or 37°C. Viability was determined by counting the coloured cells in a hemacytometer. Control tests of viability were done with suspension cultures fixed in 70% ethanol.

### 2.5 ELICITOR TREATMENT

The first type of experiment: Phenylalanine (25-100 µg/ml) was added in the 6 week old cell suspensions. The plant cells were harvested after 24, 48 and 72 hours respectively and the liquid media was used to estimate total content of flavonoid.

The second type of experiment: Copper sulphate (CuSO4) was added in flasks containing 6 weeks suspension cultures to obtain a final copper concentration of 20 and 40 µM respectively. The plant cells were harvested after 24, 48 and 72 hours respectively.

The third type of experiment: The bacterial cultures (*P. aeruginosa*) were maintained on Mueller-Hinton Agar (MH). Cultures that maintained on agar slants were transferred to 100 ml liquid medium in 250-ml flasks and incubated at room temperature. The bacterial liquid cultures were kept on a rotary shaker (90 rpm). The culture was collected after reaching

stationary phase (48 hrs). Flasks which contain bacteria were then autoclaved and the solution obtained was stored at 4˚C for future use. The pH was adjusted to 5.8 before autoclaving at 121˚C and a pressure of 1.04 kg/cm$^2$ for 20 min. The dead cells of *P. aeruginosa* (1, 2, 3 µg/ml) was added in 6 weeks old suspension culture.

### 2.6 EXTRACTION

For the extraction of flavonoids, plant cells from suspension cultures were oven dried at 45°C and pulverized. Powdered samples (1.0 g) was soaked in 100 ml of methanol for 72 hours and filtered through a Whatman No. 1 filter paper. The filtrates were concentrated using a rotary evaporator

### 2.7 TOTAL FLAVONOID ESTIMATION

Aluminium chloride colorimetric method [7] with few modifications was used to estimate total flavonoid content. The 1mL of plant cells methanol extract was mixed with 1ml of methanol, 0.5 mL aluminium chloride (1.2%) and 0.5mL potassium acetate (120mM). The mixture was allowed to stand for 30 min at room temperature, and then the absorbance was measured at 415nm. Quercetin was used as standard. Flavonoid is expressed in terms of quercetin equivalent (mg/g of extracted compound)

### 2.8 STATISTICAL ANALYSIS

Each of the tests was carried out in triplicate and the results are expressed in Mean ± STD

## 3 RESULTS

### 3.1 CALLUS INDUCTION

Callus proliferation was observed from the internodal explants of *Baliospermum montanum* (Wild.) Muell-Arg., *Dryptes roxburghii* (Wall.) Huresawa and *Codiaeum variegatum* (L.) Bl within a week of inoculation and the highest frequency of callus was observed after 5 weeks on MS medium supplemented with different concentrations of 2,4-dichlorophenoxyacetic acid and 6-benzylaminopurine. Maximum growth of Baliospermum montanum, *Codiaeum variegatum* callus were observed at 2mg/L and 3mg/L of 2,4-D respectively whereas *Dryptes roxburghii* showed maximum growth at 3mg/L of BAP.

### 3.2 VIABILITY TESTS

The MTT assay showed 88, 80, and 82% of cell viability of 6 weeks old cell suspension culture of *Baliospermum montanum* (Wild.) Muell-Arg,, *Dryptes roxburghii* (Wall.) Huresawa and *Codiaeum variegatum* (L.) Bl. respectively.

### 3.3 FLAVONOID ESTIMATION AFTER ELICITOR TREATMENT

The results are presented in Table -1


***Fig 1: Callus proliferation: 1- Baliospermum montanum (Wild.) Muell-Arg, 2- Dryptes roxburghii (Wall.) Huresawa and 3- Codiaeum variegatum (L.) Bl***

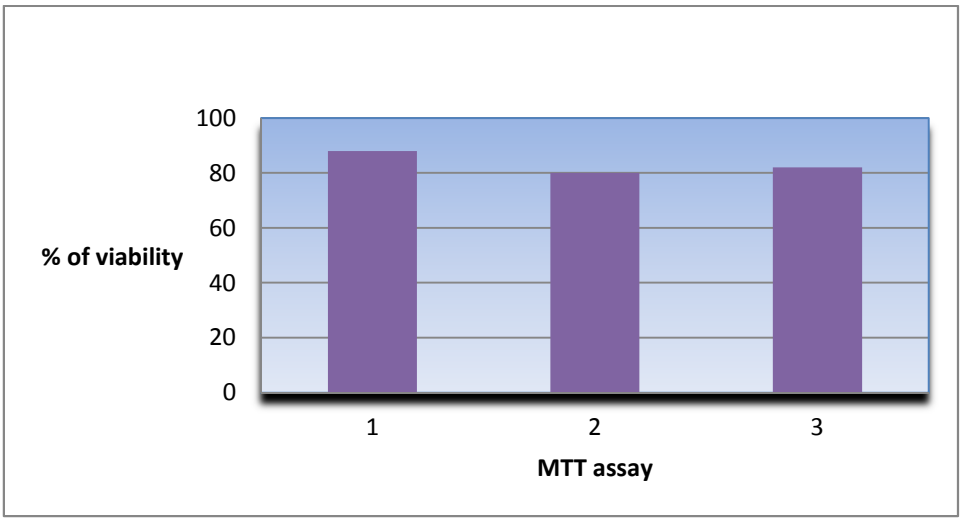


*Fig 2: MTT assay: 1- Baliospermum montanum 2- Dryptes roxburghii and 3- Codiaeum variegatum*

*Table 1- Effect of elicitors on flavonoid synthesis*

| Type of experiment | Treatment of duration (hrs.) | Concentration of elicitor | Total content of flavonoid mg/g (Bm) | Total content of flavonoid mg/g (Cv) | Total content of flavonoid mg/g (Dr) |
|---|---|---|---|---|---|
| Phenyalanine | 24 | Control | 44.08 ± 0.06 | 32.64 ± 0.24 | 22.38± 0.04 |
| | | 25 µg/ml | 48.48 ± 0.37 | 35.4 ± 0.20 | 27.16± 0.02 |
| | | 50 µg/ml | 50.50 ± 0.40 | 38.12 ± 0.10 | 29.65 ± 0.03 |
| | | 75 µg/ml | 55.44 ± 0.38 | 40.93 ± 0.08 | 31.83 ± 0.02 |
| | | 100 µg/ml | 47.03 ± 0.05 | 34.76 ± 0.06 | 25.14 ± 0.50 |
| | 48 | Control | 47.22 ± 0.08 | 33.72 ± 0.13 | 24.55± 0.03 |
| | | 25 µg/ml | 48.34 ± 0.23 | 36.91± 0.03 | 28.76± 0.02 |
| | | 50 µg/ml | 51.74 ± 0.06 | 39.66 ± 0.09 | 31.26 ± 0.02 |
| | | 75 µg/ml | 54.77 ± 0.23 | 43.25 ± 0.13 | 33.54 ± 0.02 |
| | | 100 µg/ml | 52.15 ± 0.14 | 41.12 ± 0.09 | 30.65 ± 0.02 |
| | 72 | Control | 54.40 ± 0.22 | 42.25 ± 0.07 | 32.13± 0.03 |
| | | **25 µg/ml** | **57.12 ± 0.09** | **45.33± 0.14** | **35.26 ± 0.02** |
| | | 50 µg/ml | 53.45 ± 0.14 | 43.85± 0.04 | 34.47± 0.01 |
| | | 75 µg/ml | 52.45 ± 0.09 | 41.65 ± 0.11 | 33.36 ± 0.02 |
| | | 100 µg/ml | 49.89 ± 0.04 | 39.89 ± 0.08 | 30.64 ± 0.02 |
| CuSO4 | 24 | Control | 45.22 ± 0.09 | 37.93± 0.03 | 24.48± 0.02 |
| | | **20 µM** | **49.74 ± 0.13** | **43.51± 0.13** | **31.59 ± 0.02** |
| | | 30 µM | 43.76 ± 0.08 | 38.22 ± 0.09 | 29.65 ± 0.03 |
| | | 40 µM | 42.49± 0.04 | 35.28 ± 0.20 | 27.83± 0.03 |
| | 48 | Control | 43.45 ± 0.08 | 36.8± 0.03 | 23.47± 0.01 |
| | | 20 µM | 45.41 ± 0.02 | 38.25± 0.12 | 25.35± 0.03 |
| | | 30 µM | 48.23 ± 0.09 | 40.30 ± 0.07 | 22.14 ± 0.03 |
| | | 40 µM | 44.31 ± 0.14 | 35.28 ± 0.20 | 20.24 ± 0.04 |
| | 72 | Control | 40.15 ± 0.05 | 28.80± 0.07 | 20.933± 0.03 |
| | | 20 µM | 42.3 ± 0.13 | 31.29± 0.09 | 22.83± 0.02 |
| | | 30 µM | 46.61 ± 0.19 | 37.81 ± 0.02 | 25.45 ± 0.02 |
| | | 40 µM | 43.29 ± 0.09 | 35.38 ± 0.08 | 23.65 ± 0.02 |

| | | | | | |
|---|---|---|---|---|---|
| **P. aeruginosa** | 24 | Control | 45.52 ± 0.21 | 37.16± 0.03 | 28.49± 0.03 |
| | | 1 µg/ml | 47.75 ± 0.20 | 39.5± 0.04 | 30.09± 0.06 |
| | | 2 µg/ml | 51.23 ± 0.18 | 43.59 ± 0.02 | 32.84 ± 0.02 |
| | | 3 µg/ml | 49.71± 0.08 | 44.65 ± 0.02 | 33.74 ± 0.02 |
| | 48 | Control | 48.51 ± 0.11 | 42.46± 0.03 | 32.7± 0.01 |
| | | 1 µg/ml | 52.42 ± 0.31 | 45.15± 0.44 | 33.94± 0.04 |
| | | 2 µg/ml | 53.57 ± 0.10 | 46.44 ± 0.17 | 34.18 ± 0.01 |
| | | **3 µg/ml** | **55.93± 0.04** | **48.37 ± 0.03** | **35.15 ± 0.03** |
| | 72 | Control | 51.71 ± 0.10 | 46.84± 0.02 | 34.64± 0.02 |
| | | 1 µg/ml | 47.9 ± 0.02 | 44.72± 0.16 | 32.15± 0.03 |
| | | 2 µg/ml | 43.77 ± 0.07 | 43.66 ± 0.02 | 33.53 ± 0.02 |
| | | 3 µg/ml | 41.66± 0.07 | 41.37 ± 0.03 | 30.64 ± 0.02 |

n=3, Data is presented as Mean ± STD, Bm- Baliospermum montanum, Dr- *Dryptes roxburghii*
Cv- *Codiaeum variegatum*

## 4 DISCUSSION

Secondary metabolites are non nutritive phytochemicals which are produced at different developmental stages, under stress conditions and plays important role in giving protection against pathogen attack. When these phytochemicals are ingested by humans, it enhances their resistance power. Flavonoids, widespread plant secondary metabolites, are of immense economic functions such as potential drugs, food nutraceuticals and industrial materials, while their importance was also manifested by the larger and larger demands [8]. Therefore; different methods are being employed to accelerate the phytochemical production. Many successful attempt of elicitor treatment has been reported, *Cephalocereus senile[9], Andrographis paniculata[10], Morinda citrifolia[11], Citrus hystrix[12], Marsilea quadrifolia[13].*

In the present investigation, three elicitors have been used namely phenylalanine, CuSO4 and *P. aeruginosa* to accelerate the flavonoid production in the selected medicinal plants from Euphorbiaceae family. The production of flavonoid varies with type, concentration and duration of elicitor used. Among all three elicitor, phenylalanine was found to be best and the maximum production of flavonoid was observed in *Baliospermum montanum.*

All three selected elicitors showed acceleration in uniform pattern. Phenylalanine showed maximum elicitation of flavonoid at 25µg/ml and 72hrs in Baliospermum montanum (57.12 ± 0.09), *Codiaeum variegatum* (45.33± 0.14) and *Dryptes roxburghii* (35.26 ± 0.02). The mechanism of elicitation is well known. Flavonoid belongs to phenypropanoid group of compounds which are derived from aromatic amino acid (phenylalanine) and end product of krebs cycle (acetyl Co-A.) [14] and [15]. Conjugation of malonylCoA and coumaroyl-CoA molecules to chalcones catalyzed by chalcones synathase is the first committed step of flavonoid synthesis [16]. Chalcones are converted to flavanones by the action of chalcone isomerase (CHI). Flavanones are precursors of all classes of flavonoids [17].

CuSO4 showed maximum elicitation of flavonoid at 20 µg/ml and72 in Baliospermum montanum (49.74 ± 0.13), *Codiaeum variegatum (*43.51± 0.13) and *Dryptes roxburghii (*31.59 ± 0.02). This agrees with the findings of Cristina and Constantin [18]. Similary, the literature is reported by Tumova [19] in *Ononis arvensis* suspension cultures where flavonoid is elicitated after 24 hrs using nickel, cobalt and in callus by silver. Similar results was obtained by Jeong [20] in hairy roots cultures of Panax ginseng, the addition of 20µM of NiSO4 resulted in an increase in gingeng saponin content to about 1.2 times compared with the control levels.

*P.aeruginosa* showed maximum elicitation at 3 µg/ml and 48hrs in Baliospermum montanum (55.93± 0.04), *Codiaeum variegatum (*48.37 ± 0.03) and *Dryptes roxburghiie(*35.15 ± 0.03). Savitha [21] accounted the betalain production in 7 days by treating the hairy root cultures of *Beta vulgaris* with *Penicillium notatum* (0.25 % concentration) *by* 2.2 fold. Buitelaar [22] Reported 15 % increase in thiophene accumulation in hairy root cultures of *Tagetus patula* by using *P. expansum.* Maojun [23] reported enhanced puerarin content using *Penicillium citrinum* in *Pueraria thomsonii* cell suspension culture.

## 5 CONCLUSION

Callus was well developed from intermodal explants of Baliospermum montanum, *Codiaeum variegatum* and *Dryptes roxburghii.* Suspension culture was obtained from callus which showed cell viability up to 88, 80, and 82% of *Baliospermum montanum, Dryptes roxburghii* and *Codiaeum variegatum* respectively. The present investigation revealed that Elicitor

treatment accelerates the production of flavonoid in the selected members of Euphorbiaceae and among three elicitors, phenylalanine was found to be best and maximum elicitation was observed in *Baliospermum montanum*.

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# Printed Arabic Noisy Characters Recognition Using the Multi-layer Perceptron

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**ABSTRACT:** In this paper, we present a comparison between two methods of features extraction; the first one is the Krawtchouk invariant moment (KIM). The second one is the Zernike invariant moment (ZIM). These moments are used for printed Arabic characters recognition in different situations: translated, rotated or resized and noisy. In the pre-processing phase we use the thresholding technique. In the learning-classification phase we use the multi-layer perceptron (MLP) that is considered as a neural network based on a supervised learning. The simulation result that we have obtained demonstrates that the KIM is more robust than ZIM in this recognition.

**KEYWORDS:** The noisy printed Arabic characters, the thresholding technique, the Krawtchouk invariant moments, the Zernike invariant moments, the multi-layer perceptron.

## 1 INTRODUCTION

Pattern recognition is a scientific domain whose goal is to classify the objects into a number of classes. Depending on the application, these objects can be images of characters, of numerals of faces or any type of measurements that need to be classified. It fact, it is composed from tree principal phases that are:

1. Pre-processing: In this phase, different techniques can be used such as binarization, noise removal in order to improve the quality of input patterns.
2. Features extraction: unique features are extracted from input patterns, which must discriminate it in an particular manner.
3. Classification: In this phase, the input pattern will be recognized.

On the other hand, many studies have been carried on Latin, Arabic numerals and characters by using the multi-layer perceptron [1-6] and the moments [7-12]. However, our study is focused in Arabic characters recognition.

In this study the pre-processing characters is carried by the thresholding technique. In the phase of features extraction from character image the KIM [13] and the ZIM[14] which are used to convert each image of character to a vector that will used as an input vector of MLP that are used to train the character images of the training database and to classify them in the test database. The last phase takes place as follows:

The weight matrix connecting the input and hidden layer of the network and that connecting the hidden layer and the output of the network should be learned by the back propagation algorithm for giving in the output of the network an identity matrix of order 28 (supervised learning) which is nothing other than the total number of Arabic characters. All the matrixes of connection (optimal matrixes) must be saved for forming a learning base.

In the classification a test vector (unknown character) is multiplied by the first optimal matrix for giving a vector which is multiplied by the second optimal matrix for producing another vector then the Euclidean distance is calculated between this last vector and each column vector of the identity matrix of order 28, the recognition will be attributed to character that numbered between 1 and 28 in the columns of identity matrix and has a smallest Euclidean distance to test character.

## 2 THE RECOGNITION SYSTEM

Our recognition system is presented as follow:

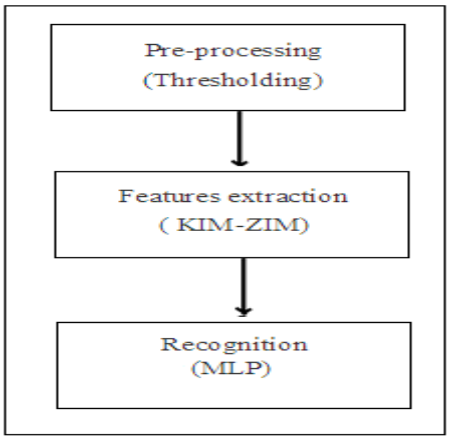


**Fig. 1: System for Arabic characters recognition.**

## 3 PREPROCESSING

Pre-processing is the first part of Arabic characters recognition system. This is used to produce a cleaned up version of the original image so that it can be used efficiently by the features extraction phase.

In our study, we preprocess the images by a thresholding technique in order to construct the images containing only the black and white colors according a preset threshold.

## 4 FEATURES EXTRACTION

The second phase of the printed Arabic characters recognition system is features extraction. Several methods can be used to compute the features. In this recognition system, we use the Krawtchouk invariant moments (KIMs) and those of Zernike (ZIMs).

### 4.1 THE KRAWTCHOUK MOMENT

#### 4.1.1 THE KRAWTCHOUK POLYNOMIAL

The Krawtchouk polynomial of order n is given by:

$$K_n(x;p,N)=\sum_{k=0}^{N} a_{k,n,p}\,x^k = {}_2F_1\left(-n,-x,-N;\frac{1}{p}\right) \quad (1)$$

*Where* : $x, n = 0,1,2 \ldots N$, $N \succ 0$, $p \in [0,1]$.

${}_2F_1$ is the hyper geometric function defined as :

$${}_2F_1(a,b;c;x) = \sum_{k=0}^{\infty} \frac{(a)_k (b)_k}{(c)_k} \frac{x^k}{k!} \quad (2)$$

And $(a)_k$ is the pochhammer symbol (called also rising factorial) defined by:

$$(a)_k = a(a+1)\ldots(a+k-1) = \frac{\Gamma(a+k)}{\Gamma(a)} \quad (3)$$

The Γ function is defined by:

$$\Gamma(x) = \int_0^{\infty} t^{x-1} e^{-t} dt \quad (4)$$

*And* : $\forall n \in N, \Gamma(n+1) = n!$

The set of $(N+1)$ Krawtchouk polynomial $\{k_n(x;p,N)\}$ forms a complete set of discrete basis functions with the weight function:

$$w(x; p, N) = \binom{N}{x} p^x (1-p)^{N-x} \quad (5)$$

And satisfies the orthogonality condition:

$$\sum_{x=0}^{N} w(x;p,N) K_n(x;p,N) K_m(x;p,N) = \rho(n;p,N)\delta_{nm} \quad (6)$$

*Where* : $m, n = 0,1,2 \ldots N$, *and* $\rho(n; p, N)$ is the squared norm, which is given by:

$$\rho(n; p, N) = (-1)^n \left(\frac{1-p}{p}\right)^n \frac{n!}{(-N)_n} \quad (7)$$

And $\delta_{nm}$ is the Kronecker symbol defined by:

$$\delta_{nm} = \begin{cases} 1 & \text{if } n = m \\ 0 & \text{others} \end{cases} \quad (8)$$

#### 4.1.2 THE KRAWTCHOUK MOMENT

The Krawtchouk moment have the interesting property of being able to efficiently extract local features of an image this moment of order $(n+m)$ of an image $f(x,y)$ is given by:

$$Q_{nm} = \sum_{x=0}^{N-1} \sum_{y=0}^{M-1} \bar{K}_n(x; p_1, N-1) \bar{K}_m(y; p_2, M-1) f(x,y) \quad (9)$$

The NxM is the number of pixels of an image $f(x,y)$ .The set of weighted Krawtchouk polynomials $\bar{K}_n(x;p,N)$ is:

$$\bar{K}_n(x; p, N) = K_n(x; p, N) \sqrt{\frac{w(x; p, N)}{\rho(x; p, N)}} \quad (10)$$

#### 4.1.3 THE KRAWTCHOUK INVARIANT MOMENT

The geometric moment of an image $f(x,y)$ is given by:

$$M_{nm} = \sum_{x=0}^{N-1} \sum_{y=0}^{M-1} x^n y^m f(x, y) \quad (11)$$

The standard set of the geometric invariant moments that are independent to rotation, scaling, translation is:

$$V_{nm} = M_{00}^{-\gamma} \sum_{x=0}^{N-1} \sum_{y=0}^{M-1} [(x-\bar{x}) \cos\theta + (y-\bar{y}) \sin\theta]^n * [(y-\bar{y}) \cos\theta (x-\bar{x}) \sin\theta]^m f(x, y) \quad (12)$$

*Where* : $\gamma = \frac{n+m}{2} + 1$, $\bar{x} = \frac{M_{10}}{M_{00}}$, $\bar{y} = \frac{M_{01}}{M_{00}}$ *and* : $\theta = \frac{1}{2} arctg \frac{2\mu_{11}}{\mu_{20} - \mu_{02}}$

And $\mu_{nm}$ are the central moments defined by:

$$\mu_{nm} = \sum_{x=0}^{N-1} \sum_{y=0}^{M-1} (x - \bar{x})^n (y - \bar{y})^m f(x, y) \quad (13)$$

The Krawtchouk invariant moment is:

$$\tilde{\Omega}_{nm} = \Omega_{nm} \sum_{i=0}^{n} \sum_{j=0}^{m} a_{i,n,p_1} a_{j,m,p_2} \tilde{V}_{ij} \quad (14)$$

$$\Omega_{nm} = [\rho(n; p_1, N-1).\rho(m; p_2, M-1)]^{-1/2} \quad (15)$$

$$With: \tilde{V}_{ij} = \sum_{p=0}^{i} \sum_{q=0}^{j} \binom{i}{p} \binom{j}{q} \left(\frac{N^2}{2}\right)^{\frac{p+q}{2}+1} \left(\frac{N}{2}\right)^{i+j-p-q} V_{pq} \quad (16)$$

$$And \quad : \binom{x}{y} = \frac{x!}{y!(x-y)!} \quad (17)$$

#### 4.2 THE ZERNIKE MOMENT

For an image $f(x, y)$ The Zernike moment of order n and repetition m is given by:

$$A_{nm} = \frac{n+1}{\pi} \sum_{x=0}^{N-1} \sum_{y=0}^{M-1} f(x, y) V^*(x, y) \quad (18)$$

$$V^*(x, y) = R_{nm}(x, y) e^{jm \arctan(y/x)} \quad (19)$$

$$And: R_{nm}(x, y) = \sum_{s=0}^{(n-|m|)/2} \frac{(-1)^s (x^2 + y^2)^{\frac{n}{2}-s} (n-s)!}{s!(\frac{n+|s|}{2} - s)!(\frac{n-|s|}{2} - s)!} \quad (20)$$

$if: n - |m| \; is \; even, \; n \geq |m|, n \geq 0, \; j = \sqrt{-1}$

And $x^2 + y^2 \leq 1$, the symbol $*$ denotes the complex conjugate operator.

##### 4.2.1 THE ZERNIKE INVARIANT MOMENT

The Zernike moment is invariant under rotation but sensitive to translation and scale. So normalization must be done of these moments.

$$f(x, y) = f(\bar{x} + \frac{x}{a}, \bar{y} + \frac{y}{a}) \quad (21)$$

Where $(\bar{x}, \bar{y})$ is the center of pattern function $f(x,y)$ and $a=(\beta/M_{00})^{1/2}$ , β is a predetermined value for the number of object points in pattern.

## 5 CHARACTER RECOGNITION

### 5.1 THE NEURAL NETWORK MULTI-LAYER PERCEPTRON

The Neural Network [15] presented in this figure is a multi-layer perceptron that we have used in our work.

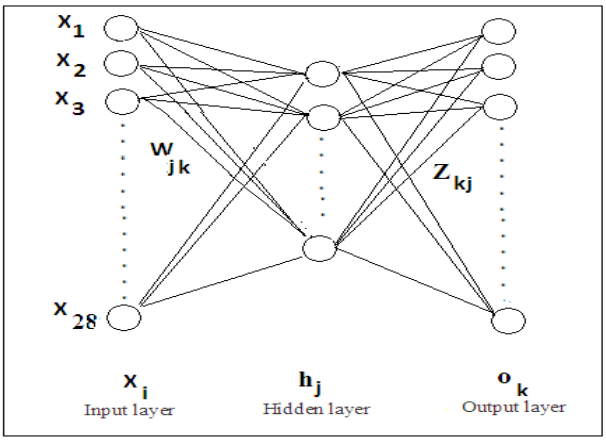


**Fig. 2: The multi-layer perceptron (MLP).**

This MLP contains the following elements:

- An input layer of 28 vectors, each has a 10 components (KIM vector :$X_i$ ).

- A hidden layer of 14 activations neural $h_j$.

- An output layer of 28 activations Neural $o_k$.

- 28×14 connections between input layer and hidden layer, each weighted by $W_{jk}$.

- 14×28 connections between hidden layer and output layers, each weighted by $Z_{kj}$

The operation of perceptron multi-layer learning contains in fact 5 phases:

- **Phase 1**: (Initializing randomly weights of connexions W and Z),

- **Phase 2**: (propagation of inputs):

The inputs $X_i$ must be presented to input layer

We propagate to the hidden layer:

$$h_j = f\left(\sum_{i=1}^{28} X_i W_{ji}\right) \quad (22)$$

After for hidden layer to output layer:

$$Z_k = f\left(\sum_{j=1}^{10} h_j Z_{kj}\right) \quad (23)$$

$f$ is the activation function which is the sigmoid or logistic function given by:

$$f(x) = \frac{1}{1 + e^{-x}} \quad (24)$$

- **Phase 3**: (Error back propagation)

For each character of learning base of the MLP, we calculate the error at output layers that is the difference between the desired output $S_k$ and $o_k$ real output:

$$E_k = o_k(1 - o_k)(S_k - o_k) \quad (25)$$

Next, we propagate this error on the hidden layer; the error of each neuron of the hidden layer is given by:

$$F_j = o_j(1 - o_j)\sum_{k=1}^{28} Z_{kj} E_k \quad (26)$$

- **Phase 4**: (Correction of connections weights):

Later, we change the weights of connections:

- Between input layer and hidden layer:

$$\Delta W_{ji} = \alpha X_i F_j \quad (27)$$

- Between hidden layer and output layer:

$$\Delta Z_{kj} = \alpha Y_j E_k \quad (28)$$

Where $\alpha$ is the learning rate comprised between 0 and 1. This is experimentally determined ($\alpha$ =0.95).

- **Phase 5**:

After the learning of MLP .We use the Euclidean distance for identifying the test character.

$$d(S_{ki}, o_{ki}) = \left(\sum_{i=1}^{28} (S_{ki} - o_{ki})^2\right)^{1/2} \quad (29)$$

Where $S_k$ is a desired output and $o_k$ is the real output of network.

## 6 EXPEREMENTS AND RESULTS

In this study we used a learning base contains 140 images which represents the Arabic characters.

In the test base we have 4340 images.

We choose the size of all character images 30x30 pixels. Each character was converted to a vector of 10 components which is the KIM and ZIM values. In first once we present a test character translated, rotated or resized and not noisy, then we add increasingly a quantity of noise of type 'Gaussian' for to know the effect of noise added on the rate recognition of each character then to global rate that is to say of all characters.

We choose: The KIM parameters: p=0, 85, q=0, 75.

The values of variance σ of Gaussian noise are: [0, 0.01, 0.02, 0.03……0.30].

And its mean value is fixed to μ=0.05.

We group the values of the recognition rate $\tau_c$ for each character that we obtained in the following table:

**Table 1: The recognition rate $\tau_c$ for each Arabic character**

| Character | $\tau_{c,ZIM}$ | $\tau_{c,KIM}$ | Character | $\tau_{c,ZIM}$ | $\tau_{c,KIM}$ |
|---|---|---|---|---|---|
| أ | 58,06% | 100,0% | ض | 100,0% | 100,0% |
| ب | 96.77% | 100,0% | ط | 100,0% | 100,0% |
| ت | 70,97% | 70,97% | ظ | 93,55% | 96,77% |
| ث | 87,10% | 93,55% | ع | 96,77% | 87,10% |
| ج | 67,74% | 64,55% | غ | 93,55% | 90,32% |
| ح | 100,0% | 90,32% | ف | 96,77% | 100,0% |
| خ | 83,87% | 93,55% | ق | 87,10% | 90,32% |
| د | 87,10% | 96,77% | ك | 100,0% | 100,0% |
| ذ | 93,55% | 90,32% | ل | 100,0% | 93,55% |
| ر | 96,77% | 100,0% | م | 90,32% | 87,10% |
| ز | 100,0% | 100,0% | ن | 100,0% | 100,0% |
| س | 58,06% | 61,29% | ه | 93,55% | 96,77% |
| ش | 100,0% | 100,0% | و | 96,77% | 100,0% |
| ص | 96,77% | 100,0% | ي | 90,32% | 100,0% |

The associated graph to table above is:

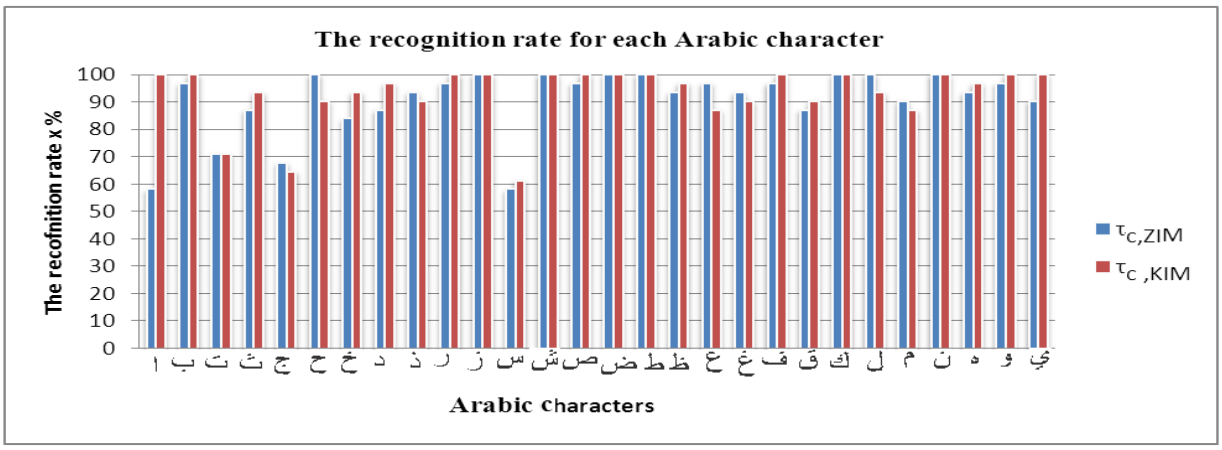


**Fig. 3: The recognition rate $\tau_c$ for each Arabic character.**

We present the evolution of the global rate recognition $\tau_g$ in function of noise added to characters:

**Table2: The global rate recognition in function of the noise added.**

| Noise | $\tau_{g,ZIM}$ | $\tau_{g,KIM}$ |
|---|---|---|
| 0.00 | 100,0% | 100,0% |
| 0.01 | 100,0% | 100,0% |
| 0.02 | 100,0% | 100,0% |
| 0.03 | 100,0% | 100,0% |
| 0.04 | 100,0% | 100,0% |
| 0.05 | 100,0% | 100,0% |
| 0.06 | 100,0% | 100,0% |
| 0.07 | 100,0% | 100,0% |
| 0.08 | 100,0% | 100,0% |
| 0.09 | 100,0% | 100,0% |
| 0.10 | 100,0% | 100,0% |
| 0.11 | 100,0% | 100,0% |
| 0.12 | 100,0% | 100,0% |
| 0.13 | 100,0% | 100,0% |
| 0.14 | 100,0% | 100,0% |
| 0.15 | 100,0% | 100,0% |
| 0.16 | 100,0% | 100,0% |
| 0.17 | 92,86% | 100,0% |
| 0.18 | 92,86% | 96,43% |
| 0.19 | 89,29% | 92,86% |
| 0.20 | 85,21% | 92,86% |
| 0.21 | 85,21% | 89,29% |
| 0.22 | 85,21% | 89,29% |
| 0.23 | 85,21% | 89,29% |
| 0.24 | 82,14% | 89,29% |
| 0.25 | 71,43% | 89,29% |
| 0.26 | 64,29% | 82,14% |
| 0.27 | 50,00% | 67,86% |
| 0.28 | 28,57% | 57,14% |
| 0.29 | 28,57% | 46,43% |
| 0.30 | 28,57% | 46,43% |

The associated graph to table below is:

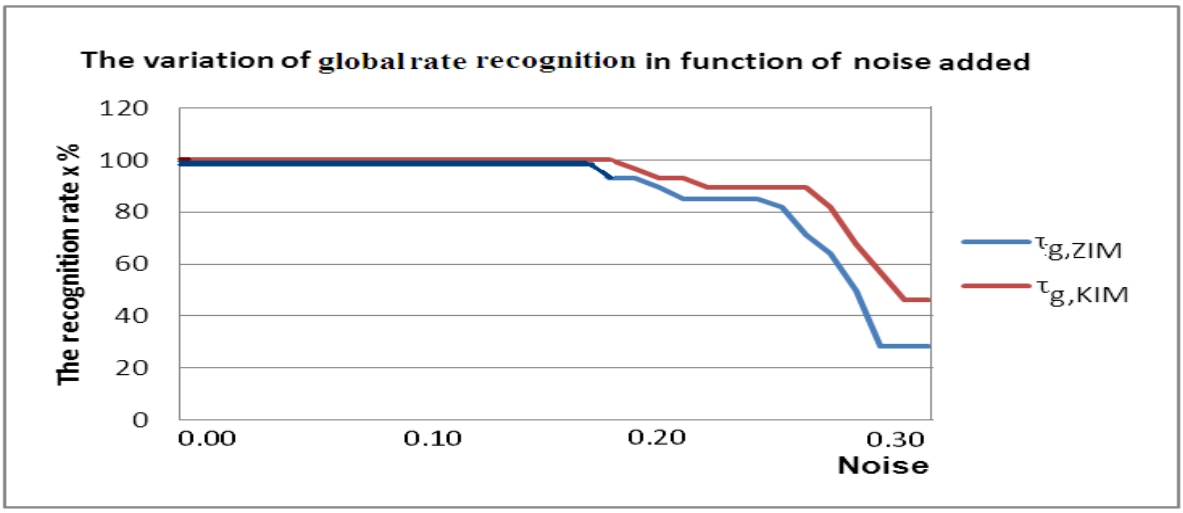


**Fig. 4: The global rate recognition $\tau_g$ Arabic characters.**

### 6.1 ANALYSIS AND COMMENT

The global rate recognition $\tau_g$ is a decreasing in function of noise dded to characters, but the important remark is that the falling of this rate of ZIM is greater than the rate of KIM, this shows that the KIM is more performing than the ZIM in recognition of noisy characters.

## 7 CONCLUSION

The results obtained in the recognition of noisy Arabic characters show that reliable recognition is possible by using the thresholding technique in the preprocessing phase and the KIM and the ZIM in the features extraction phase. The simulation results demonstrate that the KIM method is more robust against noise than the ZIM in this recognition.

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# Prevalence and Challenges of Female Genital Mutilation (FGM) in Edo State, Nigeria

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**ABSTRACT:** This paper presents the results of study conducted on women in Edo state, Nigeria. It probes into the nature, determinant and prevalence of domestic violence against women in the area of Female Genital Mutilation. Data were collected through in-depth interviews, case studies and survey. A sample size of three hundred and seventy-seven was selected for the survey. The result indicate that although prevalence of FGM is not very high in the state, however the practice is still commonly done and the women are not in position to decide in most cases on whether to have FGM done or not. To contain the prevalence of FGM the use of formal and informal channels of education to re-orientate the populace is strongly suggested. This will help to ensure attitudinal and cultural change towards FGM. In addition, there is need for policies that will genuinely protect women against FGM.

**KEYWORDS:** Women, Daughter, Violence, Health risk and Female Genital Mutilation (FGM).

## INTRODUCTION

Female Genital Mutilation (FGM) is practiced commonly in Sub-Saharan and North East Africa Countries Bettina S and Hernlund Y (2000) Abiodun A et al (2011). It involves the partial or total removal of the external female genitalia or other injury to the female genital organs for non-medical reasons with the goals of inhibiting a woman's sexual feelings Nwakeze N, (2006) Bettina S and Hernlund Y (2000). Most often the mutilation is performed before puberty, often on girls between the age of four and eight, but recently it is increasingly performed on nurslings who are only a couple of days, weeks or months old. The procedure is irreversible and the effect last a life time. FGM is practiced as a cultural ritual by ethnic groups. Nnorom C, (2000). It is typically carried out with or without anesthesia by a circumciser using knife or razor. The practice involves one or more of several procedures which vary according to ethnic group. Some cut a tip of the clitoris while some cut all the outer part leaving a small hole for urine and menstrual blood and the vagina is open up for intercourse and childbirth. FGM has no health benefit while the health effects depend on the procedure. It has immediate and late complication. Immediate complications include fatal bleeding, acute urinary retention, wound infection, tetanus, re-current infection and death (Oduro et al 2006, Onuh et al 2006). Late complications could include inability to get pregnant; complications during child birth include the need to have caesarian section and transmission of HIV if instruments are not sterile or reused (Ibekwe Perpetus C et al **(**2012), WHO (2006). It is not known how many girls or women have died from the procedure, few records are kept. Complication may not be recognized and fatalities are rarely reported.

In Nigeria like many other countries FGM is forbidden by law. However, the fact that this act is outlawed in most countries, the law is poorly enforced. There has been an international effort to eradicate this act. Law and campaigns against the practice have not been successful in eliminating the practice (Kolawole A & Anke Van. K (2011). Despite the awareness and campaign, the prevalence of this act is still on the high side. For instance in Egypt the prevalence is 91%, Sierra Leone has 88%, Burkina Faso recorded 76%, Chad 44%, Cote divoire had 38%, Nigeria 27%, Central Africa Republic 24%, Benin 13% Ghana 4% and Cameroou1% (UNICEF 2013). About 125million girls and women in Africa have undergone FGM. The practice is an ethnic maker rooted in gender inequality, ideas about purity, modesty and aesthetics and attempts to control women's sexuality. It is support by both women and men in countries that practice it, particularly by women who see it as a source of honour and authority and an essential part of raising a daughter well.

There has been much work on the practice, spatial distribution of FGM and its origin (Kandala etal 2006, Freymeyer R & Johnson B, 2007 and Nnorom C, 2000, Oduro et al 2006) but little attention is paid on the fact that the act is violation against women and many did not see it in that light except when the complication is fatal and result into death. It is against this that this study examines the violence done to women in the name of FGM with the objective of eradicating it.

## LITERATURE REVIEW AND THEORETICAL FRAMEWORK

Violence against women is the most pervasive and the least recognized human right abuse in the world. Aderinto etal (2006). The specific act that constitutes this crime according to the United Nations Declaration of violence Against Women include: sexual abuse of female children, battering, marital rape, female genital mutilation and other traditional practices harmful to women. Nigeria, with population of over 140 million NPC 2006, where about half of the population is women, hence issues concerning domestic violence against women like FGM should not be ignore. Female Genital Mutilation (FGM) is a global problem (WHO, 2006, Population Council, 2004, UNICEF 2013). It remains common in many parts of the developing world. It is endemic in Africa, particularly sub-Saharan Africa. Carr D, (1997) (e.g. Niger, Mali, Ethiopia, Chad, Kenya, Nigeria, etc.), Southeast Asia (e.g. Bangladesh, Nepal, Pakistan, Indonesia, India, Myanmar, Cambodia, etc.) and the Middle East (e.g. The Philippines, Iraq, etc.).

It is mostly common among the rural poor and populations under stress. Bettina S and Hernlund Y, 2000, (P.I., 2006). According to Population Council (2004), a third of the more than 330 million girls and young women who currently lives in developing countries were victim. It's one of the most political areas of women's health. Worldwide it's estimated that well over 120 million women have been subjected to it. Supporters of the practice say it's an important part of cultural and religious life, and some compare it to the practice of male circumcision that is more widely accepted in the Western world, but opponents say that not only is it potentially life-threatening, it's also an extreme form of oppression of women.

There are limited literatures available for policy strategies; however the international community has recognized the human rights implications of FGM. Agencies such as UNICEF and WHO have played major roles to end this menace unfortunately the effort have not yield desire results. The practice has been outlawed but has not been fully enforced for example in Nigeria government recognized FGM as harmful practice to be eliminated but no specific federal law is yet in place to ensure strict compliance Kandala et al (2006). Although the 1999 constitution shun any act of torture or inhuman treatment or violence against any person, some state have passed law against this practice they include: Ondo, Ekiti, Edo, Cross River and Bayelsa states. In most cases the person convicted under the law is liable to a fine or imprisonment. For instance, Edo state banned this practice in 1999 and convict are subject to fine or imprisonment of only six months. It is important to note here that the government law is necessary but not sufficient to eradicating FGM.

In Nigeria, FGM is endemic in the southern part, especially in the southeast and southwest geo-political zones with over 45 per cent of it occurrence. In all these endemic areas, rural girls and women are particularly affected as they continue to bear the health risks, social and economic costs FGM and forced marriage, non-consensual sex and early pregnancies. FGM is globally recognized as a blatant violation of Fundamental Human Rights.

## MATERIAL AND METHODS

This study address the following questions: what is the relationship between socio-cultural factors and FGM? To what extent does the perception of FGM seen as violence against women? How far has it affected the psychosocial and physical emotional of individuals and communities in Edo state. What is the most effective strategy for curbing FGM in Nigeria? In the quest for a comprehensive understanding, these questions influenced the study methodology.

Both qualitative and quantitative techniques were used in gathering data for the study. Survey, in-depth interviews and case studies were triangulated to explore issues relevant to the subject. The process of data collection begins with the designing of in-depth interview guide for pretest to facilitate questionnaire design. A total of 10 women of different age groups who had undergone FGM were interviewed. The data generated through this technique were rich in information. To ensure representativeness, respondents for interview were selected from specific study location within the state. Although most of the in-depth interview preceded the survey, some were conducted alongside questionnaire distribution.

A sample size of 400 respondents was anticipated for the study but a total of 377 questionnaires were fully completed and returned. The questionnaire comprises items that covered topics on socio-demographic characteristics, sexual attitudes and psychological and emotional attitude toward FGM. Beginning with the purposive selection of local governments to represent urban and rural settlement in the study area. Then the respondents in the chosen location were identified and a random selection of these groups was made. The simple random sampling was also used in the choice of individual

respondents for the study. Case study was adopted at the tangential level as a result of the serendipity of the in-depth interviews. The life stories of 4 respondents who had been victims of FGM were elicited. Qualitative data were analyzed using manual content analysis. Quantitative data generated through questionnaire were analyzed. A descriptive analysis of data was done using univariate frequency distributions

## RESULTS

### DEMOGRAPHY CHARACTERISTICS OF RESPONDENTS

The study adopted a sample size which tilted heavily in favour of women hence 77.1% of the respondents were women. However because it was necessary to obtain the views of men on such topic, a sample size of 22.9% of men was selected. (Table 1) Since the study focused on adult girls and women who had undergone FGM or have understanding of the meaning, the majority of the respondents were between the ages of thirty and fifty. The lowest age recorded was twenty-four while one respondent claimed to have attained the age of 69 years. Almost all the respondents (92.4%) belong to the Christian faith. This was expected because Christianity is the dominant faith in Edo state where the study was conducted ( Segynola 2000). Respondents that were Muslims constituted 4.8% while the remaining 2.8 belonged to various traditional religions.

***Table 1 Socio-Demographic Characteristic of Respondents***

| VARIABLE | CATEGORY | FREQ | % |
|---|---|---|---|
| Sex | Male | 87 | 22.9 |
| | Female | 290 | 77.1 |
| Age | Below 30 | 54 | 13.5 |
| | 30 – 34 | 67 | 17.5 |
| | 35 – 39 | 77 | 20.6 |
| | 40 – 44 | 81 | 21.7 |
| | 45 – 49 | 60 | 15.5 |
| | 50 – 54 | 21 | 7.8 |
| | $55^{+}$ | 17 | 3.7 |
| Religion | Christianity | 346 | 92.4 |
| | Islam | 18 | 4.8 |
| | Traditional | 17 | 2.8 |
| Marital status | Single | 50 | 6.9 |
| | Married | 327 | 87.1 |
| | Divorced | 13 | 3.4 |
| | Widowed | 10 | 2.5 |
| No of Children | 0 | 13 | 4.0 |
| | 1-4 | 239 | 70.2 |
| | 5-9 | 82 | 24.2 |
| | 10+ | 5 | 1.6 |
| Level of education | None | 1 | 0.4 |
| | Primary/Secondary | 22 | 6.1 |
| | Polytechnic | 134 | 36.3 |
| | University | 198 | 54.0 |
| | Others | 12 | 3.2 |
| Place of Residence | Urban area | 245 | 65.0 |
| | Rural area | 132 | 35.0 |

Source: Author Field work 2013.

On marital classification, 87% of all the respondents are married, 2% are separated from their spouse, 1.3% are divorce 2.5% lose their partner due to death (widowed and 6.9% are single. Most respondents (70.2%) have between one and four children, while 24.2% have between five and nine children, those that have above ten children constitute 1.6% of the sample population while the remaining 4.0% do not have any child. The educational level of respondents was high with 90.3% of

them having attained tertiary education, only 6.1% of them did not go beyond secondary school while the remaining 3.2% have other forms of education.

The place of residence was also examined. About 65% live in the urban area while the remaining 35% are in the rural area. Ethnic group composition in Edo state is diverse. About 80%of the respondents indicated they belong to one of the following groups Igbo, Isoko, Esan, and Benin which are the dominant groups in the state. Other groups represented are Yoruba, Hausa, Idoma, Ogoni, Ijaw and Itsekiri. There was evidence of intra and inter-ethnic group marriage among the respondents. By implication, intra-ethnic marriage could encourage FGM if is acceptable by both couple.

## PREVALENCE OF FGM

FGM varies from country to country, tribes, religion, and from one state and cultural setting to another and no continent in the world has been exempted. (Odoi A, 2005) In most parts of Nigeria, it is carried out at a very young age (minors) and there is no possibility of the individual's consent. (Hathout H, 1963) Type I and Type II are more widespread and less harmful compared to Type III and Type IV. In Nigeria, there is greater prevalence of Type I excision in the south, with extreme forms of FGM prevalent in the North. Nigeria, due to its large population, has the highest absolute number of female genital mutilation (FGM) worldwide (UNICEF 2001), accounting for about one-quarter of the estimated 115–130 million circumcised women in the world of the six largest ethnic groups, the Yoruba, Hausa, Fulani, Ibo, Ijaw, and Kanuri, only the Fulani do not practice any form. (International women's Issues Report on FGM 2010)In Nigeria, FGM has the highest prevalence in the south-south (77%) (among adult women), followed by the south east (68%) and south west (65%), but practiced on a smaller scale in the north, paradoxically tending to in a more extreme form.( UNICEF 2001, Adegoke P. 2005).

***Table 2 Knowledge and Prevalence of FGM***

| Zones | Percentage of Women who heard of FGM | Percentage of Women Circumcised | Types of Circumcision Type1 Type2 Type 3 % |
|---|---|---|---|
| North Central | 36.0 | 9.6 | 1.2 64.6 2.5 |
| North East | 40.1 | 1.3 | - - - |
| North West | 25.1 | 0.4 | - - - |
| South East | 87.7 | 40.8 | 0.3 12.2 2.7 |
| South South | 82.5 | 34.7 | 3.0 66.0 7.5 |
| South West | 85.7 | 56.9 | 2.2 36.3 1.3 |

Source: Nigeria Demographic and Health Survey: 2003

The Demographic Health Survey of Nigeria (2003) found a prevalence of FGM of 61% among Yoruba, 45% among Ibo and 1.5% among Hausa-Fulani tribes (Table 2), thus making it a greater problem in Southern Nigeria. (Kolawole &Anke 2012). Nigeria has a population of 150 million people with the women population forming 52%. (Adegoke P.2005). The national prevalence rate of FGM is 41% among adult women. Prevalence rates are still on the high side. However, 37% of circumcised women do not want FGM to continue. (UNICEF 2001) 61% of women who do not want FGM said it was a bad harmful tradition and 22% said it was against religion. Other reasons cited were medical complications (22%), painful personal experience (10%), and the view that FGM is against the dignity of women (10%). (UNICEF 2001) However, there is still considerable support for the practice in areas where it is deeply rooted in local tradition. (UNICEF 2001)

## NATURE AND DETERMINANT OF FGM IN NIGERIA

FGM practiced in Nigeria is classified into four types (WHO, 2007, Kolawole A &Anke 2010) as follows. Type I: It involves the removal of the prepuce or the hood of the clitoris and all or part of the clitoris. In Nigeria, this usually involves excision of only a part of the clitoris. Type II is the removal of the clitoris along with partial or total excision of the labia minora. Type I and Type II are more widespread compared to Type III. Type III is the most severe form of FGM. It involves the removal of the clitoris, the labia minora and adjacent medial part of the labia majora and the stitching of the vaginal orifice, leaving an opening of the size of a pin head to allow for menstrual flow or urine. FGM is still deeply entrenched in the Nigerian society where critical decision makers are grandmothers, mothers, women, opinion leaders, men and age groups. (WHO, 2003) Mothers chose to subject their daughters to the practice to protect them from being ostracized, beaten, shunned, or disgraced (Yoder P, & Khan S. 2007; UNICEF. 2003) FGM is regarded as a tribal traditional practice (our custom is a good tradition and has to be protected), as a superstitious belief practiced for preservation of chastity and purification, family

honor, hygiene, esthetic reasons, protection of virginity and prevention of promiscuity, modification of socio sexual attitudes (countering failure of a woman to attain orgasm), increasing sexual pleasure of husband, enhancing fertility and increasing matrimonial opportunities. Other reasons are to prevent mother and child from dying during childbirth and for legal reasons (one cannot inherit property if not circumcised). Based on secondary data from published literatures, the determinant and reason for FGM are summarize below:

**Cultural Determinants**: Cultural factor is the major determinant of FGM. It also influences lifestyle and behavior. Many people continue FGM because it is part of the societal norms handed down by their mothers and grandmothers and any attempt to discontinue the practice is met with societal pressure and risk of isolation (Babatunde, 1998, Rahman 2000, Mohammed 2000) They see it as a way for identification with the cultural heritage, initiation of girls into womanhood, social integration and maintenance of social cohesion and social acceptance.

**Psychosexual Determinant**: One of the reasons for FGM is to ensure respectability of a woman, thus enhancing her chances of marriage and getting a better 'bride price' (Rahman, 2000; Myers, 1985; Chege, 2001; Caldwell, 1997). This is more important in Southern Nigeria where FGM is linked with preservation of virginity, to attenuate sexual desire in the female, maintain chastity and virginity before marriage and fidelity during marriage, and increase male sexual pleasure.

**Hygiene and Aesthetics**: Among some societies, the external female genitals are considered unclean and unsightly, and so are removed to promote hygiene and provide aesthetic appeal (Kolawole A &Anke Van 2010). Moreover, the uncircumcised clitoris is said to emit a bad odour, itch or cause pelvic infection (Chege, 2001, Anuforo, 2004). The female external genitals are believed to be unsightly hence the cosmetic surgery. Therefore, FGM is thought to purify a woman both physically and spiritually so that children born to her are considered pure and legitimate.

**Religious**: Unlike male circumcision, the Bible and Korah did not mention FGM (Mohammed, 2000; Rahman, 2000). Female genital mutilation is practiced in a number of communities, under the mistaken belief that it is demanded by certain religions. However, since it aims to curb female "hyper sexuality" support is implied especially in Islam (Walker, 1996).

**Others**: FGM is common in rural areas of Sub-Saharan Africa and underdeveloped countries, (WHO, 2006; Dorkenoo, 1994). Since poverty, illiteracy and low social status are rife in these areas, these people are more likely to follow traditions (Anuforo, 2004; Adeokun, 2006; Myers 1985). Also it is believe to enhance fertility and promote child survival, better marriage prospects and helps delivery of babies

**Attitude towards FGM**

To determine the extent of FGM in the study area and the attitude towards it, a number of questions were asked. First respondents were asked if they had undergone FGM. About 58.9% of those living in the rural area (Table 2) claimed to have undergone it which is on the side. While those living in urban area account for the remaining 33.2% by implication, then prevalence of FGM is still high in the rural area compare to the urban area. Respondents were also asked to indicate their approval or disapproval of the practice. Majority of the respondents indicated that they will object to the act if they were to decide. Most mothers who had undergone it vow never to allow their daughters experience it. Why those whose daughter had gone through it claim they are not in position to decide.

***Table 2: Prevalence of FGM among Mother and Daughter with reference to place of residence and educational status***

| | **Mum Circumcised Yes No** | **Daughter Circumcised Yes No** |
|---|---|---|
| **Place of residence** | | |
| **Urban** | **72 (33.2%) 145 (66.8%)** | **52 (21.8%) 186 (78.2%)** |
| **Rural** | **43 (58.9%) 30 (41.1%)** | **35 (48.0%) 38 (52%)** |
| **Mother Education** | | |
| **None** | **68 (59.1%) 47(40.9%)** | **45 (39.8%) 68 (60.2%)** |
| **Some Education** | **57 (51.8%) 118 (48.2%)** | **28 (16.9%) 138 (83.1%)** |

Source : Author Field work 2013.

Women had living children of whom some daughters had undergone FGM. In the urban area, 21.8% (Table 2) had daughters that had been circumcised, while those whose daughters were not circumcised are 78.2%. However in the rural areas 48.0% has daughters that were circumcised while the remaining 52% were not. Education, awareness and enlighten are

also factors that determine the prevalence and attitude towards FGM. Among women that have undergone FGM preliminary results shows that they live in rural areas and are with no education (Table 2)

The following case studies summarize the experience of women who had undergone FGM. This was gotten from in-depth interview.

Case one

This woman is a 28years old mother and a student. According to her*: I was 6years old when it happen. All I know was I was playing outside, I also remember a lot of relatives and family friends were at the house and a lot of food and sweets were cooked. The nightmare started when my friend told me "you will be a big girl now all you have to do is to be brave and don't cry" I didn't understand when she explain what was going to happen to me, all I wanted was a way to escape. I ran so fast trying to hide I was caught and dragged to the table. I was key down I fought as much as I could but I was overpowered and cut. As I got older I have realize the damage FGM has caused me physically and mentally. The mental scar I carried till today. After my little girl was born I knew as a mother I couldn't let that happen to her.*

Case two

*The day of my circumcision was extremely appalling and traumatizing, feeling of intense fear, helplessness horror and severe pain. It all started when my aunt called me. My younger sister followed but was told to wait outside, when I got there I notice the circumcisers cleaning his small knife while he asked me to climb the table. I ran towards my aunt. They grabbed hold of my legs trying to pull them apart my aunt stuffed a big cloth in my mouth so l wouldn't scream so loud. When he was done I felt so ashamed that those men saw my private part and actually touched it and hurt me.*

*When it was my sister turn she was not too lucky, I heard her scream, I never heard such scream in my life even today when I shut my eye I can hear her screaming. She later died as a result of complication from the incident.*

Case three

*I still suffer from intrusive re-experience of the circumcision I undergone. It was perform on me unexpectedly and without any preliminary explanation. My Dad took me to the circumciser, well that is what people called them if l had to give them title it would be children butcher. He and two other elderly women pull me to the table, I started calling my Dad he had left "behave you silly girl it doesn't hurt" that was his word. I was overpowered ant cut. I suffered complications there after I remember I bled for several days.*

Case 4

This woman is married with three daughters but never wanted to allow her daughters to undergone FGM but she is not in position to decide.

*Circumcision was done to me when I was very young according to my parents I was 3months old can't remember what pain l went through. When l was pregnant of my first daughter we have been told of the health risk of FGM at anti-natal clinic and I made up my mind not to allow my daughter to be cut. But I yield to pressure from my in-law as they insist that circumcision is the family culture. I saw my daughter went through the pain and complications. She almost died and I fought my husband for not standing by me when I said no. So when the others daughters were born we decide not to perform circumcision on them.*

## DISCUSSIONS

The main objective of this paper was to examine the prevalence of domestic violence against women in the area of genital mutilation in Edo state. Ethnic and cultural factors are the reasons for its prevalence; however other factors are also contributing to it prevalence. Despite the effort of government and various groups at combating it, the prevalence is still high as the laws biding it are not properly enforced. Education, awareness and enlighten are also important factors that can reduce it prevalence. The attitude of most women towards it also reveal that they are not in support of the practice but at times they are not in position to decide Nwakeze, N (2006). Over the past years an increasing number of studies have documented that FGM practice affect the wellbeing of women and children including high risk of HIV/AIDS and death in severe cases.

## CONCLUSION AND RECOMMENDATIONS

Today violence against women has become a major topic Reichert, (1990). The problems of violence in this regard are universal and differ only in scope from one society to other UNFPA, (1999). It occurs in broad context of gender-based discrimination, with regard to access to education, resources and decision-making power in private and public life. This research drew insight from the views of women and men and especially victims of FGM in order to have clear understanding of the factors that contribute to the menace. The results of the study shows that most women that are victims of FGM would have objected to it if they are to decide and the act is rooted in cultural believe and have no health benefit.

In order to effectively contain the menace of FGM, formal education should be used to eliminate the social and cultural believe attached to FGM. Combatting FGM should be part of school curriculum. Teaching materials should be developed to informal methods of education should be encouraged. Education campaign, consisting of posters, leaflets (at health centers, schools and religious centers can be effective. The mass media can also be used to enhance more balance of the campaign. Furthermore, local authorities such as village leaders, elders, should be engaged in programmes that would help discourage FGM. These groups can intervene to relieve the prevalence of FGM to an extent. Very important laws and policies aimed at eliminating FGM should be enforced.

Female Genital Mutilation is violence against women and has no health benefit. It will not be eradicated until there is fundamental change in some norms and believe and enforcement of laws and policies where necessary.

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# Experimental and theoretical studies of vibrational motion of raw cotton on inclined mesh surface

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**ABSTRACT:** In these research paper theoretical and experimental studies of vibrational motion of raw cotton in inclined mesh surface is considered. For cleaning small trash of raw cotton, new installation that has inclined mesh surface is used. The mathematical model of the motion of flying detachment in the line of plates with elastic elements is made up. Differential equations of motion of cotton's flying detachment are composed using the Lagrange II-kind. These equations are solved numerically by the program MAPLE-9.5. Results are obtained that is characterizing the movement law of cotton on an inclined mesh surface. Experimental study shows that the small particles of trash move on vibrating surfaces with different trajectories. This ensures separation and loosening and serves cleaning cotton from various trashes. Proposed installations provide vibration that is important element in the process of sifting.

**KEYWORDS:** cotton, fiber, differential equation, vibration, fraction, inclined mesh surface, plate, springs.

## 1 INTRODUCTION

During the process of raw cotton, the main indicator is yield of cotton fiber. On the saw gin it is almost impossible to achieve complete removal of the saw fiber. Since different trash located on the surface of raw cotton, and inside it, and have a degree of fiber adhesion. It is known that the trash is divided into large and small. Large trashes found on the surface of raw cotton and have poor adhesion with it, and small trash is deeply embedded in the mass of raw cotton. Their separation requires different external influences on fiber and raw cotton. For cleaning small trash of raw cotton, horizontal, vertical and various installations are used. In contrast to existing, the authors of this article propose a new installation (Fig. 1) having inclined mesh surface. After operation of drying drum, raw cotton is cleaned from small trash with the help of mesh surface [1],[2],[3] ,[7],[8].

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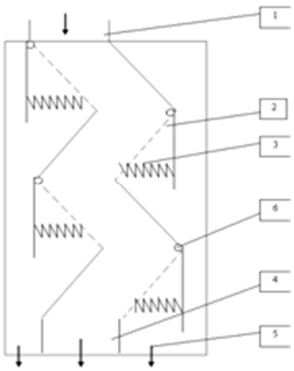


*Figure-1. Proposed installation having inclined mesh surface.*

## 2 THEORETICAL RESEARCH

Mesh surface is installed perpendicular to each other, having a certain angle from vertical. Oscillatory process of raw cotton is considered on an inclined mesh surface. Raw cotton is supplied from the feeder to the first mesh surface, moving on the mesh being subjected to vibration due to elastic relation of mesh with the base [4],[5],[6],[9],[10],[11,[12]. Scheme plate with elastic elements is shown in Fig. 2.

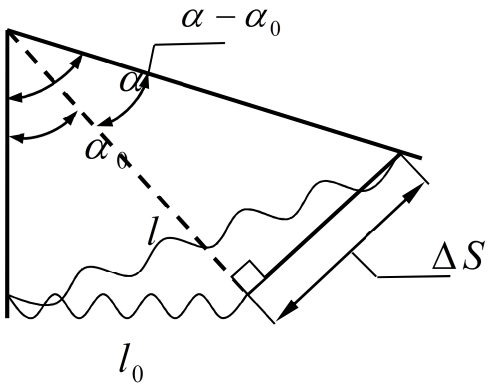



*Figure-2.*

OA-mesh plate

BA-elastic element (spring)

$\alpha_0$ - Initial inclination angle from the vertical plate

$\alpha$ - Angle plate after elongation of the elastic element

$l_0, l$ - The length of the elastic element to and after elongation

$\Delta$ - The length of the plate

$\Delta S$ - Absolute elongation of the elastic element

Ratio of triangles CCA and OBC define absolute elongation.

$\Delta l$ - the elastic element

$$\Delta l = l - l_0 \;\; \beta = \frac{\pi}{2} - \alpha + \left( \frac{\pi}{2} - \frac{\alpha - \alpha_0}{2} \right) = \pi - \frac{\alpha + \alpha_0}{2}$$

$$l_0 = a \cdot \sin \alpha_0 \;\; \Delta S = 2a \cdot \sin \frac{\alpha - \alpha_0}{2}$$

From the theory of Cosines:

$$l = \sqrt{l_0^2 + (\Delta S)^2 - 2l_0 \cdot \Delta l_0 \cdot \cos \beta} \qquad (1.1)$$

After several transformations of (1) we get:

$$l \approx a(\sin \alpha_0 + \cos \alpha_0 \cdot \Delta \alpha) \qquad (1.2)$$

Or:

$$l = l_0 + a \cdot \Delta \alpha \cdot \cos \alpha_0 \Rightarrow \Delta l = l - l_0 \Rightarrow \Delta l = a \cdot \Delta \alpha \cdot \cos \alpha_0 \qquad (1.3)$$

Hence, the stiffness of elastic elements $\Delta l \le [\Delta l]$ must satisfy the conditions $\Delta l \le [\Delta l]$ (1.4)

## 3 MATHEMATICAL MODEL OF THE MOTION OF COTTON'S FLYING DETACHMENT ALONG THE PLATE WITH ELASTIC ELEMENTS

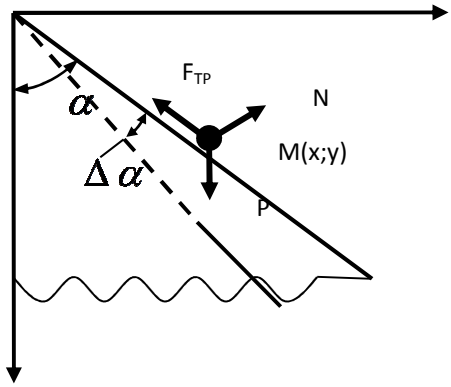



***Figure-3***

**M** – Cotton's flying detachment with weight – m

Coordinate points – **M**

$$\left.\begin{aligned} x &= s \cdot \sin \alpha \\ y &= s \cdot \cos \alpha \end{aligned}\right\} \qquad (2.1)$$

**Where** $S = OM$ - distance. Let $S_u \alpha$ - generalized coordinates of flying detachment - M. Acting forces and their projections on the axes OX and OY

a) The force of gravity:

$x_1 = 0$, $y_1 = mg$ (2.3)

b) The force of friction:

$$F_{fr} = \lfloor mg \sin \alpha + 2m\dot{S}\dot{\alpha}^2 \rfloor \qquad (2.4)$$

Projections:
$$\left.\begin{array}{l} F_{fr}: x_2 = \mathrm{F_{fr}} \cdot \sin\alpha \\ y_2 = -\mathrm{F_{fr}} \cdot \cos\alpha \end{array}\right\} \quad (2.5)$$

c) Elastic force of element:

$$\mathrm{F_{el}} = -\kappa \cdot a(\alpha - \alpha_0)\cos\alpha_0 \quad (2.6)$$

Projections:
$$\mathrm{F_{el}}: \left.\begin{array}{c} \mathrm{x_3 = F_{fr} = -\kappa \cdot a(\alpha - \alpha_0)\cos\alpha_0} \\ \mathrm{y_3 = 0} \end{array}\right\} \quad (2.6)$$

Now we define the generalized forces acting on the flying detachment point M:

$$\mathrm{Q_\alpha} = (x_1 + x_2 + x_3)\cdot\frac{\partial x}{\partial \alpha} + (y_1 + y_2 + y_3)\frac{\partial y}{\partial \alpha} \text{ or}$$

$$\mathrm{Q_\alpha = -S[(\kappa\alpha \cdot \cos\alpha_0 + mg)\Delta\alpha \cdot \cos\alpha_0 + mg \cdot \sin\alpha_0]} \quad (2.7)$$

$$\mathrm{Q_s} = (x_1 + x_2 + x_3)\cdot\frac{\partial x}{\partial s} + (y_1 + y_2 + y_3)\frac{\partial y}{\partial \alpha} \text{ or}$$

$$\mathrm{Q_s = -mg \cdot f \cdot \sin\alpha_0 - mg \cdot f \cdot \Delta\alpha \cdot \cos\alpha_0 - 2m \cdot \dot{S}\dot{\alpha} \cdot \sin\alpha_0 - 2m \cdot \dot{S} \cdot \dot{\alpha} - \kappa \cdot a \cdot \Delta\alpha \cdot \cos\alpha_0 \cdot \sin\alpha_0 + mg \cdot \cos\alpha_0 - mg \cdot \Delta\alpha \cdot \sin\alpha_0} \quad (2.8)$$

Movement of flying detachment point-M is prepared using the Lagrange equations II-kind.

$$\left.\begin{array}{l} \frac{d}{dt}\left(\frac{\partial T}{\partial \dot{\alpha}}\right) - \frac{\partial T}{\partial \alpha} = Q_\alpha \\ \frac{d}{dt}\left(\frac{\partial T}{\partial \dot{S}}\right) - \frac{\partial T}{\partial S} = Q_s \end{array}\right\} \quad (2.9)$$

Substituting (2.2) - (2.8) to (2.1), we obtain:

$$\left.\begin{array}{l} m \cdot S \cdot \ddot{\alpha} + 2m\dot{S}\dot{\alpha} + \alpha \cdot \cos\alpha_0(mg + \kappa \cdot a \cdot \cos\alpha_0) + \kappa \cdot a \cdot \alpha \cdot \cos\alpha_0 \sin\alpha_0 - \\ m\ddot{S} - m \cdot S \cdot \dot{\alpha}^2 + 2 \cdot m \cdot \dot{S} \cdot \dot{\alpha} \cdot (\sin\alpha_0 + \alpha \cdot \cos\alpha_0) + \kappa \cdot a \cdot \alpha \cdot \cos\alpha_0 \sin\alpha_0 - \\ mg\left[\cos\alpha - f \cdot \sin\alpha_0 - \alpha(\sin\alpha_0 + f \cdot \cos\alpha_0)\right] = 0 \end{array}\right\} \quad (2.10)$$

The initial conditions:

when t = 0; $\alpha = 0$; S = $S_0$; $\dot{\alpha} = 0$; $\dot{S} = 0$ (2.11)

Nonlinear system of differential equations (2.10) with (2.11), are solved by a numerical method for the program MAPLE-9.5:

Initial data $l = 1м$ , $y = 10\,\frac{м}{c^2}$ , $m = 1кг$

Variant number 1: $\mathrm{f} = 0{,}1$; $\kappa = 5 \cdot 10^2 МПа$; $\kappa_2 = 10 \cdot 10^2 МПа$ , $\kappa_3 = 15 \cdot 10^2 МПа$ , $\alpha_0 = \frac{\pi}{6}$; Figure 4a, 4b, 4c

Variant number 2: $\kappa = 5 \cdot 10^2$; $f_1 = 0{,}1$ ; $f_2 = 0{,}2$ ; $f_3 = 0{,}3$ ;

Fig. 5a, 5b, 5c

Variant number 3: $\kappa = 5 \cdot 10^2$ ; $f = 0{,}1$ ; $\alpha_1 = \frac{\pi}{6}$ ; $\alpha_2 = \frac{\pi}{4}$ ; $\alpha_3 = \frac{\pi}{3}$

Figure 6a, 6b, 6c

Curves: green - $\alpha_1 = \alpha(t)$ , red - $\alpha_2 = \alpha_2(t)$ , black - $\alpha_3 = \alpha_3(t)$

## 4 ANALYSIS OF RESULTS

Numerically solving the system (2.10) for given initial conditions, graphs are obtained characterizing change of inclined angle - $S(t)$, flying detachment moving along the length of the plate - as well as the relationship between the change in the angle $\alpha$ and displacement - S, in stationary mode.

Figure 4a, 4b, 4c - shows the variation, at different values the coefficient elasticity of the elastic element (curves 1,2,3). With increasing stiffness of elastic element, damped oscillation process occurs faster in time. The motion of flying detachment on the surface of the plate occurs almost equally regardless of changes in the stiffness of elastic element.

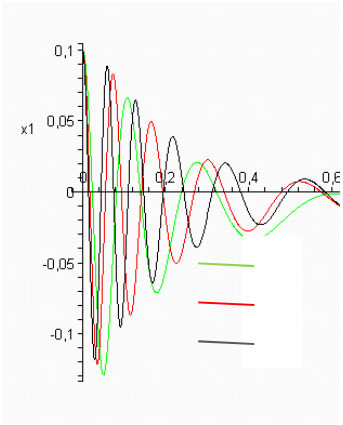



Figure-4a

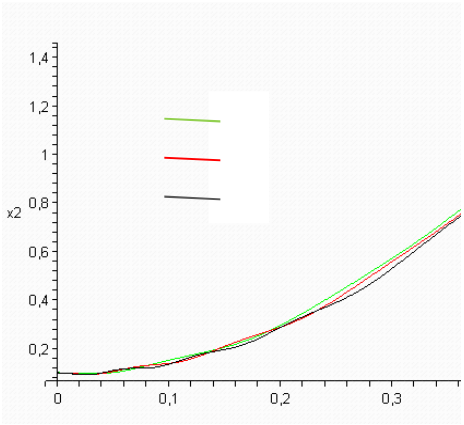



Figure-4b

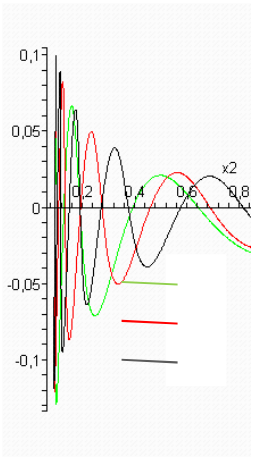



Figure-4c

Change in angle $\alpha(t)$ depending on the stiffness of elastic element, increasing the value - K corresponds to the phase of oscillation reduction.

Figure 5a, 5b, 5c, given change in inclination angle of plate - $\alpha(t)$ shift in flying detachment along the surface of the plate - $S(t)$ and the dependence for different values of the coefficient of dry friction f0 = 0,1; 0.2; 0.3 (curves 1,2,3).

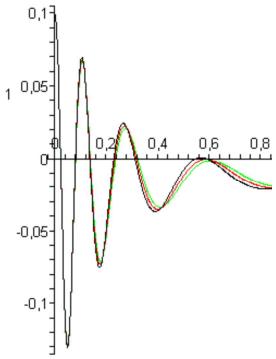



Figure-5a

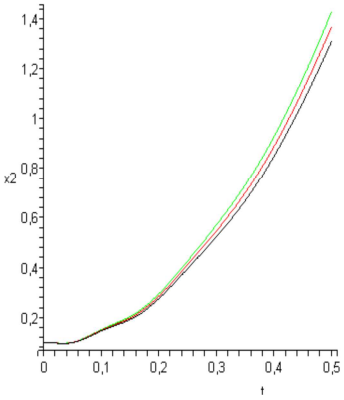



Figure-5b

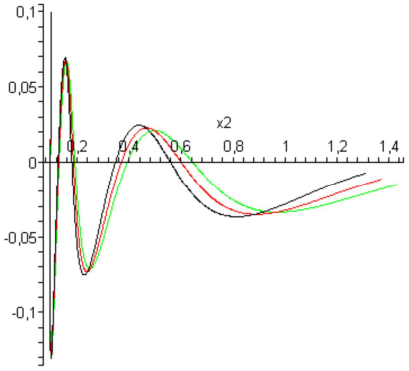
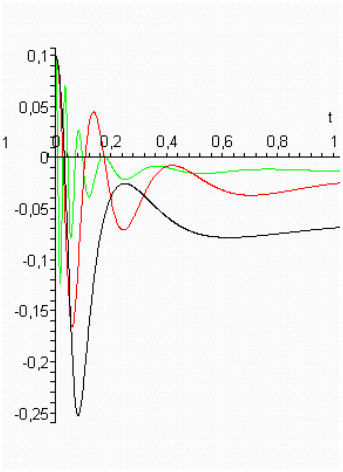



Figure-5c

From the graphs can be judged that they have a harmonic character. With the passage of time - t, change in $\alpha(t)$ - does not depend on change in coefficient of friction.

However, the movement of flying detachment along the length of the plate depends on the coefficient of friction. That is an increase - f, resulting in slower motion of flying detachment that corresponds to experimental data. Phases, the value - f, affects the oscillatory process of plate. Figure 6a, 6b, 6c - shows the character of the influence of changes in the initial angle $\alpha_0 = \frac{\pi}{6}; \frac{\pi}{4}; \frac{\pi}{3}$ (curves 1,2,3) to change in angle - $\alpha(t)$, shifted - $S(t)$ and $\alpha = \alpha(S)$;



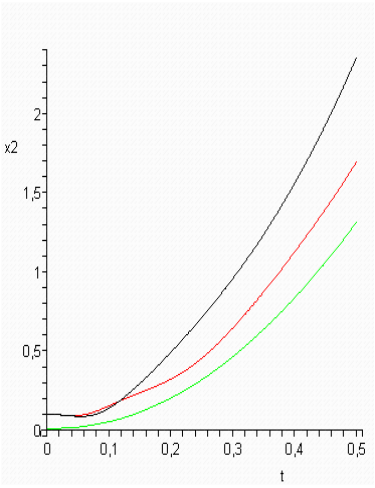




Figure-6a Figure-6b

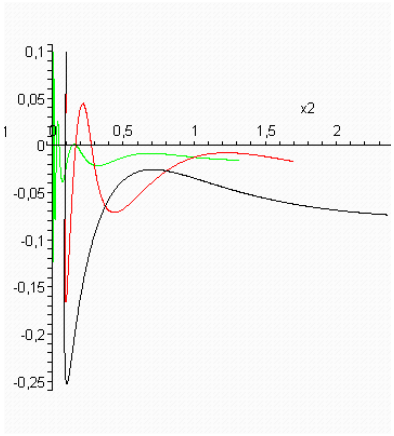



Figure-6c

From the analysis of the graphs it is evident that damped oscillation process occurs faster with an increase of the initial inclination angle.

Movement of flying detachment along the length of the plate also occurs faster with an increase of the initial angle of inclination.

Analyses of results show that the cotton's flying detachments move along the surface of the plate, obeying parabolic law, and change in the inclination damped harmonically.

## 5 EXPERIMENTAL STUDIES

In the technological process of cotton factories, after operation of drying drum significant portion of small trashes in composition of raw cotton remains. With the help of the installation, some small trash and various impurities are cleaned from raw cotton. As we know, process of cotton picking occurs in the cotton field, resulting in dirtiness of various fibers (with

dust, sand, boxes, leaves, twigs, grass seeds). Separation small trash depends on connections the fiber with it. Sometimes cotton cleaning from trash in factories is very easy; sometimes it is a very complicated process. Therefore, in the process of cotton cleaning and ginning: saws, drums, and mesh surface are used, which have many shortcomings and inaccuracies. To eliminate these drawbacks, and on the basis of theoretical studies have been designed more simple and convenient design of new cleaning machine, which provides efficient cleaning of small trash without affecting the natural properties of cotton fiber and seed. Prospective new cleaner of cotton from small trash was set to technological process in CHINABAD cotton cleaning complex of Andijan "Pahtasanoat" and the experiments were conducted. This equipment is installed after the separator, cleaned cotton with help of air flow is sent to conveying pipeline. During the experiments, all the working parts of equipment were under constant supervision.

The experimental results are listed in Table 1.1. Experiments were carried out on raw cotton breeding varieties C-6524, sorts 1-2 and humidity 8% and 2.4-2.6.

***Table 1.1 Vertically-cleaning installation***

| № | Breeding sort | Industrial sort | Humidity | Dirtiness, % | | |
|---|---|---|---|---|---|---|
| | | | | In the bulk | After separator | After installation |
| **1** | C-6524 | 1 | 8,2 | 2,4 | 1,95 | 1.76 |
| **2** | | | 8,8 | 2,5 | 1,98 | 1,77 |
| **3** | | | 8,8 | 2,6 | 1,92 | 1,74 |
| **1** | C-6524 | 2 | 8,2 | 2,4 | 1,95 | 1,52 |
| **2** | | | 8,8 | 2,5 | 1,98 | 1,55 |
| **3** | | | 8,8 | 2,6 | 1,92 | 1,56 |

## 6 ANALYSIS OF RESULTS

Due to the elastic connection of the mesh surface in the direction of the y-axis, there is a harmonic oscillation that helps angles to rotate cotton relative to the axis, as the force of friction assists in separation from different trashes and cotton cleaning.

Experimental sample of vertical mesh situated at an angle 45 with the holes of the cells 3 is 10 mm, was installed in cotton cleaning factory processing 60 tons of raw cotton capacity per day.

Experiments were conducted on breeding varieties of cotton from the 6524 2-sort and Andijan 35 1-sort, with dirtiness of 12% and 4.5% humidity. Applying in this simple way of vibration, we have increased the cleaning effect by 5%. From this we can conclude that the vibration is playing a major role in the organization of the separating process and has the following main factors:

- Vibration is an important element in the process of sifting, because it provides intensive movement of particles from the holes, increases the probability passing particles of small fraction through the holes.

## 7 CONCLUSION

1. The mathematical model of the motion of cotton's flying detachment along the plate with elastic elements is prepared. Nonlinear system of differential equations describing the motion of flying detachment is solved by a numerical method with the program MAPLE-9.5.
2. It is shown by theoretical study that the process of damped oscillation angle plate is faster with increasing initial angle. Movement of flying detachment along the length of the plate also occurs faster with an increase in initial inclined angle.

3. As a result, using vibration along with converting frictional force to particles of small trash take effect motive forces which, under appropriate conditions also lead to an increase in the intensity of the separation process where vibrational forces provide conveying of raw cotton along the working surface and product separation from small trash to appropriate receivers.
4. Small trash particles with different properties are moving on a vibrating surface with different trajectories.

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# Mosquito Species Occurrence and Diversity in Conventional larval breeding sites in Minna metropolis, Nigeria

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**ABSTRACT:** This study was carried out to provide epidemiological information on the distribution and diversity of vector mosquito species in conventional larval breeding habitats in Minna Metropolis, Nigeria. Selected larval habitats were rice-fields, gutters, septic tanks, rain pools and streams, which were sampled weekly during the months of September through November of 2013. The results indicated the occurrence of seven vector mosquito species in the area namely, *Culex pipiens pipiens* (38.84%)*, Cx. salinarius* (28.78%), *Aedes aegypti* (10.71%), *Anopheles gambiae* (7.29%), *Cx. restuans* (6.52%), *Cx. nigripalpus* (4.72%)*,* and *An. funestus* (4.15%)*. Culex p. pipiens* was the most widely distributed species, being absent only in the stream habitats, that was totally devoid of mosquitoes. *Cx. nigripalpus* and *Cx. salinarius* were encountered in three of habitat types (i.e., rice-fields, gutters and septic tanks), while *Ae. Aegypti* was encountered in the gutters and the rain pools. In addition to the rain pools, *Cx. Restuans* was also collected from gutters. The two anopheline species encountered had similar pattern of larval habitat distribution been found only in rice fields and rain pools. On the whole, the rice-fields and gutters were the most productive larval habitats, in terms of mosquito abundance (28.04% and 29.67% respectively) and diversity (diversity index=0.6940 and 0.4834 respectively). Overall mosquito species diversity for the area was 0.6985, largely contributed by *Cx. p. pipiens* and *Cx. salinarius.* The findings of this study suggest serious threat of mosquito-borne diseases to public health, in Minna Metropolis, promoted by anthropogenic alterations of the ecosystem.

**KEYWORDS:** *Aedes, Anopheles, Culex,* Habitat productivity, Larvae, Mosquito distribution

## 1 BACKGROUND

Mosquitoes are transmitters of serious human diseases including, yellow fever, malaria, filariasis, and dengue [1], [2],[3],[4],[5],[6]. More than 2,500 species of mosquitoes have been described worldwide [7]. They belong to the family Culicidae [8],[9],[10]. In Africa, Nigeria in particular, though several studies have elucidated mosquito species composition and distribution in larval breeding habitats [11],[12],[13],[14],[15],[16],[17],[18],[19],[20**],** the breeding ecology of the species vary considerably in different localities, thus significantly influencing mosquito-borne disease transmission in such areas [21],[22],[23],[24]. Therefore, effective mosquito vector control, in areas of high disease burdens, must be predicated on a good understanding of the occurrence of specific important vector species, their abundance, distribution and, hence, potential for disease transmission in the area. This information is scanty for many parts of Nigeria especially the North-central region, Minna inclusive. This is despite the fact that certain mosquito-borne diseases e.g. malaria, are holo-endemic in the area [10], [25], [26], [27].

Although, mosquito larval occurrence and abundance vary with species [25], [28], habitat [29], [30], [31], [32], [33], [34], [35], locality [10], [13], [36], [37], [38] and season [36], [39], [40], [41], [42], [43]; it is closely associated with the availability of suitable larval breeding habitats [25], [44], [45], [46], [47]. Important mosquito breeding habitats reported include rain pools, dams, swamps, drainage channels, wells, rivers, etc. [37], [36], [47], [48], [49], [50].

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Of equally important indicator of ecological and evolutionary fitness of mosquito populations in a locality is the diversity of inherent species [16], [51]. The diversity index of mosquito vector species is positively correlated with proliferation potential, survivorship, adaptability and vectorial capacity of mosquitoes in an area. Again, species diversity of Mosquitoes has been poorly studied in Nigeria. In order to fill the existing bio-ecological information gap on mosquito vectors, especially, in North-central Nigeria, this study was carried out to evaluate the occurrence, abundance, distribution and diversity of Mosquito species in conventional larval breeding habitats in Minna Metropolis, a representative cosmopolitan ecotypesetting of North-central Nigeria.

## 2 MATERIALS AND METHODS

### 2.1 DESCRIPTION OF STUDY AREA

The study was carried out in and around Minna area of North Central Nigeria. Minna is the Capital of Niger state, located within longitude $6^{o}$ 33´ E and latitude $9^{o}$ 27 ´ N; covering a land area of $88km^2$ with an estimated human population of 1.2 million. Minna is characterised by a tropical climate with mean annual temperature, relative humidity and rainfall of $30.20^{o}C$, 61.00% and 1334.00mm, respectively. The climate of the area manifests as two distinct seasons; a rainy season between May and October and dry season in November to April of the following year. The vegetation of the area is typically grass-dominated Savannah with scattered trees [52].

### 2.2 SELECTION OF MOSQUITO COLLECTION SITES

The kind of mosquito breeding sites selected for larval collection were guided by earlier reports of high productivity of such habitats [29], [30], [31], [32], [33], [34], [35]. Such sites selected were rice-fields, drains, rain pools, septic tanks and streams.

### 2.3 MOSQUITO LARVAL COLLECTION, PROCESSING AND IDENTIFICATION

Larval mosquito collection was carried out weekly in the study area, between the hours of 0700 to 1000 during the months of September through November, 2013. Dipping Method, as described by [53], [54], was employed in larval collection. Collected specimens were kept in labelled specimen bottles and transferred to the laboratory for processing prior to identification. The larvae were preserved using 10% formaldehyde solution, and identification was with the taxonomic Keys of [55], [56].

### 2.4 DATA ANALYSIS

Collected samples from the habitats were pooled together to show the actual numbers of mosquito species encountered. Specie relative abundance was calculated and expressed as simple percentages. Data on mosquito composition were analyzed quantitatively to determine the total abundance, percentage abundance of each species identified during the study period, as well as determining Shannon-Wiener diversity index (H) and Simpson's dominance index (C) for the area [16], [51].

## 3 RESULTS

Morphological identification of collected larval instars of the mosquitoes during the period of study yielded seven species belonging to three mosquito Genera (Table 1). Four species of *Culex,* two of *Anopheles,* and one for *Aedes*; comprising of *Culex pipiens pipiens* (n=978, 38.84%)*, Cx. salinarius* (n=742, 28.78%), *Anopheles gambiae* (n=188, 7.29%), *Aedes aegypti* (n=276, 10.71%), *Cx. restuans* (n=168, 6.52%), *Cx. nigripalpus* (n=119, 4.72%)*,* and *A. funestus* (n=107, 4.15%) (Table 1). In general, the larval habitats investigated were productive for at least two of the species encountered, with the exception of the streams which was void of any species. Also, at least, one of the *Culex* species encountered was found in all the positive habitats, however, their degree of preponderance varied considerably among these habitats. Furthermore, the two Anopheline species and the only Aedine species encountered were present in only two habitats, respectively, Rice fields and Rain pools, and gutters and rain pools (Table 2). *Culex nigripalpus, Cx. salinarius, Cx. pipiens pipiens, Cx. restuans, Anopheles gambiae and A. funestus* was found in Rice fields; *Culex nigripalpus, Cx. salinarius, Cx. pipiens pipiens,* and *Aedes aegypti* were found in Gutters; *Culex nigripalpus, Cx. salinarius, Cx. pipiens pipiens* were the species found in Septic tanks; while *Cx. pipiens pipiens, Cx. restuans, Aedes aegypti, Anopheles gambiae and A. funestus* were found in Rain pools (Table 2).

Most interestingly, *Culex pipiens pipiens* was found to be catholic in distribution among the habitats (Rice fields, Gutters, Septic tanks and Rain pools) followed by *Cx. nigripalpus* and *Cx. salinarius* (Rice fields, Gutters and Septic tanks only). The other species were encountered only in two habitats; *Cx. restuans* (Rice fields and Rain pools), *Aedes aegypti* (Gutters and Rain pools), *Anopheles gambiae* and *A. funestus* (both Rice fields and Rain pools) (Table 2).

From table 3, it could be shown that there was considerable difference in the contribution of the different positive habitats, both in terms of productivity and number of species collected from each. Gutters were the most productive; although, it produced only four of the species, it accounted for 29.67% of all species encountered. This was closely followed by the Rice fields (n=6, 28.04%), Septic tanks (n=3, 22.03%) and lastly by the Rain pools (n=5, 20.25%) (Table 3). The Shannon-Wiener diversity index (*H*) and Simpson's dominance index (*C*) for the habitat was also different and are respectively, Rice field (*H*=0.69399, *C*=0.23312), Gutter (*H*=0.48335, *C*=0.38227), Septic tanks (*H*=0.31231, *C*=0.57759) and Rain pools (*H*=0.50350, *C*=0.23452) (Table 3).

Table 4 shows the computation used for diversity and dominance indices of the mosquitoes species encountered in the study area. A Shannon-Wiener diversity index (*H*) of 0.69847 and Simpson's dominance index (*C*) of 0.2516 was recorded for the study area. *Cx. pipiens pipiens* had the highest frequency of occurrence followed by *C. Salinarius.* The least occurred species was *A. funestus. Cx. pipiens pipiens* had the highest Shannon-wiener diversity and Simpson's dominance indices of 0.1596 and 0.1439 respectively.

## 4 DISCUSSION

Increasing population density due to rural-urban drift is one of the major characteristics of many cities in Nigeria [35]. This increase in population brings about a rapid change in the environment, which can cause the unconscious creation of man-made environment which aid the proliferation of mosquitoes. Furthermore, Agro-economic activities such as rice farming have contributed immensely in the provision of man-made habitats [14]. Meanwhile, the greatest challenge posed by mosquitoes to man is their ability to breed in any collection of stand water [23]. Though they breed everywhere, human activities and behaviour have continued to create more and renewed diversity in the occurrence and proliferation of mosquito species [57], [58].

In the present study, three genera of mosquitoes were encountered, this is similar to an earlier by [38]; a total of 2,578 mosquito species belonging to seven species were encountered, consisting of *Culex pipiens pipiens* (38.84%), *Cx. salinarius* (28.78%), *Anopheles gambiae* (7.29%), *Aedes aegypti* (10.71%), *Cx. restuans* (6.52%), *Cx. nigripalpus* (4.72%), and *A. funestus* (4.15%). Although, higher than that reported by [23], [35]; the former reported a total of eight species consisting of *Aedes aegypti*, *Ae. vittatus*, *Culex quinquefasciatus*, *Cx. tigripes*, *Cx horridus*, *Cx. cinereux*, *Cx annuliorus* and *Anopheles gambiae* in Owerri and Orlu, Nigeria while the latter reported a total of six species namely, *Aedes aegypti, Aedes albopictus, Aedes vittatus*, *Anopheles gambiae* complex, *Cx. quinquefasciatus* and *Eretmapodite chrysogaster*, it was considerably lower than that reported by [14], who reported a total of 25 species; five most common species collected during their study were *Anopheles arabiensis* Patton (52.5%), *Culex quinquefasciatus* Say (36.7%), *Anopheles pharoensis* Theobald (5.2%), *Anopheles coustani* Laveran (1.4%), and *Anopheles funestus* Giles (1.3%). Furthermore, in their study, [59] collected a total of 953 mosquitoes, which is lower than that reported in this study. Significant variations in mosquito species composition have been attributed to differences in ecotypes [14], microclimatic conditions [60] and sometimes sampling techniques [48].

In their study, [38] reported that drains were the most productive mosquito larval habitat, which is similar to the findings of the present study; we also reported an additional epidemiological contributor, the rice-fields. The reasons for this high productivity of the drains could be due to its high organic contents as most of them were clogged during larval collection. The rice field could be highly productive as a result of its water-logging attributes, high organic decay and inorganic chemical inputs by the farmers. Similarly, streams were also noted not to be epidemiologically important, as no mosquito larvae were encountered, this may be due to the fast flowing nature of the streams, which cause the washing away of the eggs and also due to the presence of large predators [61] and its apparent minimal organic content [38].

*Cx. p. pipiens* mosquitoes dominated the collections of larvae from the study area. The ecology of this mosquito species explains this finding, as the species is the foremost cosmopolitan mosquito thriving particularly in urban slums where anthropogenic environmental degradations result in the proliferation of polluted water receptacles preferred for breeding by the mosquito [8]. The preponderance of *Cx. p. pipiens* in Minna metropolis, therefore, pose serious public health threat, as the species is the principal vector of important human diseases especially filariasis.

Only 2 anopheline species (i.e., *An. gambiae* and *An. funestus*) were encountered during the study period in the area, and they occurred in relatively low densities. The scanty distribution of anopheline mosquitoes in the area may be due to the

ongoing large-scale aggressive anti-anopheline vector control being implemented in Minna under the auspices of Roll-Back-Malaria. The campaign is particularly targeted against anopheline breeding and resting sites in the city.

Unlike the results of this study, [11] reported a higher number of mosquito Genera (five); *Anopheles, Aedes, Culex, Mansonia and Psorophora* and 18 species from four irrigated millet and guinea-corn fields in Gezawa Agricultural Zone, Kano, North-Central Nigeria. This may mean that Minna is less clement for the distribution of mosquito species and, hence, reduced transmission of mosquito-borne diseases. They also reported a Shannon-Wiener and Simpson's diversity values of 1.1431 and 0.0925 for the mosquito species encountered, this is, however, different from this study where a Shannon-Wiener and Simpson's diversity values of 0.69847 and 0.25163 respectively, was observed. Ephantus *et al.* (2006) in their study also reported mosquito species diversity (*H*) and evenness (*EH*) in non-irrigated agroecosystem as *H* = 1.507 and *EH* = 0.503 respectively, *H* = 0.968, *EH* = 0.313 for unplanned rice agroecosystem and *H* = 1.040, *EH* = 0.367 for planned rice agroecosystem, which are significantly higher than that obtained in this study.

## 5 TABLES

***Table 1. Mosquito Species composition and abundance in Minna Metropolis, Nigeria***

| Species | Species Aggregate | Percentage Abundance (%) |
|---|---|---|
| *Culex nigripalpus* | 119 | 4.72 |
| *Cx. salinarius* | 742 | 28.78 |
| *Cx. pipiens pipiens* | 978 | 38.84 |
| *Cx. restuans* | 168 | 6.52 |
| *Aedes aegypti* | 276 | 10.71 |
| *Anopheles gambiae* | 188 | 7.29 |
| *A. funestus* | 107 | 4.15 |
| Aggregate | 2,578 | 100 |

***Table 2. Relative distribution of mosquito species in conventional larval breeding habitat in Minna Metropolis, Nigeria.***

| Species | Habitat | | | | | |
|---|---|---|---|---|---|---|
| | Rice fields | Gutters | Septic Tanks | Rain Pools | Streams | **AGGREGATE** |
| *Culex nigripalpus* | 52 | 39 | 28 | -* | - | 119 |
| *Cx. Salinarius* | 212 | 401 | 129 | - | - | 742 |
| *Cx. pipiens pipiens* | 236 | 228 | 411 | 103 | - | 978 |
| *Cx. Restuans* | 107 | - | - | 61 | - | 168 |
| *Aedes aegypti* | - | 97 | - | 179 | - | 276 |
| *Anopheles gambiae* | 71 | - | - | 117 | - | 188 |
| *A. funestus* | 45 | - | - | 62 | - | 107 |
| **Aggregate** | 723 (28.04) | 765 (29.67) | 568 (22.03) | 522 (20.25) | - | 2,578 (100) |

*absence of mosquito larvae

***Table 3. Relative productivity and species diversity of conventional Mosquito larval breeding habitats in Minna Metropolis, Nigeria.***

| Habitats | Numbers of Species encountered | Shannon-Wiener diversity index | Simpson's dominance index |
|---|---|---|---|
| Rice Fields | 6 (28.04%) | 0.69399 | 0.23312 |
| Gutters | 4 (29.67%) | 0.48335 | 0.38227 |
| Septic Tanks | 3 (22.03%) | 0.31231 | 0.57759 |
| Rain Pools | 6 (20.25%) | 0.50350 | 0.23452 |
| Streams | *- (00.00%) | * - | - |

*absence of mosquito larvae

*Table 4. Species diversity and dominance indices of Mosquitoes populations breeding in conventional larval breeding habitats in Minna Metropolis, Nigeria*

| *Species* | *fi* | *fi log fi* | *fi log$^2$ fi* | *pi* | *(pi)$^2$ or (ni/N)$^2$* | *ni (ni-1)/N (N-1)* | *Pi log Pi* | *Pi In Pi* | *Pi(In Pi)$^2$* | *Shannon-Wiener diversity index, H= –( Pi log Pi)* | *Simpson's dominance index, C= Σ (ni/ N)$^2$* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Culex nigripalpus*** | 119 | 246.99 | 512.63 | 0.0461 | 0.00213 | 0.0021 | -0.061 | -0.1419 | 0.43665 | 0.06165 | 0.00213 |
| ***Cx. salinarius*** | 742 | 2129.84 | 6113.50 | 0.2878 | 0.08284 | 0.0827 | -0.155 | -0.3584 | 0.44642 | 0.15567 | 0.08284 |
| ***Cx. pipiens pipiens*** | 978 | 2924.55 | 8745.40 | 0.3793 | 0.14391 | 0.1438 | -0.159 | -0.3677 | 0.35639 | 0.15969 | 0.14391 |
| ***Cx. restuans*** | 168 | 373.85 | 831.94 | 0.0651 | 0.00424 | 0.0042 | -0.077 | -0.1779 | 0.48596 | 0.07728 | 0.00424 |
| ***Aedes aegypti*** | 276 | 673.69 | 1644.42 | 0.1070 | 0.01146 | 0.0114 | -0.103 | -0.2392 | 0.53448 | 0.10388 | 0.01146 |
| ***Anopheles gambiae*** | 188 | 427.54 | 972.27 | 0.0729 | 0.00531 | 0.005 | -0.082 | -0.1909 | 0.49994 | 0.08292 | 0.00531 |
| ***A. funestus*** | 107 | 217.14 | 440.67 | 0.0415 | 0.00172 | 0.0017 | -0.057 | -0.1320 | 0.42022 | 0.05735 | 0.00172 |
| ***∑*** | 2578 | 6993.61 | 19260.86 | 1 | 0.25163 | 0.2513 | -0.698 | -1.6083 | 3.18010 | 0.69847 | 0.25163 |

**Key:** fi = Abundance of species, N = total number of individuals, Pi = Proportion of individuals found in the ith species, In = the Natural (Naperian) logarithms ($\log_e$), $(ni/N)^2 = (Pi)^2$

## 6 CONCLUSIONS

Vector mosquito species in Minna is dominated by the Culicines especially *Culex.* Thus, the ongoing anti-anopheline control interventions, to reduce malaria burdens, in the city should be broadened to target the breeding sites of the Culicines as well, as these mosquitoes transmit diseases of burdens that can rival malaria. The drains (Gutters) and rice-fields were the most productive mosquito larval habitats in the city. These findings further confirm the fact that anthropogenic activities are the principal drivers of mosquito proliferation in domestic and peri-domestic environments; such activities should therefore be strictly regulated. The diversity indices of the mosquito populations in Minna indicate that the established species are well adapted to the ecological conditions of the area, and will require consistent aggressive larvicidal interventions for effective control. The findings of this study will help in achieving a better understanding of the epidemiology of mosquito-borne diseases in Minna, a pre-requisite for sustainable disease control.

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# Influence of Ecological Setting on Occurrence of Artificial Container-breeding Vector Mosquito Species (Diptera: Culicidae) and Oviposition Attraction to Mineral Salts in Larval Habitats, in Minna, North-central Nigeria

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**ABSTRACT:** The peculiar challenges associated with mosquito vector control in developing urban areas, occasioned by the complex heterogeneity in vector behaviour and population dynamics, informed this study to elucidate the influence of eco-type on Mosquito species occurrence and responses to presence of mineral salts in oviposition sites. Two distinct ecotypes namely, semi-mineral and Urban, were selected as ovitrap stations, in Minna, Nigeria. In addition to the control experiment, adequately replicated ovitraps enriched with individual and combinations of nitrates, sulphates and phosphates were setup in the two ecotype sites and monitored for mosquito oviposition activities. The results indicated significantly ($P<0.05$) lower number of species and aggregate Mosquito densities in the urban (Mean=17.14±4.52 larvae/ovitrap) than semi-rural ecotype (21.76±3.93 larvae/ovitrap). While, three mosquito species: *Aedes aegypti*, *Culex p. pipiens* and *Cx. restuans,* were common to both ecotypes, additional three species namely; *Anopheles quadrimaculatus, Cx. Tarasalis* and *Cx. quinquefasciatus* were encountered in the semi-rural ecotype, though in low densities. Significantly higher larval densities were recorded in ovitraps enriched with mineral salts (range= 19.75±4.57 to 24.25±4.62 larvae/ovitrap) than the control (14.50±4.86 larvae/ovitrap). While, Nitrate ovitraps yielded the highest number of larvae (23.50±7.39 larvae/ovitrap) among the individual mineral salt-enriched ovitraps, and closely rivalled those containing combination of all three salts. The individual mosquito species demonstrated significant preferences for certain lone/single or combined salts-ovitraps. These findings revealed significant spatial heterogeneity in cosmopolitan mosquito population behaviour; and calls for the incorporation of diverse species-and ecotype-sensitive tools in mosquito vector control programs in such human communities.

**KEYWORDS:** *Aedes, Anopheles, Culex,* Ecotype, Mosquito distribution, Ovitrap

## 1 BACKGROUND

Mosquito-borne diseases including, malaria, Filariasis, encephalitis, yellow fever, dengue fever, etc, constitute the principal bane of public health challenges, particularly, in the Tropics [1]. Recent WHO statistics revealed that mosquito borne diseases are collectively responsible for several millions of human deaths and more than a billion cases of morbidity worldwide every year [2], [3]. Though, most of the mosquito-mediated diseases are extensively distributed on a global scale [4]; their local occurrence and intensity of transmission are closely related to those of the Culicid vectors [5], [6]. More importantly, however, the population ecology of vector mosquito species in a locality is largely determined by the suitability pf prevailing ecologic setting, for immature development and survival, as well as, dispersal of the adult stage [7]. While, mosquitoes breed profusely in naturally occurring water bodies [8], [9], [10], many of the vector species have evolved

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preferences for man-made water receptacles in peri-domestic environments [11], [12]. As a result of anthropogenic degradation of artificial mosquito breeding sites, the physico-chemical properties of the water bodies of artificial mosquito larval habitats have been significantly tilted in favour of the proliferation of certain species. This development have resulted in alteration of the otherwise mosquito species composition and relative abundance balance that often characterise natural ecological settings.

To this end, mosquito vector species composition and relative abundance, and hence transmitted diseases, have often demonstrated spatial heterogeneity in large human communities, especially where different ecological settings, dictated by degree of urbanisation, are contiguous. Thus, resulting in complex epidemiological patterns of mosquito-borne diseases; and making effective vector control difficult to attain. Most sub-Saharan urban settlements are typical conglomerations of diverse eco-types ranging from a cosmopolitan core to semi-rural outskirts [11]. Yet, the same anti-mosquito control strategies are implemented in all segments of such heterogeneous ecotypes [13], [14], irrespective of differences in vector behaviour and ecology, occasioned by spatial disparities in species occurrence and relative abundance. Therefore, in order to have a better understanding of the influence of ecotypes on mosquito population and oviposition behaviours in heterogeneous human communities, a necessary/vital information for effective control; this study was carried out to determine variabilities in species composition, relative abundance and oviposition behaviour of mosquito vectors in the representative ecotypes of Minna, North-central Nigeria.

## 2 MATERIALS AND METHODS

### 2.1 STUDY AREA

Located in North-central Nigeria, the study area, Minna (Long. $6^{o}$ 33'E and Lat. $9^{o}$ 37'N) is the capital city of Niger state. The area, covering an estimated 88 $Km^2$ land mass, is inhabited by more than 1 million people. The climate of Minna is tropical, with two characteristic seasons namely, rainy (from May through October) and dry (December - March). Transitional seasonal periods occur in April and November. The area is relatively warm and dry, with mean annual temperature of about $30^{o}$C and 60% relative humidity. Though, the total annual rainfall (1,334 mm) is effectively within the range for the Sudan savannah, the area is prone to water-logging during the middle of the rainy season, due to its poor drainage, occasioned by the characteristic pre-dominant low land *Fadama* edaphic and topographic features.

### 2.2 ECOTYPES

**The Urban Setting:** The urban ecotype selected for placement of ovitraps was located in Tunga area of Minna metropolis. The site is characterized by dense human population and modern housing structures. The drainage system is fairly well-planned. The vegetation is very scanty, consisting only of distantly distributed shade-providing trees and land-scaped horticultural species. Reasonable spaces around many of the houses are concreted/cemented and sometimes contiguous among a length of houses.

**Semi-rural Ecotype:** This eco-type was selected in the agrarian outskirt of Chanchaga sector of Minna, about 16 kilometres from the selected urban ecotype. The semi-rural setting was densely vegetated, with widely-spaced low standard houses thus, making room for inter-house expanse of open vegetated earth. Drainage system was practically non-existent in the area, resulting in proliferation of natural water receptacles in the rainy season. There were low anthropogenic pressures on the natural ecological attributes occasioned by low human population density.

### 2.3 EXPERIMENTAL DESIGN AND IDENTIFICATION OF MOSQUITO LARVAE

In each ecotype selected, four replicates of ovitraps consisting of a clay pot (3 litres capacity) holding 2 litres of rainwater were set up per treatment. The treatments consisted of the following: 9.50, 0.50 and 0.90 mg/Litre, respectively, of Nitrate (N), Phosphate (P) and Sulphate (S) salts individually dissolved in a set of four replicate ovitraps; as well as combinations of salt concentrations given above of Nitrate and Phosphate, N+P, Nitrate and Sulphate, N+S, Phosphate and Sulphate, P+S, and Nitrate, Phosphates and Sulphates, N+P+S. The salt concentrations used in this study were arrived at, been the average concentrations of such mineral salts in mosquito larval habitats in the study area [15], [16]. Also, a control experiment was set up, consisting of same number of ovitrap replicates as the test experiments, but with no mineral salt whatsoever dissolved in the water. The experimental setup was replicated at two stations in the field for seven days before mosquito larvae were recovered from them and taken to the Laboratory for identification. Seven days was considered long enough to attract ovipositing-mosquitoes, but not for adult emergence, as mosquito larval development takes between 9 – 15 days in

the area [17], [18]. Mosquito identification was done to species level, using standard taxonomic keys [19], [20], [21]. The whole experiment was repeated within one week of termination of the first exercise.

### 2.4 DATA ANALYSIS

Data collected on mosquito larval density were processed as Mean±SD, using Microsoft Excel. Differences in mean values, among mosquito species, were compared for statistical significance using the Chi-square test; while the students' t-test was used for those between urban and semi-rural ecotypes. All statistical analyses were done at P=0.05 level of significance.

## 3 RESULTS

The differential occurrence and distribution of mosquito species in urban and semi-rural ecotype areas in Minna, North-central Nigeria, are highlighted in Table 1. Three mosquito species namely *Aedes aegypti, Culex pipiens pipiens* and *Cx. restuans,* were encountered in both eco-types but, in addition, three other species, i.e., *Anopheles quadrimaculatus, Cx, tarsalis* and *Cx. quinquefasciatus* were collected from the semi-rural eco-type. However, the additional mosquito species encountered in the semi-rural area occurred in significantly (P<0.05) low densities (range= 0.36±0.35 to 1.57±1.50 larvae/ovitrap). Significantly, *Cx. pipiens pipiens* was the most common species in both ecotypes (range= 9.29±2.78 to 11.47±3.35larvae/ovitrap). On the other hand, while *Cx. restuans* was the second most abundant mosquito in the urban setting (mean= 5.57±5.57 larvae/ovitrap), the species more-or-less shared the position with *Ae. Aegypti* in the semi-rural area (3.36±1.30 and 3.57±1.40 larvae/ovitrap respectively). Except for *Ae. Aegypti,* with respect to both individual species and aggregate mosquito collection, significantly higher densities were encountered in the semi-rural than urban eco-type.

Table 2 shows details of oviposition responses of the mosquito species to the presence of salt nutrients in the ovitraps. Significantly (P<0.05) lower aggregate larval density was recorded in the control ovitraps (mean=14.50±4.86 larvae/ovitrap) than any of the mineral salt-enriched ovitraps (range=19.75±4.57 to 24.25±4.62 larvae/ovitrap, in N+ S and N + P +S media, respectively). Individual attraction of the mineral salts for mosquito oviposition was significantly highest in the Nitrate (N) ovitraps (23.50±7.39 larvae/ovitrap), than the other salts, i.e. Sulphate (S) and Phosphate (P) which were almost equally attractive. Attractiveness of dual combinations of the mineral salts to mosquitoes were not significantly different (P>0.05) (range=19.75±4.57 to 21.25±3.94 larvae/ovitrap). However, combination of all three salts was significantly productive.

In term of number of species, the control and Sulphate (S) ovitraps were the least productive, as only three (3) species were encountered in them. While, only *An. quadrimaculatus* was absent in Nitrate ovitraps, those of Phosphates harboured all six (6) mosquito species encountered in this study. For ovitraps of salt combinations, only those of N + P were deficient in species representation, as *An. quadrimaculatus* and *Cx. tarsalis* were absent from their collections. Except for *Ae. Aegypti,* whose density distribution among the ovitraps varied within narrow limits (range=1.75±0.75 to 3.75±1.25 larvae/ovitrap), the mosquito species demonstrated oviposition preferences for individual or certain combinations of mineral salts. *An. quadrimaculatus* and *Cx. restuans* showed significant preference for P + S and N + P ovitraps, respectively. The *Cx. p. pipiens* mosquito had significant affinity for Sulphate, whether alone or combined with other salts. On the other hand, *Cx. tarsalis* and *Cx. quinquefasciatus* were preferentially attracted to ovitraps containing all the three mineral salts, although *Cx. tarsalis* showed a similar preference for Phosphate-enriched ovitraps.

## 4 DISCUSSION

The intensity of anthropogenic activities as reflected by differential ecotypes in Minna, North-central Nigeria, significantly influenced species occurrence and relative abundance of mosquitoes in the area. The higher number of mosquito species encountered in the semi-rural than urban setting recorded in this study, may be due to the greater diversity of larval breeding sites as well as adult ecological niches, characteristic of the former, i.e., rural ecotype, as earlier observed elsewhere in the tropics [22]. The requirements of urban development often results in clearance of natural climax vegetation and modifications of micro-climatic conditions. Thus, resulting in the simplification and/or elimination of natural larval breeding sites and adult resting sites in which many mosquito species have evolved to survive [23]. Usually, in urban areas, only few cosmopolitan mosquito species capable of utilizing the limited and often degraded larval habitats may occur [24]. However, the few mosquito species adapted to occurring in urban areas tend to have large densities, as a result of reduced competition and abundant supply of blood meal source. This phenomenon, however, contradicts the results of this study, as significantly higher aggregate mosquito density was recorded in the semi-rural than urban ecotype. The lower mosquito density recorded in urban ecotype may be due to the better anti-mosquito awareness and aggressive vector control activities in Nigerian urban centres [25]. Such anti-mosquito campaigns are directed primarily at the vectors of malaria, through the

WHO-supported wide-spread deployment of insecticide-treated bednets and elimination of larval habitats. This, probably, explains the absence of anopheles species from collections made in the urban ecotype.

Three mosquito species namely, *Ae. Aegypti, Cx. p. pipiens* and *Cx. restuans*, were collected in relatively high densities. Particularly, the first two (2) species are more serious vectors and nuisance mosquitoes of human peri-domestic environments, where they pose serious threats to public health. Thus, mosquito control strategies in the area must incorporate tools targeted at specific behaviour and ecology of the culicine mosquitoes as well; as such mosquitoes may be as important, epidemiologically, as the anophelines. The paucity of the three species restricted to the semi-rural area, i.e. *An. quadrimaculatus, Cx. tarsalis* and *Cx. quinquefasciatus* may be due to their ability to compete favourably with the more abundant species.

Significantly, higher Larval densities were recorded in ovitraps enriched with mineral salts than those containing only water (i.e., Control), even when such salts were present alone. This finding underscores the importance of mineral salts in mature development of mosquitoes. Mineral salts may affect mosquito larval development directly by moderating water physico-chemical parameters necessary for maintaining osmotic balance between the immature stages and the immediate environment or may affect them indirectly by enhancing the proliferation of phytoplankton [26], the major source of larval diet. More often than not, unguided peri-domestic anthropogenic activities result in the pollution of standing water bodies with mineral salts including those tested in this study, i.e., nitrates, phosphates and sulphates. Therefore, there is need to discourage the introduction of mineral salt-laden wastes into potential mosquito breeding sites, especially, where such habitats cannot be immediately eliminated or treated with larvicides.

Certain individual (e.g., Nitrate) and combination (e.g. N + P + S) of mineral salts were found to be significantly attractive to the mosquitoes while this may be due to biological requirements of the mosquitoes, it further confirms the ability of mosquitoes to discriminate among qualities of available oviposition [27] for optimum immature development. According to [28] the right choice of oviposition sites by gravid female mosquitoes, promote immature survival and vectorial fitness of emerging adults. To this end, chemical oviposition attractants of mosquitoes have been elucidated. In terms of number of species, the Sulphate (S) and Nitrate and Phosphate (N+P) ovitraps were the, respective, least productive individual and combined mineral salts media. This result does not show clearly, the relative importance of the mineral salts tested, for mosquito oviposition. It is, therefore, likely that other exogenous factors secondarily influenced by the mineral salts were involved in the attraction of the ovitraps to mosquito species. While. *Ae. aegypti* showed the least discrimination among the mineral salt-enriched ovitraps, relative to the Control, *Cx. p. pipiens* mosquitoes were particularly associated with sulphate ovitraps, whether alone or in combination. These observations are consistent with reported breeding ecology of the two mosquito species. *Ae. aegypti,* for example, is a foremost domestic container-breeding mosquito; and such containers are often found indoor and hardly receive nutrient salt inputs. This, probably, explains the reduced sensitivity of the *Ae. aegypti* mosquitoes to presence of mineral salts in the ovitraps. On the other hand, *Cx. p. pipiens* breeds intensely in highly polluted sites, such as septic tanks [29], [30], where sulphates constitute a major product of the decomposition of sewage.

***Table 1. Mosquito species occurrence and relative abundance in urban and semi-rural ecological settings in Minna, North-central Nigeria.***

| **Mosquito Species** | **Ecological Setting** | |
|---|---|---|
| | Urban | Semi-Rural |
| *Ae. Aegypti* | 2.29±0.59[a*] | 3.57±1.40[a] |
| *An. Quadrimaculatus* | 0.00±0.00[a] | 0.36±0.35[b] |
| *Cx. pipiens* | 9.29±2.78[a] | 11.47±3.35[b] |
| *Cx. restuans* | 5.57±5.75[b] | 3.36±1.30[a] |
| *Cx. tarsalis* | 0.00±0.00[a] | 1.43±1.15[b] |
| *Cx. quinquefasciatus* | 0.00±0.00[a] | 1.57±1.50[b] |
| Aggregate | 17.14±4.52[a] | 21.76±3.93[b] |

[*] Values followed by similar alphabets, in a row, are not significantly different at $P = 0.05$.

***Table 2. Oviposition responses of mosquito species to presence of mineral salts in Ovitraps, in Minna, North-central Nigeria.***

| Mosquito Species | Control | Mineral Elements | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | $NO_3$ | $SO_4$ | $PO_4$ | $NO_3$&$SO_4$ | $NO_3$&$PO_4$ | $PO_4$&$SO_4$ | $NO_3$,$PO_4$&$SO_4$ |
| *Ae. Aegypti* | 2.50 ±1.13$^{ab}$ | 3.75±1.25$^{b}$ | 3.50±1.50$^{b}$ | 2.75 ±0.25$^{ab}$ | 1.75±0.75$^{a}$ | 2.00±1.00$^{a}$ | 3.00±0.00$^{b}$ | 3.75±1.25$^{b}$ |
| *An. quadrimaculatus* | 0.00±0.00$^{a}$ | 0.00±0.00$^{a}$ | 0.00±0.00$^{a}$ | 0.50±0.32$^{b}$ | 0.50±0.17$^{b}$ | 0.00±0.00$^{a}$ | 1.00±0.33$^{b}$ | 0.50±0.15$^{b}$ |
| *Cx. pipiens* | 9.50±3.29b$^{c*}$ | 12.25±0.28$^{c}$ | 13.25 ±1.75$^{d}$ | 10.75±1.75$^{c}$ | 13.50±2.50$^{d}$ | 6.15±0.15$^{a}$ | 8.25±2.75$^{b}$ | 8.50±0.50$^{b}$ |
| *Cx. restuans* | 2.50 ±0.44$^{a}$ | 4.50±3.00$^{b}$ | 3.50±1.50$^{a}$ | 2.75±0.25$^{a}$ | 2.00±0.50$^{a}$ | 11.50±7.50$^{c}$ | 3.50±0.50$^{a}$ | 3.50±1.00$^{a}$ |
| *Cx. tarsalis* | 0.00 ±0.00$^{a}$ | 1.50±0.28$^{b}$ | 0.00±0.00$^{a}$ | 3.00±1.20$^{c}$ | 1.00 ±0.26$^{b}$ | 0.00±0.00$^{a}$ | 1.50±0.42$^{b}$ | 3.00±0.94$^{c}$ |
| *Cx. quinquefasciatus* | 0.00 ±0.00$^{a}$ | 1.50±1.11$^{b}$ | 0.00±0.00$^{a}$ | 1.50±0.17$^{b}$ | 1.00±0.39$^{b}$ | 0.50±0.43$^{b}$ | 1.50±0.18$^{b}$ | 5.00±0.78$^{c}$ |
| **Aggregate** | 14.50±8.86$^{a}$ | 23.50±7.39$^{c}$ | 20.25±4.75$^{b}$ | 21.25±3.94$^{b}$ | 19.75±4.57$^{b}$ | 20.15±9.08$^{b}$ | 18.75±4.18$^{b}$ | 24.25±4.62$^{c}$ |

$NO_3$ = Nitrate; $SO_4$ = Sulphate; $PO_4$ = Phosphate

$^{*}$ Values followed by similar alphabets, in a row, are not significantly different at $P = 0.05$.

## 5 CONCLUSION

Ecological setting variation significantly influenced mosquito species occurrence and relative abundance in Minna Metropolis of North-central Nigeria. However, the encountered species may be those that are not vulnerable to the ongoing anti-anopheline campaign in the area. The mosquito species were significantly attracted to ovitraps enriched with mineral salts in whatever constitution. This portends serious threat to public health, as unavoidable mosquito larval breeding sites in the peri-domestic environments are often laden with anthropogenic wastes that decompose to release mineral nutrients that have served as oviposition attractants for mosquitoes in this study. Thus, mosquito control strategies in human communities with diverse eco-types must equally incorporate varied tools for effective and species-encompassing vector population reduction.

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# دراسة تأثير تقنيات الاتصال التسويقي على سلوك المستهلك الجزائري: دراسة ميدانية لمستخدمي الهاتف النقال في الجزائر

# [ Study the impact of marketing communications techniques on Algerian consumer behavior: An Empirical Study of mobile phone users in Algeria ]

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**ABSTRACT:** The aim of this study is identify the importance of marketing communications techniques in influencing consumer behavior, and to achieve the purpose of this Research paper, we dropped our study on mobile phone users in Algeria, trying the figure out the impact of these policies on consumer behavior, and to achieve the objectives of the study and testing of hypotheses, we selected sample of 627 persons, the study concluded that both of personal selling, sales promotion and public relations are the most influential on consumer behavior compared to the rest of the elements, and that there are strong impact of marketing communication policies on subscription decision in mobile phone telecommunication service.

**KEYWORDS:** Marketing communication, marketing mix, consumer behavior, telecommunications service, Algerian consumer.

**ملخص:** تهدف هذه الدراسة إلى التعرف الى مدى أهمية سياسات الاتصال التسويقي في التأثير على سلوك المستهلك الجزائري ولتحقيق هدف هذه الدراسة قمنا بإسقاط دراستنا ميدانيا على مستخدمي الهاتف النقال في الجزائر ومحاولة معرفة تأثير هذه السياسات على سلوكه، وذلك من حيث قرار الاشتراك واختيار نوع المتعامل وكذا نوع الاشتراك، ومعدل الاستخدام، و الخروج بنتائج تساعد على تقديم توصيات حول كيفية زيادة فاعلية وكفاءة استخدام سياسات الاتصال التسويقي من قبل متعاملي الهاتف النقال للتأثير على سلوك المستهلك الجزائري، و لتحقيق أهداف الدراسة واختبار فرضياتها فقد تم اختيار عينة ميسرة من مجتمع الدراسة مكونة من 627 فرد من مدينة قالمة و بنسبة استرجاع بلغت 96.46 % ولقد توصلت الدراسة إلى أن كل من البيع الشخصي و تنشيط المبيعات و العلاقات العامة هم العناصر الأكثر تأثيرًا على سلوك المستهلك مقارنة ببقية العناصر،كما توصلت الدراسة الى وجود تأثير قوي لعناصر سياسات الاتصال التسويقي مجتمعة على قرار الاشتراك في خدمة الاتصال بالهاتف النقال.

**كلمات دلالية:** الاتصال التسويقي، المزيج التسويقي، سلوك المستهلك، خدمة الاتصالات، المستهلك الجزائري.

## 1 مقدمة

أمام المنافسة الشديدة و كذا التطورات السريعة المحيطة ببيئة المؤسسات خاصة وجدت هذه الاخيرة نفسها مجبرة على تغير استراتيجيتها و ذلك عن طريق المقاربة التي تجعل من المستهلك نقطة انطلاق نشاط المؤسسة فالتغير في سلوكات المستهلكين جعل المؤسسات تدرك انه من الضروري الاهتمام بسياسات الاتصال التسويقي و من خلالها التعرف على المستهلك و حاجاته و رغباته في محاولة امكانية تقديم السلع و الخدمات التي تناسبه و العمل على امكانية تنويعها و تميزها عن باقي منتجات المنافسين، و كذا التعرف على أي الطرق و الوسائل هي أكثر فاعلية و كفاءة في التأثير على سلوكه وقراراته الشرائية، كما تشتمل سياسات الاتصال

التسويقي على مجموعة من العناصر متكاملة فيما بينها تتولى عملية الاتصال بالمستهلكين الحاليين و المحتملين، و دراسة الاهداف المراد تحقيقها، و اختيار الوسيلة الترويجية، تحليل خصائص الجمهور المستهدف، من بين العديد من العوامل التي يجب دراستها من اجل نجاح و فعالية سياسة الاتصال التسويقي، فأهمية الاتصال التسويقي برزت بشكل كبير خاصة مع اشتداد المنافسة و ازدياد الثقافة الاستهلاكية للمستهلكين وتعدد اختياراتهم، لذلك فان اختيار و وضع السياسات الاتصال التسويقي يعد أمر اكثر من ضروري.

فالمؤسسات تهدف بشكل كبير الى تحقيق تأثير أكثر فاعلية بالنسبة للجمهور من خلال جعل محتوى و مضمون الرسالة الاتصالية يحظى بقبول و قناعة و أكثر من ذلك حدوث استجابة، وكذلك الاستفادة من المعلومات الراجعة اي التغذية العكسية لعملية الاتصال من اجل تعديل رسالتها الاتصالية و تقييمها بالإضافة الى امكانية اكتشاف الفرص التسويقية الناتجة عن بروز حاجات ورغبات غير مشبعة و العمل على اشباعها بالطرق التي تناسب كل فئة.

ومن خلال الطرح السابق، تتبين لنا ملامح الاشكالية التي يمكن بلورتها في التساؤل التالي:

ما مدى تأثير سياسات الاتصال التسويقي على سلوك المستهلك الجزائري؟

و من الاشكالية السابقة تتفرع لنا الاسئلة الفرعية التالية :

- ما هي اكثر الوسائل اهمية في التأثير على سلوكه؟
- هل يختلف تأثير هاته الوسائل على سلوك المستخدم باختلاف خصائصه الديمغرافية؟

وتستمد اهمية هذه الدراسة من اهمية سياسات الاتصال التسويقي خاصة بعد اشتداد المنافسة كما تكمن اهميتها من خلال التعرف على سياسات الاتصال التسويقي المطبقة فعلا في الجزائر، كما تحاول دراستنا اثراء المعرفة العلمية خاصة فيما يتعلق بسلوك المستهلك، واعتماد على الدراسة الكمية و النوعية و التوصل الى نتائج منطقية تعكس الاداة المستخدمة في جمع المعلومات، اضافة مرجع جديد يحاول تفسير تأثير سياسات الاتصال التسويقي على سلوك المستهلك الجزائر في مجال خدمات الاتصال الخليوي، يمكننا ان نوجز اهم اهداف دراستنا فيما يلي :

- التعرف على سياسات الاتصال التسويقي و عناصره التي يمكن لها ان تؤثر على سلوك المستهلك.
- عرض شامل لأهم المداخل الخاصة بدراسة سلوك المستهلك وكذا العوامل المؤثرة عليه.
- التعرف على سياسات الاتصال التسويقي التي ينتهجها متعاملي الهاتف النقال في الجزائر، ومدى تأثيرها على سلوك مشتركي الهاتف النقال.

ولقد تم اعتماد ثلاثة فرضيات رئيسية نوردها فيما يلي:

**الفرضية الرئيسية الاولى:**

يقوم متعاملي الهاتف النقال في الجزائر باعتماد على سياسات الاتصال التسويقي.

**الفرضية الرئيسية الثانية:**

توجد فروق معنوية ذات دلالة احصائية عند مستوى 0.05 % بين سياسات الاتصال التسويقي عند اخذ عناصرها بشكل مجتمع وبين سلوك المستهلك الجزائري.

**الفرضية الرئيسية الثالثة:**

توجد فروق معنوية ذات دلالة احصائية عند مستوى 0.05 % بين سياسات الاتصال التسويقي عند اخذ عناصرها بشكل منفرد وبين سلوك المستهلك الجزائري.

ويتكون مجتمع الدراسة من جميع العناصر التي يرغب الباحث بدراستها و التوصل الى استنتاجات عنها، و العنصر هو وحدة التحليل التي يفترض على اساسها القياس، وفي دراستنا يشمل مجتمع الدراسة جميع مشتركي الهاتف النقال في الجزائر و المقدر عددهم ب 32.780.165 مشترك حتى ديسمبر 2010، ونظرا لصعوبة الحصر الشامل لعناصر مجتمع الدراسة جميعها اعتمدنا على اسلوب العينة العشوائية البسيطة وذلك على أساس السهولة و الملائمة في الوصول إليهم و ضمن شروط محددة، منها العمل على شمولية عينة الدراسة على فئات عمرية، و دخلية، و مستويات تعليمية مختلفة تعكس جميع المجتمع محل الدراسة و هو ما يسمح بفرص متساوية لكل فرد من المجتمع المدروس بالظهور في هذه العينة مع امكانية تعميم نتائج الدراسة على كامل مجتمع الدراسة، و لقد تم إختيار 650 عينة من مدينة قالمة و بلغت نسبة استرجاع الاستبيانات السليمة ب 96.46%.

اما المتغيرات محل الدراسة فقد قمنا بتقسيمها الى ثلاثة اقسام:

- المتغيرات المستقلة: وقد تمثلت في المزيج الترويجي و هي: الإعلان البيع الشخصي، ترويج المبيعات، الدعاية و العلاقات العامة، التسويق المباشر.
- المتغيرات التابعة: وقد تم تمثيلها في: قرار الاشتراك، اختيار المتعامل، اختيار نوع الاشتراك، معدل الاستخدام.
- المتغيرات ألوسيطة تمثلت في الخصائص الديمغرافية للمستجوبين مثل: الجنس، العمر، الدخل، مستوى التعليم.

لقد قمنا بتصميم الاستمارة و صياغة عباراتها وفقا لأهداف الدراسة و كذا طبيعة المجتمع محل الدراسة، و قد قمنا بتقسيم هذه الاستمارة الى اربع اجزاء كالتالي:

الجزء الأول تقديم تعريف مختصر للدراسة و ذلك بذكر عنوان الدراسة، و الهداف منها، و ايضا تذكير المستقصين منهم ان اجاباتهم هدفها خدمة الاغراض البحث العلمي.

- الجزء الثاني: و يتعلق الامر بالبيانات الشخصية للمستقصين منهم مثل الجنس، العمر، الحالة الاجتماعية، المستوى التعليمي، المهنة و الدخل الشهري، بالإضافة الى نوع المتعامل، طبيعة الاشتراك.
- الجزء الثالث: و لقد ضم عبارات خاصة بسياسات الاتصال التسويقي و تم تقسم هذا الجزء الى خمس اقسام هي:

✓ الاعلان : و قد ضم 14 عبارة و قد تم صياغة عباراته على اساس: وسائل الاعلان المستخدمة، مدة الرسالة الإعلانية تكرار الرسالة و كذا التصميم الفني و الاخراج.

- ✓ البيع الشخصي: و لقد ضم 9 عبارات تناولت التغطية الجغرافية لنقاط البيع، مظهر موظفي البيع، مؤهلاتهم و مستوى تعليمهم، قدرتهم على العرض و الاقناع.
- ✓ ترويج المبيعات: و ضم 11 عبارة و تم قياس هذا العنصر من خلال: العروض البيعية المقدمة، المسابقات و الجوائز، المعارض و كذا الطمبولات، المناسبات البيعية و مدتها.
- ✓ الدعاية و العلاقات العامة: و لقد ضم هذا العنصر 10 عبارات تناولت الانشطة الخيرية، الرعاية، تقبل شكاوي الزبائن و اهتمامها بالبيئة.
- ✓ التسويق المباشر: تناولنا في هذا العنصر الموقع الالكتروني، سهولة الولوج اليه، الرسائل القصيرة، بالإضافة الى البريد المباشر و الكتالوجات وذلك في 7 عبارات.

الجزء الرابع: ضم هذا الجزء عبارات خاصة بسلوك المستهلك الجزائري في 19 عبارة تناولت الاشتراك في خدمة الهاتف النقال، اختيار نوع المتعامل، نوع الاشتراك، وكذا معدل الاستخدام.

و ذلك وفقا لسلم ليكارت الخماسي (1)غير موافق تماما، (2) غير موافق، (3) محايد، (4) موافق، (5) موافق تماما.

## 2 الاطار النظري و الدراسات السابقة:

### 2.1 الاطار النظري

**أ- الاتصالات التسويقية:**

يرجع الكثير من المسوقين على أن ظهور الاتصالات التسويقية ولو في صورتها القديمة الى اليونان، و بالضبط الى تاجر متجول لمستحضرات التجميل، و أيضا تحمل جدران بومبي أقدم إعلان سياحي، رغم أن الكثير يعتبر أن الكتابات و النقوش الموجودة في اللوحات البابيلية هي الاقدم، لتختفي تقريبا انشطة الاتصالات التسويقية الى غاية القرن الثاني عشر و بالضبط سنة 1140م مع ظهور المنادي الذي يجوب الشوارع، حيث اتسعت رقعة نشاطهم في فرنسا بعدما كانت مقتصرة على إنكلترا [1]، و تعتبر إنكلترا مهد أول قانون ينظم الاعلان، ففي سنة 1614م أجبر التجار على أن لا يتعدى الاعلان المرسوم على حائط اي مبنى 8 أقدام، و مع اختراع المطبعة ظهرت الاعلانات المطبوعة، حيث يعود اول إعلان في الصحف الانجليزية الى سنة 1625، رغم كون أول صحيفة طبعت و نشرت هي صحيفة أخبار الاسبوع للندن the weekly news of london [2]، و مع بداية الثورة الصناعية في بريطانيا و زيادة وتيرة الانتاج و ظهور العلامات التجارية كوسيلة للتسويق المنتجات لجأ المصنعين الى الاعلان في الصحف و المجلات.

يمكن تعريف الاتصالات التسويقية على أنها "العملية التي يمكن من خلالها المسوق تطوير و تقديم مجموعة ملائمة من الاتصالات المحفزة إلى مجموعة أو فئة مستهدفة على قصد إظهار رغباته في مجموعة من الاستجابات" [3]، و قد عرفها فيل كريس على أنها "العمليات الإدارية القائمة على حوار تفاعلي مع الجمهور المستهدف من خلال تنظيم و تطوير و تقييم سلسلة من الرسائل الموجهة نحو المجاميع المختلفة منهم باتجاه خلق مكانة ذهنية للمنظمة في أذهان الجمهور" [4]، و هذا التعريف يضم ثلاثة عناصر أساسية لعملية الاتصال التسويقي و هي: الحوار، المكانة الذهنية و الاستجابة.

أما عن أهداف عملية الاتصال التسويقي فيمكن حصرها في ثلاثة عناصر: [5]

**–أهداف إدراكية :**

و في هذا المجال يعمل الاتصال التسويقي على التعريف بالمنتوج و خصائصه و بوجوده إذا كان المنتوج جديد كما يعمل على التعريف بالمرسل في حد ذاته إذا كان الغرض من الحملة الاتصالية هو التعريف بالمؤسسة و علامتها التجارية.

**-الأهداف الحسية :**

و هنا العمل يركز على تقوية صورة المؤسسة أو المنتوج عند المستهلك بالتأثير عليه و جعله يغير ولاءه لعلامة المرسل على حساب العلامات المنافسة الأخرى.

**- أهداف السلوكية :**

أما الأهداف السلوكية للاتصال التسويقي تعمل على التغيير سلوك الجمهور المستهدف من خلال فهم أنماط الشراء لديه و العمل على تغييرها نحو السلع المروج لها بالاعتماد على نشاطات البيع الشخصي خاصة و تقديم العينات المجانية لتجريبها و التحفيز على الشراء الفعلي للمنتوج.

أما عن عناصر أو مزيج الاتصالات التسويقية فتتكون من خمس عناصر رئيسية و هي الاعلان، البيع الشخصي، تنشيط المبيعات، العلاقات العامة، التسويق المباشر، و تعتبر العناصر الثلاثة الاخيرة مدعمة و مكملة لكل من الاعلان و البيع الشخصي.

و عن كيفية بناء استراتيجية للاتصالات التسويقية على مستوى المؤسسة فيعتبر نموذج سوستاك –SOSTAC – من أهم المداخل و أشهرها حيث تمر عملية التخطيط للاتصال التسويقية عبر ستة مراحل: [6]

S –Situation Analysis - اين نحن الان

O –Objectives – ما الذي نريد ان نقوم به

S-Strategy – كيف يمكن ان نقوم بذلك

T-Tactics – تفاصيل الاستراتيجية

A-Action – وضع الخطة للعمل

C-Control – القياس، المراقبة، التعديل

و تضمن كل مرحلة الموارد التالية أو ما يعرف ب M3:

Men : و يقصد بها الموارد البشرية.

Money : الميزانية و الامكانات المالية المخصصة

Minutes : الوقت المتاح للعملية

و على العموم تمر عملية الاتصالات التسويقية عبر ستة مراحل أساسية و هي: تحديد أهداف الاتصال التسويقي، تحديد الجمهور المستهدف، تصميم الرسالة، اختيار وسيلة الاتصال، تحديد ميزانية الاتصال، و أخيرا تقييم فعالية الاتصال التسويقي.

كما تتأثر عملية الاتصال التسويقية بعدة عوامل و لعلى أهمها: الامكانات المالية المتاحة، طبيعة السوق، و كذا طبيعة المنتوج.

**ب- سلوك المستهلك:**

ان تحديد حاجات ورغبات المستهلكين الحاليين و المحتملين و العمل على تكييف اوضاع المؤسسة لتقديم المستوى الافضل من الاشباع لهذه الحاجات بفاعلية و كفاءة كبيرتين من اهم المهام الاساسية للمؤسسة اذا لم نقل انها هي المهمة الرئيسية التي نتجت عن زيادة الاهتمام بدراسة سلوك المستهلك وارتباطه بالمفهوم التسويقي الحديث، أما عن تعريف سلوك المستهلك فيعرفها إنجل جايمس على أنه "مجموعة التصرفات التي تصدر عن الافراد و المرتبطة بشراء واستعمال السلع الاقتصادية و الخدمات، بما في ذلك عملية اتخاذ القرارات التي تسبق وتحدد هذه التصرفات" [7]، لقد تطور حقل سلوك المستهلك كنظام تسويقي متكامل وذلك نتيجة اسباب كثيرة وعوامل عديدة اهمها مايلي: [8]

- قصر دورة حياة السلعة و الفشل الكبير في تسويق السلع وخاصة تلك التي تم انتاجها وتقديمها دون دراسات وافية لسلوك المستهلك، حيث ان الكثير من السلع سواء كانت معدلة او محسنة تم تطويرها دون مراعاة لحاجات و اذواق المستهلكين و امكانياتهم الشرائية مما قلل فرص تسويقها، والسلع التي تم تسويقه منها كان بتكاليف تسويقية عالية وهامش ربح قليل، الامر الذي ادى الى فشل خطط الكثير من المؤسسات التسويقية وذلك بسبب تراكم المخزون من السلع التي لم تلقى رواجا وكذلك بطلان الاستعمال.
- ان الكثير من السلع المقدمة للمستهلك كانت لها اضرار كبير وخاصة المنظفات الكيماوية و العبوات و المخلفات و النفايات وغيرها، ولهذا توجب القيام بالدراسات حول سلوك المستهلك وكل ما يهمه في مجال السلع، وبخاصة بعد ازدياد دور جمعيات حماية المستهلك في المراقبة الصارمة على السلع و الخدمات المقدمة او تنامي دور مؤسسات حماية البيئة في فرض شروطها على المنتجين بشكل عام، الامر الذي قلل من مساحة حرية الانتاج و التوزيع الى حد كبير.
- الدور الفعال لجمعيات حماية المستهلك و التي اخذت تمارس ضغوط كبيرة ومؤثرة على المنتجين و المسوقين، لذلك توجب على المسوقين الاهتمام بدراسة سلوك المستهلك وذلك بهدف انتاج وتقديم سلع او خدمات بالكميات و النوعية و الاسعار المناسبة.
- الاهتمام المتزايد للحكومات بالمستهلكين الذي اجبر المسوقين و الشركات المعنية الى التركيز على دراسات سلوك المستهلك بالشكل الذي ينسجم مع التعليمات و القوانيين الحكومية الصادرة لحماية المستهلك.
- تزايد اهمية قطاع الخدمات في حياة الفرد و الجماعة ادى الى تزايد عدد الخدمات وتنوعها مما اجبر الشركات المعنية الى اجراء الدراسات الوافية لامكانيات الشراء لدى المستهلكين في الاسواق المستهدفة، لان الحاجة الى الكثير من السلع و الخدمات المطروحة في الاسواق حاليا مؤقتة وغير متنامية.
- اهتمام المؤسسات غير الربحية في دراسات سلوك المستهلك نتيجة تشابك العوامل البيئية حول تلك المؤسسات وتطبيقها مفاهيم التسويق الحديث الامر الذي يجبرها ان تدلي بدلوها في دراسات سلوك المستهلك.
- الحاجة المتزايدة امام جميع الشركات العاملة بنجاح لدخول الاسواق الخارجية دفع بها الى اجراء دراسات دقيقة عن الاسواق المستهدفة بما في ذلك المستهلكين في تلك الاسواق حتى لا يكون الدخول فيها مجرد مغامرة فاشلة لتلك المؤسسات وبخاصة الجديدة منها في تلك الاسواق.

يتاثر السلوك الاستهلاكي و الشرائي بعدة عوامل، عوامل نفسية: تشمل كل من الدوافع، الادراك، التعلم و الاتجاهات، اما العوامل الشخصية فتتمثل في السن، الدخل، و نمط الحياة و الشخصية، و العوامل الاقتصادية تتمثل في الجماعات المرجعية، العائلة، المكانة الاجتماعية، اما العوامل الثقافية فهي الثقافة، الثقافة الجزئية.

و تمر عملية اتخاذ القرار الشرائي عبر ستة مراحل تبدأ بعملية تحديد الحاجة و الرغبة، ثم البحث عن المعلومات عن طريق مصادر داخلية تتمثل في المعلومات المخزنة التي إكتسبها الفرد مسبقا، كما يوجد نوع ثاني من مصادر المعلومات يتمثل في المصادر الخارجية و التي تتمثل في وسائل الاعلان، الاصدقاء و الاقارب...، أما المرحلة التالية تتمثل في تقييم البدائل المتاحة و تختلف معايير التقييم من فرد لاخر و كذا لطبيعة السلعة، أما المرحلة الرابعة فتتمثل في إختيار البديل الافضل و ذلك بناءا على المرحلة السابقة، أما المرحلة التالية فهي مرحلة الشراء فبعد تقييم البدائل و اختيار البديل المناسب يقوم الفرد بعملية الشراء، لتنتهي عملية اتخاذ القرار الشرائي بمرحلة شعور ما بعد الشراء و هي عبارة عن عملية تقييم لعملية الشراء و تنهي إما أن يكون الفرد راضيا عن عملية الشراء أو غير راضي.

## 2.2 الدراسات السابقة

**الدراسات باللغة العربية :**

- دراسة وقنوني باية ( 2008 ) : وكانت هذه الدراسة تحت عنوان " **أثر العلاقات العامة على سلوك المستهلك الجزائري** " وقد بينت هذه الدراسة وجود علاقة بين العلاقات العامة و سلوك المستهلك، حيث اكدت هذه الدراسة على تأثير وسائل العلاقات العامة على تكوين الاثر المعرفي و الوجداني للمستهلك وعلى صورة المنظمة التي تساهم في تكوين الاثر السلوكي.
- دراسة حلاسي هجيرة ( 2009 ) : ورغم ان هذه الدراسة لم تدرس أثر سياسات الاتصال التسويقي على سلوك المستهلك بل على مبيعات المؤسسة الاقتصادية حيث خلصت هذه الدراسة الى وجود تأثير لسياسات الاتصال التسويقي على مبيعات المؤسسة.
- دراسة نظام موسى سويدان ( 2006 ) : وكانت تحت عنوان " **تأثير الكلمة المنطوقة على القرار الشرائي للمستهلك من حيث اختياره وولائه لعلامة التجارية** "، وقد اجرى الباحث هذه الدراسة على 430 متسوق موزعين على 3 مراكز تجارية وقد خلص في بحثه الى ان تأثير الكلمة المنطوقة قد يكون قويا لدرجة قدرتها على تغيير رأي المستهلكين عن شراء منتج ما حتى لو كانوا في اخر مراحل عملية اتخاذ القرار الشرائي، تمثل الكلمة المنطوقة اعلان متحرك لصالح العلامة التجارية، تكمن مصداقية الكلمة المنطوقة من كونها خلاصة تجارب فعلية للمؤثرات الاجتماعية المختلفة التي يتعرض لها المستهلكون.
- دراسة هاني حامد الضمور، محمد تركي الشريدة ( 2008 ): وهدفت هذه الدراسة إلى التعرف الى مدى أهمية عناصر المزيج الترويجي في التأثير على قرارات المستهلك الأردني في استخدام خدمة الهواتف الخلوية في الأردن وكانت الدراسة تحت عنوان "**دراسة تأثير عناصر المزيج الترويجي على قرار**

**الشرائي للمستهلك الاردني"** وقد خلصت الدراسة الى ما يلي: أن تنشيط المبيعات هو العنصر الترويجي الأكثر تأثيرًا على قرار المستهلك في الاشتراك، وجود تأثير لعناصر المزيج الترويجي على قرار الاشتراك في خدمة الاتصال بالهاتف الخلوي عند اخذ جميع هذه العناصر معا، تعتمد أهمية تأثير المزيج الترويجي على قرار المستهلك في الاشتراك على عامل الدخل أكثر من بقية العوامل الديمغرافية الأخرى إلتي شملتها الدراسة مثل الجنس والعمر والمؤهل التعليمي والحالة الاجتماعية.

- دراسة عزالدين علي بوسنينة ( 2006 ): حملت هذه الدراسة عنوان **"أثر الإعلان التلفزيوني على السلوك الشرائي للمستهلكين الليبيين"** و كان هدف هذه الدراسة تحديد أثر الإعلانات التلفزيونية الصادرة في قنوات بث غير محلية على السلوك الشرائي للمستهلكين الليبيين، وقد خلصت هذه الدراسة الى: فضل المستهلكون الليبيون من سكان مدينة بنغازي الإعلان التلفزيوني عن غيرهِ من أنواع الإعلانات الأخرى، يؤثر الإعلان التلفزيوني بشكل إيجابي في توجيه السلوك الشرائي للمستهلكين الليبيين، ولكنه ليس تأثيرا قويا. و كان أثر الإعلان في استثارة الرغبة للشراء هو الأقوى، بينما لم يكن هناك أثر للإعلان عند الاستجابة السلوكية.
- دراسة مؤيد الحاج صالح ( 2010 ): هدف هذا البحث إلى دراسة أثر مواصفات المنتج والعوامل الشخصية والاجتماعية للمستهلك نحو الولاء للعلامة التجارية من خلال دراسة ميدانية لمشتري أجهزة الهاتف المحمول في مدينة دمشق وقد حملت هذه الدراسة عنوان **"أثر مواصفات المنتج والعوامل الشخصية والاجتماعية للمستهلك نحو الولاء للعلامة التجارية"** وقد خلصت الدراسة إلى وجود علاقة ارتباط متفاوتة بين مواصفات جهاز الهاتف المحمول والعوامل الشخصية من ناحية والولاء لعلامته التجارية من ناحية أخرى.

**الدراسات باللغة الاجنبية:**

- دراسة Karjaluto و leppaniemi (2005 ) : وحملت عنوان "

Factors influencing consumers' willingness to accept mobile advertising"حيث ارادا الباحثان دراسة العوامل المؤثرة على اختيار المستهلك الفنلندي للهاتف النقال الجديد والعوامل المؤثرة على قرار تغيير الهاتف النقال وقد خلصت الدراسة الى إن قرار شراء الهاتف النقال الجديد هو قرار شخصي إلا انه يوجد بعض العوامل العامة التي ترشد عملية اتخاذ القرار، كما كانت لهم العديد من الدراسات في نفس المجال.

- دراسة (2010) Sabbir Rahman , Ahasanul Hague , Mohd Ismail Sayyed Ahmed

وقد كانت هذه الدراسة في الجامعة الاسلامية الدولية في ماليزيا وقد ارادا الباحثون من خلال هذا البحث دراسة العوامل المؤثرة في اختيار نوع مزود خدمات الهاتف النقال في ماليزيا، حيث ركز الباحثون على جودة الخدمات، السعر، الخدمات المتوفرة، بالاضافة للترويج، وقد اثبت هذه الدراسة الى ان كل من السعر و جودة الخدمات هما العنصران المؤثران على قرار اختيار نوع المتعامل.

## 3 التحليل الاحصائي

تمت عملية التحليل الاحصائي باستخدام البرنامج الاحصائي للعلوم الاجتماعية SPSS، من خلال أدوات التحليل الوصفي مثل: الوسط الحسابي و الانحراف المعياري، و كذا بعض الاختبارات الاحصائية مثل اختبار معامل كرونباخ ألفا، كولموغروف سميرنوف، معامل الارتباط بيرسون، وكذا اختبار ستيودنت للتأكد من صحة فرضيات الدراسة.

- **الخصائص الديمغرافية**

يتم وصف الخصائص الديمغرافية من خلال قائمة الاحصاء الوصفي، بعد تفريغ الاستبيانات يتضح لنا أن 56.1 % من العينة المدروسة هم من الذكور اي 352 فرد، مقابل 43.9 % من الاناث اي مامجموعه 275 فرد، ان 7.2 % من العينة المدروسة تقل اعمارهم عن 20 سنة اي 45 فرد من مجموع 627 فرد محل الدراسة، كما ان عدد الافراد الدين تتراوح اعمارهم مابين 20 و 29 سنة يمثلون 40.2 % اي 252 فرد، كما ان 24.9 % من العينة المدروسة يتراوح اعمار افرادها مابين 30 و 39 سنة اي 156 فرد، وقد بلغ عدد افراد العينة الذين تتراوح اعمارهم ما بين 40 و 49 سنة 14.4 % اي وجود 90 فرد في حين باغ عدد الافراد الذين ينتمون لفئة العمرية من 50 الى 59 سنة 60 فرد اي 9.6 %، في حين ان 3.8 % من الافراد المدروسين يتجاوز اعمارهم 60 سنة اي وجود 24 فرد من مجموع 627، كما ان 47.2 % من عينة الدراسة دخلهم اقل من 15000 دينار جزائري اي 296 فرد، و 17.2 % اي 108 افراد يتراوح دخلهم مابين 15000 و 24999 دينار جزائري، في حين ان 19.3 % اي 121 فرد يتراوح دخلهم مابين 25000 الى 34999 دينار جزائري، و 9.6 % من عينة الدراسة يتراوح دخلهم مابين 35000 الى 44999 دينار جزائري، في حين ان هناك 3.8 % من افراد العينة اي 24 فرد يتراوح دخلهم مابين 45000 الى 54999 دينار جزائري، كما ان هناك 2.9 % من الافراد محل الدراسة اي 18 فرد يزيد دخلهم عن 55000 دينار جزائري، و من مجموع 627 فرد محل الدراسة يوجد 445 فرد ينتمون الى المتعامل اوراسكوم تيليكوم الجزائر اي مانسبته 71 % من الفئة المدروسة، كما ان هناك 51 فرد اي 8.1 % من الفئة المدروسة ينتمون الى المتعامل الوطنية للاتصالات الجزائر – نجمة، في حين ان هناك 20.9 % اي 131 فرد ينتمون للمتعامل الوطني موبيليس.

- **ثبات أداة القياس**

لقد قمنا بإختبار ثبات أداة القياس عن طريق اختبار معامل كرونباخ ألفا، حيث بلغت قيمتها 0.885 و هي قيمة مقبولة، حيث أن النسبة المقبولة في هذا النوع من الدراسات هي 0.60 أي 60%، أنظر الجدول رقم (1).

و لاختبار توزيع البيانات نستخدم اختبار كولموغروف سميرنوف Sample K-S، حيث بلغت قيمته 0.58 و هي أكبر من قيمة الدلالة المعتمدة في الدراسة و هي 0.05.

- **اختبار الفرضيات**

**الفرضية الرئيسية الاولى :**

H0 : لا يطبق متعاملي الهاتف النقال في الجزائر سياسات الاتصال التسويقي.

H1 : يطبق متعاملي الهاتف النقال في الجزائر سياسات الاتصال التسويقي.

تقوم الفرضية الرئيسية الاولى على مقارنة الوسط الحسابي للإجابات على مدى تطبيق متعاملي الهاتف النقال لسياسات الاتصال التسويقي مع الوسط الحسابي للاداة (3) على اساس مقياس ليكرت الخماسي المستخدم ، لاختبار هذه الفرضية نستخدم One-Sample T Test

تبين المخرجات - الجدول رقم (3)- ان الوسط الحسابي لإجابات العبارات المكونة لسياسات الاتصال التسويقي قد بلغ 3.5312 وبانحراف معياري قدره 0.40202 حيث ان قيمة t المحسوبة قد بلغت 33.086 و هي اعلى من قيمتها الجدولية البالغة 1.97 وبالتالي يمكننا رفض الفرضية الصفرية وقبول الفرضية البديلة القائلة بان متعاملي الهاتف النقال في الجزائر يطبقون سياسات الاتصال التسويقي و المتمثلة في المزيج الترويجي، ومما يؤيد هذا القرار ان مستوى الدلالة المحسوب هو 0.000 وهو اقل من 0.05 اي المستوى المعتمد لان اختبار الفرضية من طرف واحد.

**الفرضية الرئيسية الثانية:**

H0 : لايوجد تأثير ذو دلالة احصائية عند مستوى 0.05 % لاستراتيجيات الاتصال التسويقي عند اخذ عناصرها بشكل مجتمع على سلوك المستهلك الجزائري.

H1 : يوجد تأثير ذو دلالة احصائية عند مستوى 0.05 % بين استراتيجيات الاتصال التسويقي وبين سلوك المستهلك الجزائري.

لاختبار الفرضية الرئيسية الثانية وحيث ان كلا المتغيرين المستقل و التابع كميا فأننا نستخدم تحليل الانحدار الخطي بإدخال الاتصال التسويقي كمتغير مستقل و سلوك المستهلك كمتغير تابع.

يبين لنا الجدول رقم (4) ان قيمة الارتباط الثنائي كانت 0.567 كما بلغ معامل التحديد 0.321 ، مما يعني ان 32.1 % من التغير في سلوك المستهلك يعود الى سياسات الاتصال التسويقي.

وحيث ان قيمة F المحسوبة تساوي 295.813 وهي اكبر من قيمتها الجدولية البالغة 5.1 وبما ان مستوى الدلالة يساوي 0.000 وهو اقل من 0.05 اي مستوى الدلالة المعتمد، فاننا نرفض الفرضية الصفرية ونقبل الفرضية البديلة القائلة بوجود تأثير ذو دلالة احصائية عند مستوى 0.05 % بين استراتيجيات الاتصال التسويقي وبين سلوك المستهلك الجزائري.

و معادلة الانحدار الخطي بين سياسات الاتصال التسويقي و سلوك المستهلك كمايلي:

Y : 1.956+0.386MARCOM

علما بان Y تمثل المتغير التابع اي سلوك المستهلك، تمثل هذه المعادلة اثر سياسة الاتصال التسويقي على سلوك المستهلك الجزائري بواسطة المعامل (B) 0.386.

**الفرضية الرئيسية الثالثة:**

H0 : لا يوجد تأثير ذو دلالة احصائية عند مستوى 0.05 % لاستراتيجيات الاتصال التسويقي عند اخذ عناصرها بشكل منفرد على سلوك المستهلك الجزائري.

H1 : يوجد تأثير ذو دلالة احصائية عند مستوى 0.05 % لاستراتيجيات الاتصال التسويقي عند اخذ عناصرها بشكل منفرد على سلوك المستهلك الجزائري.

لاختبار هذه الفرضية نستخدم تحليل الانحدار الخطي و بادخال عناصر سياسات الاتصال التسويقي كمتغير مستقل و سلوك المستهلك كمتغير تابع.

**بالنسبة للإعلان:**

من الجدول رقم (5) ان قيمة معامل الارتباط الثنائي كانت 0.279 كما بلغ معامل التحديد 0.078، مما يعني ان 7.8 % من التغير في سلوك المستهلك الجزائري يعود الى عنصر الاعلان.

وحيث ان قيمة F المحسوبة هي 52.940 وهي اكبر من قيمتها الجدولية، و بما ان مستوى الدلالة يساوي صفر وهو اقل من المستوى المعتمد للدراسة، فأننا نرفض الفرضية الصفرية و نقبل الفرضية البديلة القائلة بوجود اثر دال احصائيا لعنصر الاعلان على سلوك المستهلك الجزائري.

معادلة الانحدار الخطي بين عنصر الاعلان وسلوك المستهلك الجزائري كمايلي:

Y : 2.683 + 0.169 PUB

**بالنسبة للبيع الشخصي:**

تبلغ قيمة معامل الارتباط الثنائي 0.511 كما بلغ معامل التحديد 0.261، مما يعني ان 26.1 % من التغير في سلوك المستهلك الجزائري يعود الى عنصر البيع الشخصي.

وحيث ان قيمة F المحسوبة هي 221.027 وهي اكبر من قيمتها الجدولية، وبما ان مستوى الدلالة يساوي صفر وهو اقل من المستوى المعتمد للدراسة، فاننا نرفض الفرضية الصفرية و نقبل الفرضية البديلة القائلة بوجود اثر دال احصائيا لعنصر البيع الشخصي على سلوك المستهلك الجزائري.

و معادلة الانحدار الخطي بين عنصر البيع الشخصي وسلوك المستهلك الجزائري كمايلي:

Y : 2.616 + 0.204 PES

**ترويج المبيعات:**

من الجدول رقم (5) يبين لنا ان قيمة معامل الارتباط الثنائي كانت 0.496، كما بلغ معامل التحديد 0.246، مما يعني ان 24.6 % من التغير في سلوك المستهلك الجزائري يعود الى عنصر ترويج المبيعات.

وحيث ان قيمة F المحسوبة هي 204.031 وهي اكبر من قيمتها الجدولية، وبما ان مستوى الدلالة يساوي صفر وهو اقل من المستوى المعتمد للدراسة، فإننا نرفض الفرضية الصفرية و نقبل الفرضية البديلة القائلة بوجود اثر دال احصائيا لعنصر ترويج المبيعات على سلوك المستهلك الجزائري.

و يمكن كتابة معادلة الانحدار الخطي بين عنصر ترويج المبيعات وسلوك المستهلك الجزائري كمايلي:

Y : 2.352 + 0.276 PRO

**الدعاية و العلاقات العامة:**

يبين لنا الجدول السابق ان قيمة معامل الارتباط الثنائي كانت 0.489، كما بلغ معامل التحديد 0.240، مما يعني ان 24 % من التغير في سلوك المستهلك الجزائري يعود الى عنصر الدعاية و العلاقات العامة.

وحيث ان قيمة F المحسوبة هي 204.031 وهي اكبر من قيمتها الجدولية، وبما ان مستوى الدلالة يساوي صفر وهو اقل من المستوى المعتمد للدراسة، فإننا نرفض الفرضية الصفرية و نقبل الفرضية البديلة القائلة بوجود اثر دال احصائيا لعنصر الدعاية والعلاقات العامة على سلوك المستهلك الجزائري.

و معادلة الانحدار الخطي بين عنصر الدعاية والعلاقات العامة وسلوك المستهلك الجزائري كمايلي:

Y : 2.382 + 0.270 PUBILCRELATION

**التسويق المباشر:**

قيمة معامل الارتباط الثنائي كان 0.384، كما بلغ معامل التحديد 0.147، مما يعني ان 14.7 % من التغير في سلوك المستهلك الجزائري يعود الى عنصر التسويق المباشر.

وحيث ان قيمة F المحسوبة هي 108.079 وهي اكبر من قيمتها الجدولية، وبما ان مستوى الدلالة يساوي صفر وهو اقل من المستوى المعتمد للدراسة، فإننا نرفض الفرضية الصفرية و نقبل الفرضية البديلة القائلة بوجود اثر دال احصائيا لعنصر التسويق المباشر على سلوك المستهلك الجزائري.

معادلة الانحدار الخطي بين عنصر التسويق المباشر وسلوك المستهلك الجزائري كمايلي:

Y : 2.729 + 0.180 DIRECTMAR

## 4 النتائج و التوصيات

بعد تحليل وتفسير البيانات توصلنا الى النتائج التالية :

- بينت الدراسة الميدانية ان سلوك مستخدمي الهاتف النقال من حيث قرار الاشتراك في خدمة الهاتف النقال و اختيار نوع المتعامل وكذا نوع الاشتراك ومعدل الاستخدام يتأثر بسياسات الاتصال التسويقية التي تستخدمها المؤسسة.
- وجود تأثير لكل عناصر سياسات الاتصال التسويقي على سلوك المستهلك في مجال خدمة الهاتف النقال حيث بينت الدراسة ان كل من البيع الشخصي و تنشيط المبيعات بالإضافة الى الدعاية و العلاقات العامة هم العناصر الترويجية الاكثر تأثير على سلوك المستخدم الجزائري للهاتف النقال.
- اما بالنسبة للمتعاملين فقد بينت الدراسة ان مشتركي كل من الوطنية للاتصالات الجزائر – نجمة – و اتصالات الجزائر –موبيليس – يتأثر سلوكهم من حيث اختيار نوع الاشتراك و معدل الاستخدام بسياسات الاتصال التسويقي اكبر من تأثير مشتركي المتعامل اوراسكوم تيليكوم الجزائر- جازي -.
- كما اظهرت الدراسة ان كل متعاملي الهاتف النقال في الجزائر يستخدمون سياسات ترويجية متكاملة حسب العينة المدروسة.
- يزداد تأثير سياسات الاتصال التسويقي عند اخذ كل عناصرها بشكل مجتمع على سلوك المشترك من حيث قرار الاشتراك و معدل الاستخدام.

**تحليل الفرضيات:**

**الفرضية الرئيسية الاولى:**

يقوم متعاملي الهاتف النقال في الجزائر باعتماد على سياسات الاتصال التسويقي.

**الفرضية الرئيسية الثانية:**

توجد فروق معنوية ذات دلالة احصائية عند مستوى 0.05 % بين سياسات الاتصال التسويقي عند اخذ عناصرها بشكل مجتمع وبين سلوك المستهلك الجزائري.

**الفرضية الرئيسية الثالثة:**

توجد فروق معنوية ذات دلالة احصائية عند مستوى 0.05 % بين سياسات الاتصال التسويقي عند اخذ عناصرها بشكل منفرد وبين سلوك المستهلك الجزائري.

**التوصيات:**

بناء على النتائج السابقة يمكن اقتراح التوصيات التالية:

- استخدام سياسة الاتصال التسويقي بهدف التأثير على سلوك المستهلك من حيث قرار الاشتراك في خدمة الهاتف النقال، كذلك اختيار نوع المتعامل ونوع الاشتراك وكذا معدل الاستخدام وذلك بالتركيز على البيع الشخصي و ترويج المبيعات و كذلك العلاقات العامة.
- التركيز على تطوير القوة البيعية وكذلك تدريبها و تكوينها وكذا تطوير العروض الترويجية لتشمل كافة الفئات.
- دعم عنصر العلاقات العامة من خلال رعاية الفرق و المنتخبات الوطنية ، ايضا رعاية التظاهرات الثقافية وكذا تقديمها للدعم المالي للجمعيات و المؤسسات الخيرية.
- التركيز على عامل الدخل وكذا الوظيفة خلال عملية تقسيم السوق.
- الاعتماد على الاعلان عن طريق المجلات و وسائل النقل، وتكثيف نقاط البيع و مراكز الخدمات، الاهتمام بالبيئة من خلال تنظيم حملات تطوعية، استخدام البريد المباشر وكذا البريد الالكتروني و التركيز على مواقع التعارف الاجتماعي.

## 5 خلاصة

تعتبر سياسة الاتصال التسويقية من الانشطة الهامة على مستوى المؤسسة توليها اهمية كبيرة لتحقيق اهدافها و تتكون عناصر الاتصال التسويقي من الاعلان، البيع الشخصي و تنشيط المبيعات، العلاقات العامة بالاضافة للتسويق المباشر و يجب على المؤسسة أن تراعي في اعدادها لحملتها الترويجية العديد من الخصائص مثل : الجمهور المستهدف، الوسيلة المستخدمة، الميزانية المخصصة للحملة ... الخ .

يعتبر دراسة سلوك المستهلك من اهم الدراسات التي تساعد المؤسسات نجاحها خاصة في ظل المنافسة و يتأثر سلوك المستهلك بالعديد من العوامل منها ما هو داخلي كالعوامل النفسية و الشخصية ومنها ما هو خارجي كالثقافة و العوامل الاجتماعية، كما تتأثر الاستجابة السلوكية للمستهلك بالعوامل الموقفية ويمر المستهلك عند اتخاذه القرار الشرائي عبر خمسة مراحل تبدأ بالتعرف على المشكلة ثم البحث عن المعلومات يليها المفاضلة بين الحلول المتاحة ثم اتخاذ قرار الشراء لتنتهي بسلوك مابعد الشراء.

يعتبر سوق الهاتف النقال من القطاعات الواعدة في الجزائر لوجود أكثر من 33 مليون مشترك، حيث يقوم متعاملي الهاتف النقال باعتماد على مزيج من العناصر في سياستها الاتصالية، كما تبرز الرعاية خاصة الرياضية و التنظيم المسابقات و الطمبولات والمشاركة في المعارض و الصالونات كوسائل للوصول الى الجمهور المستهدف.

كما يجب على المؤسسات أن تراعي جملة من العناصر لجعل سياستها التسويقية تحقق الاهداف المنوطة بها، من بين هذا النقاط:

- الاهتمام بدراسة سلوك المستهلك ومواقفه قبل اعداد الحملات الترويجية.
- تكثيف الانشطة الترويجية للمؤسسات وتنويعها خاصة عنصر التسويق المباشر.
- تقييم الانشطة الترويجية للمؤسسات لمعرفة اسباب نجاحها او فشلها ودراسة انشطة الاتصال التسويقي للمؤسسات للمنافسة.
- تطوير العروض البيعية واستحداث مغريات بيعية جديدة لزيادة معدلات الاستخدام.
- الاهتمام بعنصر العلاقات العامة خاصة لرسم صورة جيدة عن المنظمة سواء بالنسبة للجمهور او الموظفين.

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## الجداول

الجدول رقم (1) ثبات أداة القياس

| العينات | معامل كرونباخ ألفا |
|---|---|
| 627 | 0.885 |

الجدول رقم (2) المتوسط الحسابي و الانحراف المعياري لبعض عبارات الاستبيان

| العبارات | المتوسط الحسابي | الانحراف المعياري |
|---|---|---|
| تقوم المؤسسة في تقديمها رسالتها الاعلانية بالاعتماد على الجرائد اليومية | 4.21 | .648 |
| تستخدم المؤسسة أكثر من وسيلة اعلانية في اتصالها مع الزبون | 4.28 | .687 |
| تقوم المؤسسة بالإعلان عن طريق المجلات المتخصصة | 2.83 | 1.083 |
| تقوم المؤسسة بالإعلان في وسائل النقل . | 2.86 | 1.125 |
| تقوم المؤسسة بالإعلان عن طريق اللوحات الاشهارية على الطرق . | 4.22 | .730 |
| تقوم المؤسسة بالإعلان في التلفاز و الراديو | 4.52 | .688 |
| تقوم المؤسسة بالإعلان عن طريق الملصقات. | 3.76 | 1.042 |
| تعتبر مدة الرسالة الاعلانية كافية لإيصال الرسالة الى الزبون . | 3.41 | 1.077 |

الجدول رقم (3): إختبار صحة الفرضية الاولى

| | الوسط الحسابي | الانحراف المعياري | T المحسوبة | T الجدولية | مستوى الدلالة | النتيجة |
|---|---|---|---|---|---|---|
| الفرضية الاولى | 3.5312 | 0.402 | 33.086 | 1.97 | 0.00 | رفض |

الجدول رقم (4): إختبار صحة الفرضية الثانية

| | الارتباط الثنائي | معامل التحديد | F المحسوبة | F الجدولية | مستوى الدلالة | النتيجة |
|---|---|---|---|---|---|---|
| الفرضية الثانية | 0.567 | 0.312 | 295.81 | 5.1 | 0.00 | رفض |

الجدول رقم (5): إختبار صحة الفرضية الثالثة

| الفرضية الثالثة | الارتباط الثنائي | معامل التحديد | F المحسوبة | F الجدولية | مستوى الدلالة | النتيجة |
|---|---|---|---|---|---|---|
| الاعلان | 0.279 | 0.078 | 52.940 | 5.1 | 0.00 | رفض |
| البيع الشخصي | 0.511 | 0.261 | 221.027 | 5.1 | 0.00 | رفض |
| تنشيط المبيعات | 0.496 | 0.246 | 204.031 | 5.1 | 0.00 | رفض |
| العلاقات العامة | 0.489 | 0.240 | 204.031 | 5.1 | 0.00 | رفض |
| التسويق المباشر | 0.384 | 0.147 | 108.079 | 5.1 | 0.00 | رفض |

## الملاحق

**الجمهورية الجزائرية الديمقراطية الشعبية**
**وزارة التعليم العالي و البحث العلمي**

**الاستبيان :**
تحية طيبة وبعد،
تقوم دراستنا الموسومة "دراسة تاثير سياسة الاتصال التسويقي على سلوك المستهلك الجزائري" بمحاولة قياس تأثير سياسات الاتصال التسويقي على سلوك مستخدمي الهاتف النقال في الجزائر و لتحقيق هدف هذه الدراسة نعرض عليكم هذا الاستبيان المتضمن ثلاثة أجزاء،
لذا نرجوا من حضراتكم التكرم و الاجابة على الاسئلة الموجودة في هذه الاستبيان، كما اننا على ثقة تامة بان الموضوعية وصدق الاستجابة سوف يكون لها اثر عميق في الوصول الى نتائج اكثر دقة، ونوجه انتباهكم الى ان المعلومات التي ستدلون بها ستستخدم لاغراض البحث العلمي فقط .
**شاكرين لكم اهتمامكم ودعمكم للبحث العلمي**

**الجزء الاول : البيانات الشخصية :**

الرجاء وضع العلامة **(X)** في المكان المناسب :

1- **الجنس** :

ذكر ( ) انثى ( )

2- **العمر** :

أقل من 20 ( ) من 20 الى 29 ( ) من 30 الى 39 ( )
من 40 الى 49 ( ) من 50 الى 59 ( ) 60 ومافوق ( )

3- **الحالة الاجتماعية** :

أعزب ( ) متزوج ( ) أرمل ( ) مطلق ( )

4-**المستوى التعليمي** :

بدون مستوى ( ) أبتدائي ( ) متوسط ( ) ثانوي ( )
جامعي ( ) مابعد التدرج ( )

5-**المهنة** :

بطال ( ) عامل ( ) تاجر ( ) موظف ( )
طالب ( ) متقاعد ( ) اطار ( ) اعمال حرة ( )

6-**الدخل الشهري** :

أقل من 15000 دينار ( ) من 15000 الى 24999 دينار ( )
من 25000 الى 34999 دينار ( ) من 35000 الى 44999 دينار ( )
من 45000 الى 54999 دينار ( ) 55000 دينار ومافوق ( )

7-**نوع المتعامل** :

جازي ( ) نجمة ( ) موبيليس ( )
اذا كنت تتعامل مع أكثر من متعامل حدد ايهما تعتمد عليه أكثر : .....

8- **نوع الاشتراك** :

الدفع المسبق prépayée ( ) الدفع المؤجل postpayée ( )

**الجزء الثاني : سياسات الاتصال التسويقي**

يرجئ وضع العلامة **(x)** في المربع الذي يتفق مع رأيك وذلك أمام كل عبارة من العبارات التالية :

| **الاعلان** | **موافق تماما** | **موافق** | **محايد** | **غير موافق** | **غير موافق على الاطلاق** |
|---|---|---|---|---|---|
| تقوم المؤسسة في تقديمها رسالتها الاعلانية بالاعتماد على الجرائد اليومية | | | | | |
| تستخدم المؤسسة أكثر من وسيلة اعلانية في اتصالها مع الزبون | | | | | |
| تقوم المؤسسة بالإعلان عن طريق المجلات المتخصصة . | | | | | |
| تقوم المؤسسة بالإعلان في وسائل النقل . | | | | | |
| تقوم المؤسسة بالإعلان عن طريق اللوحات الاشهارية على الطرق . | | | | | |
| تقوم المؤسسة بالإعلان في التلفاز و الراديو | | | | | |
| تقوم المؤسسة بالإعلان عن طريق الملصقات. | | | | | |
| تعتبر مدة الرسالة الاعلانية كافية لإيصال الرسالة الى الزبون. | | | | | |
| انتشار وتكرار الرسالة الاعلانية يسمح لي بفهمها و استيعاب مضمونها | | | | | |
| تقدم المؤسسة رسالتها الاعلانية في اوقات مختلفة وبشكل مناسب | | | | | |
| الاعلان المستخدم من طرف المؤسسة سهل الفهم . | | | | | |
| تقوم المؤسسة في تقديمها للاعلان بجعل جودة الخدمة في قمة اهتمامات وادراكات الذهنية للزبون . | | | | | |
| تتميز الرسالة الاعلانية للمؤسسة بالجودة العالية في التصميم و الاخراج | | | | | |
| تشجعني المؤسسة من خلال الاعلان على تبني الخدمة وخلق تفضيلات لدي نحوها | | | | | |
| **البيع الشخصي** | **موافق تماما** | **موافق** | **محايد** | **غير موافق** | **غيرموافق على الاطلاق** |
| تعتمد المؤسسة على نقاط البيع في اتصالاتها معي . | | | | | |
| رجال البيع لديهم مؤهلات ومستوى تعليمي مناسب مع المهام البيعية . | | | | | |
| يتميز رجال البيع التابعيين للمؤسسة بحسن المظهر و الشخصية الواضحة . | | | | | |
| نقاط البيع التابعة للمؤسسة تغطي مختلف المناطق الجغرافية . | | | | | |
| رجال البيع ذوي كفاءة مهنية عالية . | | | | | |
| رجال البيع يقومون بالمجهودات الكافية لايصال المعلومة لي . | | | | | |
| لدى رجال البيع القدرة على فهم احتياجات ومتطلبات الزبون بسهولة . | | | | | |
| يقدم رجال البيع المساعدة و الخدمات المتنوعة للزبون في مجال اداء الخدمة . | | | | | |
| لدى رجال البيع التابعيين للمؤسسة القدرة على التحفيز و الاقناع . | | | | | |
| **ترويج المبيعات** | **موافق تماما** | **موافق** | **محايد** | **غير موافق** | **غير موافق على الاطلاق** |
| تشجعني المؤسسة على تكرار التعامل معها . | | | | | |
| تشجعني المؤسسة للحصول على خدمات جديدة من خلال العروض الترويجية . | | | | | |
| تقوم المؤسسة بتقديم جوائز لي نتيجة استمراري بالتعامل معها . | | | | | |
| تعتمد المؤسسة على المسابقات وسحوب اليانصيب من اجل تشجيعي على التعامل معها . | | | | | |
| تقدم المؤسسة عروض واغراءات سعرية مناسبة . | | | | | |
| تقدم المؤسسة حزمة من العروض الترويجية تناسب | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| الجميع . | | | | | |
| تقوم المؤسسة ببناء علاقات مع الافراد الذين لايتعاملون معها لتحفيزهم على التعامل معهم مستقبلا | | | | | |
| عروض المؤسسة التي اتعامل معها افضل من عروض الشركات المنافسة الاخرى . | | | | | |
| الفترة الزمنية التي تستغرقها العروض الترويجية كافية | | | | | |
| تقدم المؤسسة عروض ترويجية في المواسم و الاعياد | | | | | |
| تقوم المؤسسة بحجز اجنحة داخل المعارض من اجل التعريف بخدماتها . | | | | | |
| **الدعاية و العلاقات العامة** | **موافق تماما** | **موافق** | **محايد** | **غير موافق** | **غير موافق على الاطلاق** |
| لدى المؤسسة توجه قوي للقيام بالاعمال الخيرية | | | | | |
| تقوم المؤسسة برعاية التظاهرات الثقافية و الاجتماعية . | | | | | |
| تقوم المؤسسة برعاية مختلف الفرق الرياضية الوطنية و المنافسات الرياضية . | | | | | |
| تتلقى المؤسسة الانتقادات وتدرس الشكاوي بكل مودة وترحاب . | | | | | |
| تهتم المؤسسة بالبيئة و المحيط . | | | | | |
| تقوم المؤسسة باستطلاع اراء جمهورها واخذها بعين الاعتبار . | | | | | |
| تحاول المؤسسة رسم صورة ايجابية للمؤسسة لدى المجتمع المدني . | | | | | |
| تقوم المؤسسة بالترويج و التوضيح الدقيق للمسؤولية الاجتماعية للمؤسسة . | | | | | |
| تقوم المؤسسة بالحيلولة دون حدوث عدم فهم في العلاقة بين المؤسسة و جمهورها . | | | | | |
| تتمتع المؤسسة بسمعة جيدة نتيجة تداول احاديث ايجابية عنها من طرف زبائنها . | | | | | |
| **التسويق المباشر** | **موافق تماما** | **موافق** | **محايد** | **غير موافق** | **غير موافق على الاطلاق** |
| تستخدم المؤسسة الموقع الالكتروني في تزويد زبائنها بالمعلومات | | | | | |
| الموقع الالكتروني للمؤسسة مناسب من حيث التصميم و الولوج اليه | | | | | |
| تقوم المؤسسة بالاتصال عبر الهاتف مع زبائنها من اجل الاجابة على الاستفسارات | | | | | |
| تستخدم المؤسسة البريد المباشر للمراسلة معي . | | | | | |
| تقدم المؤسسة كتالوجات عن مختلف خدماتها المطروحة في السوق | | | | | |
| تقوم المؤسسة بالرد عن استفسارات الزبون عن طريق البريد الالكتروني | | | | | |
| تستخدم المؤسسة الرسائل القصيرة في اعلامي بالجديد. | | | | | |

**الجزء الثالث : سلوك المستهلك الجزائري**

يرجئ وضع العلامة **(x)** في المربع الذي يتفق مع رأيك وذلك أمام كل عبارة من العبارات التالية :

| **عبارات سلوك المستهلك الجزائري** | **موافق تماما** | **موافق** | **محايد** | **غير موافق** | **غير موافق على الاطلاق** |
|---|---|---|---|---|---|
| اقبل الاشتراك في خدمة الاتصالات الخليوية مقابل دفع رسوم محددة | | | | | |
| اقوم بدفع مبلغ ذات تعرفة محددة مقابل الاستفادة من خدمات الاتصالات الهاتف المحمول | | | | | |
| ان الاشتراك في خدمة الهاتف النقال مهم وضروري جدا | | | | | |
| ان المؤسسة التي اتعامل معها هي الاحسن الموجودة في السوق | | | | | |
| ان المؤسسة الذي اتعامل معها تقدم خدمات جيدة | | | | | |
| تولي المؤسسة لزبونها اهتمام خاص | | | | | |
| تتمتع المؤسسة بسمعة وصورة جيدة | | | | | |
| ان العروض التي تقدمها المؤسسة احسن من منافسيها . | | | | | |
| اخترت الدفع المسبق لانه يلائم طبيعة وضعيتي الحالية | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| اخترت الدفع الموجل لانه الانسب وطبيعة وضعيتي الحالية | | | | | |
| اخترت الدفع المسيق لانه يلائم ودخلي الحالي | | | | | |
| اخترت الدفع المؤجل لانه يلائم ودخلي . | | | | | |
| قيمة الفتورة الشهرية او مايعادلها من بطاقات الشحن التي ادفعها مرتفع جدا . | | | | | |
| قيمة الفاتورة الشهرية او مايعادلها من بطاقات الشحن التي ادفعها مرتفع . | | | | | |
| قيمة الفاتورة الشهرية او مايعادلها من بطاقات الشحن التي ادفعها متوسط . | | | | | |
| قيمة الفاتورة الشهرية او مايعادلها من بطاقات الشحن التي ادفعها منخفضة . | | | | | |
| قيمة الفاتورة الشهرية او مايعادلها من بطاقات الشحن التي ادفعها منخفضة جدا . | | | | | |
| معدل استخدامي للهاتف النقال يكون بصفة ثابتة | | | | | |
| معدل استخدامي الهاتف النقال غير ثابت المستوى . | | | | | |

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# القروض والتمويل وعلاقتهما بالتنمية: دراسة مقارنة بين البنوك التقليدية والإسلامية

# [ Loans, financing and development of their relationship: A Comparative Study Between conventional and Islamic banks ]

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**ABSTRACT:** The aim of this study was to clarify the difference between the areas of investment for both conventional and Islamic banks and their relationship to development, despite the short period in which they fought Islamic banks nascent but it provided an excellent example to receive the funds, and employment recruitment legitimate and legal, to ensure the rights of depositors and does not harm investors and users of these funds, as well as on the grounds of economic development, and social priorities of men and women, grants or prevention of the financing and investment of funds, which are needed to accommodate the expansionist policy of the money flowing to and employ optimum.

**KEYWORDS:** Loans, relationship, comparative study, conventional banks, Islamic banks.

**ملخص:** تهدف هذه الدراسة إلى توضيح الفرق بين المجالات الاستثمارية لكل من البنوك التقليدية والسلامية وعلاقتهما بالتنمية، ورغم قصر الفترة التي خاضتها البنوك الإسلامية الوليدة إلا أنها قدمت نموذجاً رائعاً في استقبال الأموال، وتوظيفها التوظيف الشرعي والقانوني، بما يضمن حقوق المودعين ولا يضر بالمستثمرين والمنتفعين بهذه الأموال، علاوة على اعتبار التنمية الاقتصادية، والاجتماعية من أولويات ومسلمات المنح أو المنع للتمويل وتوظيف الأموال، التي هي بحاجة إلى سياسة توسعية لاستيعاب الأموال المتدفقة إليها وتوظيفها التوظيف الأمثل.

**كلمات دلالية:** مجال الاستثمار، أدوات الاستثمار، التنمية الشاملة، الأنشطة التشغيلية، الأنشطة التمويلية.

### 1.1 مدخل

قبل البدء بمجالات الاستثمار التي تستثمر فيها البنوك الإسلامية والتقليدية وتوظف أموالها، كان علينا أن نعرج على تعريف الاستثمار بشكل أوضح أولاً، ثم التميز بين مجال الاستثمار، وأداة الاستثمار لكليهما.

### 1.2 فيعرف الاستثمار لغةً

كما جاء في لسان العرب[i]: " الثمر حمـــل الشجـــر، والثمر أنواع المال، والثمر الذهب والفضة قال تعالى: { وَكَانَ لَهُ ثَمَرٌ فَقَالَ لِصَاحِبِهِ وَهُوَ يُحَاوِرُهُ أَنَا أَكْثَرُ مِنْكَ مَالًا وَأَعَزُّ نَفَرًا } [الكهف: 34] قال مجاهد: ما كان في القرآن من (ثـَمر) بالفتح فهو مال، وما كان من( ثُـمر) بالضم فهو من ثماره، وثمر ماله: نماه ويقال ثمر الله مالك: أي كثره

### 1.3 الاستثمار في الاقتصاد الوضعي

هو التخلي عن أموال يمتلكها الفرد في لحظة زمنية معينة ولفترة من الزمن بقصد الحصول على تدفقات مالية مستقبلية تعويضية عن القيمة الحالية للأموال المستثمرة، وكذلك عن النقص المتوقع في قيمتها الشرائية بفعل عامل التضخم وذلك مع توفير عائد معقول مقابل تحمل المخاطر المتمثلة باحتمال عدم تحقق هذه التدفقات. [ii]

### 1.4 الاستثمار في الاقتصاد الإسلامي:

إن الاستثمار" نشاط إنساني إيجابي مستمد من الشريعة الإسلامية ويؤدي إلى تدعيم وتحقيق النظام الاقتصادي، ومن خلال الأولويات الإسلامية التي يعكسها واقع الأمة الإسلامية. "[iii]

وخلاصة ما سبق: لتعريفات الاستثمار أن الاستثمار هو: طلب نماء المال وتثميره وبعد تعريف الاستثمار نتحول إلى ما هو الفرق بين مجال الاستثمار، وأداة الاستثمار؟

**1.5 فمجال الاستثمار هو:**

ذلك النشاط الذي يرغب المستثمر أن يستثمر أمواله فيه بغرض تحقيق عائد، فإن وظف مستثمرٌ أمواله في استثمارات محلية؛ بينما يوظف آخر أمواله في استثمارات أجنبية، فإن تفكيرنا ينصب حول مجال الاستثمار، بينما لو وظف مستثمرٌ أمواله في سوق العقار، والآخر في سوق الأوراق المالية، فإن تفكيرنا سينصب نحو أداة الاستثمار.[iv]

**2.1 مشكلة الدراسة**

تتمثل مشكلة الدراسة في التساؤل التالي: هل مجالات التمويل والاقراض الاستثمارية التي يسلكها البنكان " التقليدي والإسلامي " تخدم العمليات التنموية والاقتصادية؟

**2.2 فرضية الدراسة**

وعلى ضوء الإشكالية نفترض أن عمليات التمويل في البنوك الإسلامية تتميز بمعايير ذات جودة وسلامه عالية وتتمتع بدرجة عالية من الكفاءة الاقتصادية تستطيع دعم ورفد التنمية على كل المستويات.

**2.3 أهمية الدراسة**

على ضوء الاشكالية المطروحة والفرضية القائمة فتكمن أهمية الدراسة في محاولة إبراز دور البنوك ومؤسسات التمويل الإسلامية والجهات ذات العلاقة ومساهمتها في مجال التنمية، لاسيما المناهج التمويلية الحديثة التي تقوم علي المساهمة في الأرباح والخسائر.

**3 المبحث الأول: البنوك التقليدية**

تمثل عمليات الإقراض النشاط الأكثر جاذبية للبنوك التقليدية كونها المصدر الرئيسي لربحيتها، ولذا تتنوع أنشطة هذه البنوك وتتوجه نحو مجالات عددية لأنها تحتل مركزاً مهما في الأسواق المالية والنقدية ومن هذه المجالات:

**3.1.1 القروض الموجهة لتمويل نشاطات الاستغلال**

هي النشاطات التي تقوم بها المؤسسات خلال دورة الاستغلال، وفي الغالب تتكرر هذه النشاطات باستمرار في المواسم، وأثناء عملية الإنتاج ومن أمثلتها: التموين، الإنتاج، التخزين، التوزيع...

وهي تنقسم إلى:

**3.2.1 قروض لتمويل الأصول المتداولة ومن هذه الأصول:**

**ضمانات على البضائع**: تقدم لتمويل مخزون معين والحصول مقابل ذلك على بضائع كضمان للمقرض.

**ضمانات على الصفقات العمومية:** وهي عبارة عن اتفاقات للشراء أو تنفيذ أشغال لصالح الجهات العمومية من جهة والمقاولين والموردين من جهة أخرى والتي منها:

**الخصم التجاري**: تتمثل عملية الخصم التجاري في قيام البنك بشراء الورقة التجارية من حاملها قبل تاريخ الاستحقاق فيقوم البنك بإعطاء سيولة لصاحب الورقة قبل أن يحين أجلها وتعتبر عملية الخصم قرضا باعتبار أنه يعطي مالا لحاملها وينظر تاريخ الاستحقاق لتحصيل هذا الدين.

**الضمان الاحتياطي:** هو عبارة عن تعهد من قبل البنك لضمان القروض الناجمة عن خصم الأوراق التجارية.

**الكفالة:** هي عبارة عن التزام مكتوب من طرف البنك يتعهد بموجبه تسديد الدين الموجود على عاتق العميل.

**3.2.2 قروض تشغيل**

وهي قروض موجهة لتخفيف صعوبات السيولة المؤقتة أو القصيرة الناتجة عن تأخر الإيرادات عن النفقات حيث يتم اللجوء إلى مثل هذه القروض في فترات معينة كنهاية الشهر، ويقوم البنك بحساب أجر هذا التسهيل على أساس الاستعمال الفعلي له، وعلى أساس المدة الزمنية الفعلية.

3.2.3 **القروض المقدمة للأفراد:**

وهي ذات طابع شخصي بشكل عام، هدفها تمويل العقارات للاستهلاك الخاص بالأفراد دون استعمال النقود، وتوجد أيضا القروض الشخصية التي تقدم عادة للأشخاص ذوى الدخول الثابتة ويتناسب مبلغها مع الدخل الشهري. [v]

**3.1.2 القروض الموجهة لتمويل نشاطات الاستثمار**

**فأنشطة الاستثمار:** هي: تلك العمليات التي تقوم بها المؤسسات لفترات طويلة وتهدف إلى الحصول على وسائل الإنتاج، أو عقارات مثل الأراضي والمباني الصناعية والتجارية والإدارية. [vi]

**أما التمويل الاستثماري** هو: الائتمان الذي يمنح للمشروع سواء في صورة نقدية أو تعاقدية لتمويل استثماراته في الأصول الثابتة، أو الإنتاجية، أو القدر الثابت

من رأس المال العامل اللازم لتشغيل المشروع. [vii]

**الائتمان الايجاري** هو: عبارة عن عملية يقوم بموجبها البنك أو المؤسسة بتوكيل شركة تأجير مؤهلة لذلك قانوناً بوضع آلات، أو معدات، أو أصول مادية أخرى بحوزة مؤسسة مستعمِلة على سبيل الإيجار، مع إمكانية التنازل عنها نهاية المدة المتعاقد عليها ويتم التسديد على أقساط يتفق، بشأنها تسمى ثمن الإيجار. [viii]

### 3.1.3 الأدوات المالية

هناك العديد من الأدوات المالية التي يمكن للبنك أن يصدرها ومنها:

**الأسهم** وهي: عبارة عن ورقة مالية تثبت امتلاك حاملها لجزء من رأس مال المؤسسة مع الاستفادة من كل الحقوق وتحمل كل الالتزامات التي تنتج عن امتلاك هذه الورقة.

**السندات** وهي: عبارة عن ورقة مالية تثبت دائنية حاملها للمؤسسة التي أصدرتها، فالسند هو عبارة عن إثبات لعملية قرض، هذا ويستفيد حامل السند من فائدة ثابتة بغض النظر عما إذا كانت الشركة أو المؤسسة حققت ربحا أو خسارة. [ix]

### 3.1.4 القروض الموجهة للتجارة الخارجية

مثل التطور الهائل لانتشار التجارة الخارجية وتوسعها على نطاق كبير من العالم ضرورة ملحة لإيجاد آليات تضمن بقاءها واستمرارها للطرفين، استدعى ذلك وجود وسيط أو طرف ثالث يحفظ للمستورد والمصدر حقوقهما، ويؤمن إجراء التبادل بشكل مستمر، ويضمن الوفاء بالتزامات جميع الأطراف فكان البنك هو الوسيط وهذه بعض الوسائط التي يجريها:

**الاعتمادات المستندية** وهي: عبارة عن تعهد مكتوب يصدره البنك المصدر للاعتماد، أو البنك فاتح الاعتماد بناءً على طلب أحد المستوردين من عملائه، ووفقاً لتعليماته ويسمي معطى الأمر، لصالح شخص آخر يسمى المستفيد بأن يدفع له مبلغاً من النقود وبالعملة المتفق عليها خلال فترة محددة، مقابل تقديم مستندات معينة ومحددة في عقد فتح الاعتماد ذاته. [x]

**التحصيل المستندي** وهو: أمر يصدره البائع إلى البنك الذي يتعامل معه لتحصيل مبلغ معين من المشتري مقابل تسلمه مستندات شحن البضاعة المباعة إليه، ويتم السداد إما نقداً أو مقابل توقيع المشتري على كمبيالة، وعلى البنك تنفيذ العملية.

**التحويل الحر** وهي: عملية قائمة على أساس الثقة بين المستورد المحلي وممونه الأجنبي، حيث يرسل الثاني المنتجات إلى الأول، ووظيفة البنك هنا هي تحويل الأموال فقط.

**التوطين المصرفي** وهو: إجراء يقوم به البنك التجاري باعتماد البنك المركزي لأصل زبائنه من مستوردين ومصدرين بقصد توطيد العلاقة التجارية بينهم وبين المتعاملين من الموردين وكذلك تسهيل وتبسيط عملية الدفع والقبض بينهم، وتشمل عملية التوطين التنسيق لتمويل عملية الاستيراد. [xi]

### 3.1.5 المجالات الحديثة في التمويل

حاولت البنوك جاهدةً لإغراء عملائها بوسائل شتى للحفاظ عليهم، واستقطاب عملاء آخرين للولوج في أبوابها، وذلك عبر ابتكار وسائل جديدة لتقديم الخدمات المتعلقة بأعمالهم ساعية بذلك إلى ترشيد المصروفات، وإنجاز الأعمال بأقرب وقت وأقل جهد ومن تلك الخدمات: [xii]

- إدارة الأعمال وممتلكات العملاء وتقديم الاستشارات الاقتصادية والمالية لهم مثل: إعداد الدراسات المالية المطلوبة للمتعاملين معه عند إنشاء مشروعاتهم، ويتم على أساس هذه الدراسات تحديد الحجم الأمثل للتمويل المطلوب في الشراء والإنتاج والبيع والتحصيل.
- تمويل الإسكان الشخصي من خلال الإقراض العقاري، ومن الجدير بالذكر أن لكل بنك تجاري سقف محدد للإقراض في هذا المجال يجب أن لا يتجاوزه.
- البطاقة الائتمانية: تعد أشهر الخدمات البنكية الحديثة التي استحدثتها البنوك التجارية وتتلخص في منح الأفراد بطاقات من البلاستيك تحتوي على معلومات عن اسم المتعامل ورقم حسابه.
- خدمات الكمبيوتر: أخذت البنوك تستخدم العقول الإلكترونية مما يسمح لها بتقديم هذه الخدمات للبنوك، فقد تقوم البنوك بتزويد المتعاملين معها بكشوف موحدة شاملة؛ تبين أوضاعهم كما يعرفها البنك، وتزودهم بكشوف تبين الضرائب المترتبة على إيراداتهم وتراقب الموجودات بخزائنهم.
- تحويل العملة إلى الخارج.
- تحويل النفقات والسفر.
- التحصيل والدفع نيابة عن الغير.
- المساهمة في تمويل مشروعات التنمية.

**4 وثائق الجدول**

فكما أن مجالات الاستثمار تختلف فإن أدواته تختلف أيضاً وعليه: يمكن تبويب مجالات الاستثمار على النحو التالي في الجدول

**4.1.1** جدول مجالات الاستثمار وأدواته

| م | الباب | التصنيف |
|---|---|---|
| 1 | مجالات الاستثمار | صناعية |
| 2 | | تجارية |
| 3 | | زراعية |
| 4 | | خدمية – صحة تعليم ... |
| 5 | | بنية تحتية: طرق، صرف، صحي، كهرباء... |
| 6 | | اجتماعية |
| 1 | جهة الاستثمار | فردي |
| 2 | | شركات ومؤسسات |
| 3 | | حكومي |
| 4 | | اجنبي |
| 1 | رأس المال | عيني ( سلع ، معدات ، آلات .. |
| 2 | | نقدي ( سيولة نقدية |
| 3 | | مالي( اوراق مالية سندات، اسهم ... |
| 1 | هدف الاستثمار | استبدالي ( تجديد ، تحديث |
| 2 | | توسعي |
| 3 | | جديد ( خطوط انتاج جديدة |
| 1 | مدة الاستثمار | قصير المدى |
| 2 | | طويل المدى |
| 3 | | متوسط المدى |
| 4 | | استراتيجي |
| 1 | المعيار الجغرافي | استثمار محلي |
| 2 | | استثمار دولي |
| 1 | نوع الاصل | استثمار حقيقي |
| 2 | | استثماري مالي |

المصدر: شوام بوشامة، تقييم واختيار الاستثمارات، دار العرب للنشر والتوزيع، بيروت – 1999م – ص 30 بتصـــــرف

**5 المبحث الثاني: البنوك الإسلامية**

والآن نشرع في مجالات التمويل في البنوك الإسلامية

**5.1.1 مجال الخدمات المصرفية**

تقوم البنوك الإسلامية بالعديد من الخدمات المصرفية التي تيسر للمتعاملين معها إجراءاتهم المالية المتعلقة بالبنك، وخدمة لعملائها نظير أجر متفق عليه على ضوء الضوابط، والتكيفات الشرعية والتي منها:

**خطابات الضمان**: هي تعهد كتابي يتعهد البنك بموجبة بكفالة أحد عملائه (طالب الخطاب) في حدود مبلغ معين لدى طرف ثالث عن التزام ملقى على عاتق المكفول، وذلك ضماناً لوفاء العميل بالتزامه تجاه الطرف الثالث؛ خلال مدة من الزمن معينة وينص عادة في الخطاب على أن يدفع البنك المبلغ المضمون عند أول طلب من الطرف الثالث يرد خلا ل مدة سريان خطاب الضمان، رغم معارضة العميل إن اعترض. [xiii]

**التحويلات المصرفية**: هي عملية تحويل الأموال داخليا وخارجيا، وبين البنوك والمصارف أجنبية ومحلية وصرف العملات كما تقوم بهذه الأعمال كوكيل تتقاضى أجر الوكالة حسب كل عملية.

**عملية الاكتتاب في الأسهم**: تقوم البنوك الإسلامية في هذه العملية بدور الوسيط في عملية الاكتتاب الخاص بالشركات والمؤسسات التي تفتح باب الاكتتاب. ويكون البنك في حالة قيامة بإصدار الأسهم وكيلا عن الشركة، ويمكن له أخذ الأجر والعمولة نظير عمله الذى وكلته الشركة فيه. [xiv]

- **تأجير الخزائن الحديدة:** تقوم البنوك الإسلامية بتأجير الخزائن الحديدة لعملائها لغرض حفظ الوثائق والمستندات والمقتنيات المختلفة... وبحسب الحجم والمدة يتقاضى البنك أجر مقابل هذه الخدمة.
- **فتح الاعتمادات المستندية**
- **تحصيل وخصم الأوراق المالية**

### 5.1.2 القطاعات الاستثمارية

- **المجال الصناعي**

تستهدف البنوك الإسلامية المجال الصناعي في استثماراتها كونه ركيزة أساسية في إنعاش الاقتصاديات المحلية، وتوفير فرص العمل، والعمل على الاكتفاء الذاتي على المنهج الإسلامي في التنمية، وذلك عبر صيغ التمويل الإسلامية كالمشاركة والمضاربة، وال استصناع، والسلم و...

- **المجال الزراعي**

تولى البنوك الإسلامية المجال الزراعي اهتماماً في توظيف أموالها، واستثمار الطاقات البشرية العاملة، وإحياء الأرض، والاستفادة من خيرها وتحقيق الاكتفاء الذاتي خاصة من المواد الأساسية كالقمح، والأرز، والسكر... عبر صيغ التمويل المختلفة كالسلم، والمرابحة، وغيرها.

### 5.1.3 المجال الخدمي

تهدف البنوك الإسلامية إلى تحقيق التنمية الشاملة عبر استهداف جميع المجالات التنموية، خاصة المتعلقة بأساسيات الحياة والتطور... حيث تعد الصحة والتعليم من أكثر المجالات التي لها أهمية في تحقيق النمو البشري، ومن ذلك المستشفيات والمؤسسات التعليمية بالتمويل اللازم لسد احتياجاتها وتلبية طلباتها حيث تؤدي رسالتها بيسر وسهولة، ومهنية عالية.

### 5.1.4المجال الاجتماعي

تقوم أساسيات المنهج الإسلامي على العمل عل الاكتفاء الذاتي للإنسان واعتماده على النفس، كافيا من حوله من المجتمع شر الإعالة ومذلة الناس، فتقوم البنوك بتمويل المشاريع الصغير والتمويل الأصغر لمختلف المهن والحرف التي يستطيع أفراد المجتمع مزاولتها غير أنهم لا يستطيعون شراء الأدوات والمعدات البسيطة التي تمكنهم من القيام بمزواله ما يجيدونه من حرف ومهن عبر مؤسسات التمويل الأصغر التابعة لفروع البنوك.

### 5.1.5 البنية التحتية

تعمل البنوك الإسلامية جاهدة من خلال تمويل مشاريع البنية التحتية بالأموال اللازمة لتحقيق نهضة عمرانية؛ تقوم على استكمال البنية التحتية لمختلف المشاريع الخدمية كالطرق، والكهرباء، وشبكة الصرف الصحي عبر صيغ تمويل المضاربة والمشاركة، والمرابحة، والإجارة المنتهية بالتمليك ...

## 6 المبحث الثالث: العلاقة بالتنمية

من خلال النتائج المحققة لكلا من عمليات القروض في البنوك التقليدية، وصيغ التمويل في البنوك الاسلامية والأثار المترتبة على تنفيذها يمكن قياس علاقتها بالتنمية.

وأثناء استهدافها القطاعات الاقتصادية المتعددة، ومجالات الاستثمار المتنوعة سوف تظهر مؤشرات ونتائج يمكن الحكم من خلالها على مدى ارتباط مخرجاتها بمجالات التنمية المختلفة من عدمه.

وعلى سبيل المثال إذا أخذنا التدفقات النقدية والتي تشمل "الأنشطة التمويلية، والاستثمارية، والتشغيلية" في البنوك اليمنية لعامي 2007-2009 كمقارنة بين البنك اليمني للإنشاء والتعمير والبنك التجاري اليمني كبنوك تقليدية وبنك سبأ الاسلامي كبنك إسلامي على ضوء التقارير السنوية للقوائم المالية التي تظهر حسب الجدول

**4.1.2** جدول يوضح نسب التدفقات النقدية لأنشطة البنوك

| البنك | بنك سبأ | | | البنك اليمني | | | البنك التجاري | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| سنة الدراسة | 2007 | 2009 | النسبة | 2007 | 2009 | النسبة | 2007 | 2009 | النسبة | المتوسط |
| الانشطة التمويلية | 57% | 21% | 39% | 3% | 31% | 17% | 6% | 0% | 3% | 22% |
| الانشطة الاستثمارية | 39% | 62% | 51% | 6% | 29% | 18% | 2% | 2% | 2% | 26% |
| الانشطة التشغيلية | 4% | 17% | 11% | 91% | 40% | 66% | 92% | 92% | 95% | 52% |

المصدر: من إعداد الباحث من واقع القوائم المالية للبنوك الخاضعة للبحث

ومن خلال الجدول فإنه يعكس المؤشرات التالية للتدفقات النقدية للبنوك

1. تشكل الأنشطة التشغيلية من إجمالي التدفقات النقدية للبنوك الخاضعة للمقارنة ما نسبته 57% توزعت كالتالي: البنك التجاري 55% والبنك اليمني 38% وسبأ 7%. تشير مؤشرات التدفقات التشغيلية إلى اتجاه البنكين التجاري واليمني نحوها أكثر من غيرها بينما يفضل بنك سبأ الاتجاه نحو القطاع الاستثماري والتمويلي حسب الجدول الذي يوضح نسب التدفقات النقدية لأنشطة البنوك.
2. تشكل التدفقات النقدية من الأنشطة التمويلية للبنوك الخاضعة للبحث نسبة 20% من إجمالي التدفقات النقدية بنك سبأ66% والبنك اليمني 29% البنك التجاري 5%.وبناءً عليه فالاتجاه التصاعدي لبنك سبأ 66% مقابل 29% للبنك اليمني و5% للبنك التجاري.

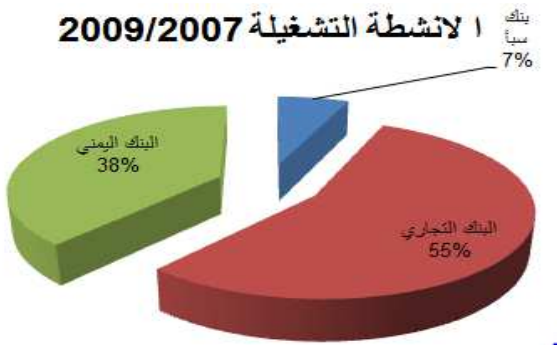
3. تشكل التدفقات النقدية من الأنشطة الاستثمارية نسبة 23.66% من إجمالي التدفقات النقدية للبنوك حيث كان نصيب بنك سبأ 72% والبنك التجاري 25% والبنك اليمني 3%. الاتجاه التصاعدي لبنك سبأ بنسبة 72% مقابل الاتجاه الهبوطي للبنك اليمني والبنك التجاري.

خلاصة ما سبق:

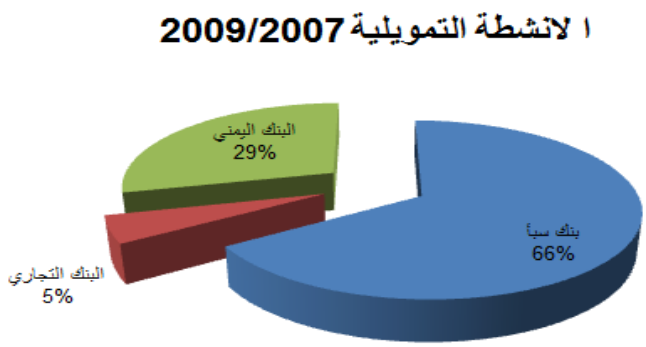
من التدفقات النقدية للبنوك الخاضعة للبحث الاتجاه المتصاعد لبنك سبأ في التدفقات النقدية من الانشطة التمويلية والاستثمارية مقابل الاتجاه الهبوطي للبنك اليمني والبنك التجاري والاتجاه التصاعدي للبنكين في التدفقات التشغيلية.

ولعل الرسوم المساحية التالية توضح النتائج بشكل أوضح

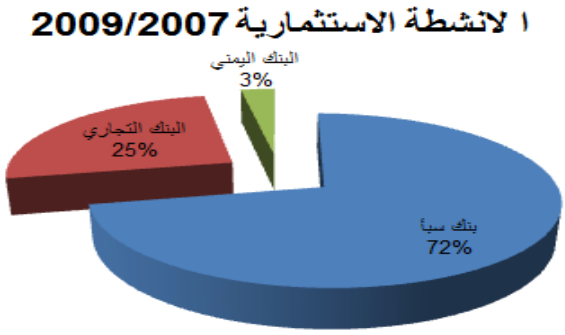
**6 وثائق الرسوم المساحية**




*رسم مساحي يوضح الانشطة الشغيلة*




*رسم مساحي يوضح الانشطة التمويلية للبنوك الخاضعة للبحث*




*رسم مساحي يوضح الانشطة الاستثمارية للبنك الخاضعة للبحث*

**7 النتائج**

وبناءً على ما سبق من نتائج المقارنة فإن لصيغ التمويل في البنوك الإسلامية مؤشرات للتنمية تظهر أثناء تطبيقها كالتالي:

**7.1.1 مؤشرات ونتائج تطبيق صيغ المضاربة :**

- الحصول على الموارد المالية، وتوفير السيولة النقدية.
- توجيه أموال الودائع الاستثمارية والادخارية، وتوظيف الفائض المالي.
- إمداد المضاربين والمستثمرين بالأموال اللازمة لتنفيذ أعمالهم وتجاوز عجز السيولة.
- تسهيل تسيل الاستثمار في المضاربة عبر بيع صكوك المضاربة.

**7.1.2 مؤشرات ونتائج تطبيق صيغ المشاركة:**

- الابتعاد عن مشكلات القروض وآثارها السلبية في سعر الفائدة والضمانات وتأخير سداد القروض.
- تحقيق الأرباح، وتقوية قدرات البنك والطرف المشارك، ونقل الخبرات بينهما.
- توزيع المخاطر، والمسؤولية كلا بقدره توزيعا عادلا.
- تمويل المشروعات المنتجة للدخل المنظم؛ كالمنشآت الزراعية، والصناعية والمستشفيات، والمؤسسات التعليمية.
- وتحقيق الاكتفاء للمشاركين بانتهاء ملكية هذه المشاريع لهم دون الولوج في مشكلات الفائدة وسعرها، وتسديد الأقساط المرهقة.

**7.1.3 مؤشرات ونتائج تطبيق صيغ التمويل التأجيري:**

- القدرة على تسيل الأصول الثابتة، وتوفير سيولة مستمرة، والمساعدة في امتصاص المدخرات والودائع. [xv]
- السماح بتوسيع النشاط للمستأجر، مع تحسين سيولة، والمساعدة في استقلاليته المالية.
- العائد المناسب، والمنتظم، والمعقول للمؤجر بخلاف سعر الفائدة.
- يلبي الحاجات الضرورية للمجتمع والمؤسسات، ويرفد ويساعد الطاقات البشرية والأيدي الماهرة.

**7.1.4 مؤشرات ونتائج تطبيق صيغ ال استصناع:**

- فتح أسواق جديدة للمنتجات المحلية، وتحقيق الاكتفاء الذاتي، والاستقرار.
- توفير مختلف السلع الانتاجية والاستهلاكية، إضافة إلى تصدير المنتجات وحيازة العملة الأجنبية.
- تقليل المخاطر المتعلقة بالتمويلات البنكية، ومخاطر القروض.

**7.1.5 مؤشرات ونتائج تطبيق البيع بالتقسيط :**

- تمكن المؤسسات الصغيرة من شراء المواد الخام مع ما يتناسب ووضعها المالي.
- التخلص من عقود الإذعان التي تحتوي عليها سعر الفائدة، والانتفاع بالسلع عن طريق التراضي بين الطرفين.
- تمكين أصحاب الدخول المحدودة من تملك الأشياء بالوضع الطبيعي الميسر حسب إمكانياتهم وقدراتهم من خلال مدة التقسيط وحجمه.

**7.1.5 مؤشرات ونتائج تطبيق صيغ المرابحة:**

- تنشيط حركة البيع والشراء في السوق المحلية من خلال توفير احتياجات قطاع التجارة الداخلية والخارجية، والمساهمة في دوران النشاط الاقتصادي من خلال رفع حجم الطلب الكلي.
- دعم الكفاءات الإنتاجية للاقتصاد الوطني من خلال توفير مستلزمات الإنتاج من المواد الخام، والمعدات والسلع، والأدوات، والأجهزة ...
- تنمية الاقتصاد الوطني من خلال توفير وسائل الإنتاج وتصريف المنتجات ودعم النشاط الاستثماري للمؤسسات الصغيرة والمتوسطة.[xvi]

**7.1.6 مؤشرات ونتائج تطبيق صيغ السلم:**

- تحسين الإنتاج وتوفير المحصول الزراعي من خلال تغطية نفقات الدورة الإنتاجية من شراء مستلزمات الإنتاج، والآت...
- تمويل القطاع الصناعي بتوفير المواد الأولية للمصانع مقابل الحصول علي جزء من منتجاتهم، ثم بيعها بهامش ربح، وتمويل الحرفين، وأصحاب المهن والصناعات الصغيرة.
- تغطية عجز ميزان المدفوعات من خلال رفع حصيلة الصادرات في تمويل التجارة الخارجية، وتوفير الديون وتحميل أعباءها في حالة الاستيراد.[xvii]

**7.1.7 مؤشرات ونتائج تطبيق القرض الحسن**

- توظيف طاقات الشباب المعطلة وحل أزماتهم النفسية، والاجتماعية، والمالية وذلك بمساعدتهم في تحمل أعباء الزواج، والسكن، والتعليم وتحويلهم إلى طاقات منتجيه.
- تنشيط المشاريع المتعثرة والمعطلة بسب العجز المالي، أو زيادة التكاليف.
- تطبيق أهداف والمبادئ السامية للشرع الإسلامي الحنيف من الرفق والتعاون والتكامل بين أفراده.
- تعظيم قيمة الإنسان من خلال تمكينه وإمداده بوسائل العيش والحياة والاستفادة من طاقاته وقدراته وتوظيفها للنهوض بعمارة الأرض واستغلال مواردها.
- تفعيل مبدأ وقاعدة لكي "لا يكون دولة بين الأغنياء منكم" حيث يتم كسر حلقة الاكتناز، والعمل على دوران المال بين كل أفراد المجتمع لتثميره وزيادة نماءه.

**8 خلاصة الدراسة**

يظهر الفرق والتميز بين مجالي القروض والتمويل بين كلا من البنوك التقليدية والإسلامية بشكل مبدئ أيهما أكثر نفعاً وتيسرا للعمليات التمويلية والاستثمارية للمشاريع سواء على مستوى الفرد أو المؤسسة أو الدولة إلا أن ثمة فرق جوهري وهو مبدأ التخصص والتنوع حيث يتمثل هذا المبدأ في أنه كلما كان العمل في مجال معين أكثر تخصصا وتنوعا كلما زادت منفعته وتعظمت قيمته، وكان المجتمع أكثر إنتاجية ومن ثم يزيد الدخل للأفراد ويرتفع.

وعلى هذا فإننا سنجد في الصيغ التمويلية الإسلامية المختلفة متسعاً ومتنفساً لاستيعاب أكثر المجالات الاستثمارية من خلال الصيغ التمويلية المختلفة والمتعددة التي تستوعب كل طاقات ونشاطات ومهارات أفراد المجتمع وطموحاتهم المهنية والحرفية كالمضاربة، والمرابحة، والمشاركة، والسلم، وال استصناع، والمزارعة والمساقاة ونحوها...

إلا أننا في المقابل سنجد التمويلات في البنوك التقليدية تقتصر على الإمداد بالمال فقط وبشكل قروض وسلفيات دون غيرها من الوسائل والصيغ كالتي شاهدناها في التمويلات الإسلامية.

حيث أن رفاهية المجتمع لا تتثمل بكثرة النقود وتوافرها بقدر ما تتمثل بتوفر السلع والخدمات وتنوعها وكلما كان الاقتصاد أكثر تقدما كلما كانت السلع والخدمات أكثر تنوعا وتعددا، فالتخصص يستلزم التنوع ومن ثم يزدهر الاقتصاد.

والله ولى التوفيق والهداية

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# EXPERIMENTAL STUDY TO THE EFFECT OF GURNEY FLAP ON THE CLARK Y-14 AIRFOIL WING MODEL

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**ABSTRACT:** An experimental wind tunnel investigation was undertaken to determine the effect of Gurney flap on the aerodynamic characteristics of Clark y-14 airfoil wing at a Reynolds number of $2.1x10^5$. The heights of plain flap change from (1.19% C) to (5.60% C).In addition the (5.60% C) was serrated to different heights and configurations. The Gurney flap improve performance of Clark y-14 airfoil wing compare with clean wing, the results show that the most beneficial Gurney flap is (1.19% C) which increase maximum lift to drag ratio to (5.31%) compared with clean wing. The serrated Gurney flap tend to be increase lift to drag ratio significantly, the rectangular serrated Gurney flap provides the best performance among the serrated Gurney flaps by improve lift to drag ratio to (42.8%).

**KEYWORDS:** Rectangular wing, Gurney flap, lift enhancement, wind tunnel tests, lift to drag ratio.

## 1 INTRODUCTION

Lift increase is necessary in order to climb to the cruise altitude at take-off and to be able to fly at the necessary low maneuver speeds in case of landing .While a rise in lift for the wings is easily obtained by increasing the angle of attack, the necessary lift improvement to obtain maximum performance of the aircraft is unrealizable without the use of high lift systems [1]. The Gurney flap is a vertical tab added to the trailing edge on the pressure side of a wing. Car racer "Dan Gurney" is credited as the inventor in the early 1970s [2], this flap was never tested until Gurney's aerodynamicist introduced it to Robert Liebeck [3], who tested it in the wind-tunnel.

The direct effect of Gurney flap on lift and drag were demonstrated by other experimental studies and it was found that the improvement in aerodynamic performance diminishes rapidly by increased flap height [4]. Gurney flaps work by separating flow near the trailing edge, inducing vortices that work to turn the flow. In doing so, pressure is decreased on the suction side and increased on the pressure side. This results in an increase in $C_{Lmax}$ of the airfoil and a shift in the zero lift angle of attack [5]. , pressure and velocity measurement on airfoil surface as well as PIV (particle image velocimetry) measurement and die-injection flow visualization has been carried out by various researchers. Instantaneous flow patterns around the G.F. show a wake containing an alternatively shed Karman vortex sheet. The time averaged velocity profile concluded that the wake downstream the flap consisting of a rotating vortices is turned downwards Fig. 1 [6].

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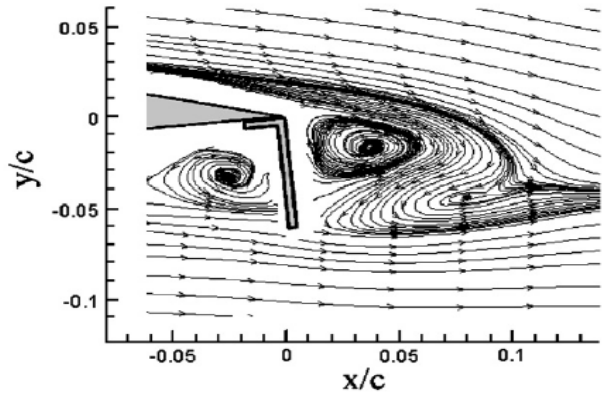


**Fig. 1. Time-averaged streamlines with 6% C G.F. at α=2.5° [6].**

The effect on drag that a Gurney flap exerts is largely dependent on the size of the flap. A Gurney flap of 5% can actually increase the lift to drag ratio, while increasing the size has a progressively higher drag penalty. [7]. D. R. Troolin et al [8] study a NACA 0015 airfoil with and without Gurney flap through time-resolved PIV Two distinct vortex shedding modes were found to exist and interact in the wake downstream of flapped airfoils. The dominant mode resembles a Kàrmàn vortex street shedding behind an asymmetric bluff body. The second mode, which was caused by the intermittent shedding of fluid recirculating in the cavity upstream of the flap.

Michael A. Cavanaugh et al. [9] conducted a Wind Tunnel Test of Gurney Flaps and T-Strips on an NACA 23012 Wing Results showed that Gurney flaps produced an increment in lift coefficient, a negative shift in the zero-lift angle of attack, T strips produced an increase in the slope of the lift curve and an increase in maximum lift coefficient, Gurney flaps produced a negative (nose-down) shift in the pitching moment. Lee T. Su [10] investigated the impact of Gurney flaps of different heights on the flap surface on the aerodynamic and wake characteristics of a NACA 0015 airfoil. The results shows that the addition of the Gurney flap to the produced a further increase in the downward turning of the mean flow (increased aft camber), leading to a significant increase in the lift, drag, and pitching moment.

The present work aimed to conduct an experimental study of full scale cambered rectangular wing Clark y-14 is to evaluate the aerodynamics characteristics of clean and flapped airfoil for different Gurney flap height ranged from (1.19% C to 5.65% C) and different serration depth on (5.6% C) mounted on the pressure side of the airfoil at different AOA ranged from ($-8^{o}$ to $18^{o}$).

## 2 MATERIALS AND METHODS

The experimental works were performed at The AEROLAB Educational Wind Tunnel (EWT) at power laboratory of Alnahrain University. The Tunnel is of Open Circuit test section, maximum speed is in excess of (64.8 m/s). Its contraction ratio of 8.3:1 and low turbulence level of 0.12% (average turbulence based on measurements taken at 13 different speeds) [11]. The tests were conducted at speed equal to 35.7 m/s Corresponding to Reynolds numbers of $0.21x10^{6}$, the clean and flapped wing model were tested at different angels of attack (α) ranged from ($-8^{o}$) to ($18^{o}$).

The wing model used was a rectangular wing of a Clark y-14 airfoil Fig. 2, the wing section manufactured from steel and had a maximum thickness of 14 % chord. And an aspect ratio (AR) of 2.77, the wing model used has 25cm span and 9cm chord. Model is mounted in the EWT by fastening it to the sting force Balance. The model positioning system (MPS) is a series of parallel arms mounted to a gearbox. The sting balance mounts to the top of the MPS vertical arms and provides a perfect perch for models. The model positioning systems allows for pitch angle adjustment from approximately +20° to -20°.

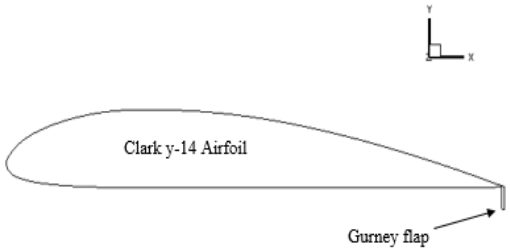


**Fig. 2. Airfoil profile**

The EWT system is provided with electronic instrumentation which consists of three-component sting Force balance. In order to take measurements, these instruments require the provided data acquisition (DAC) system of LABVIEW software**.** The Gurney flap for different heights and different configurations Fig. 3. was manufactured based on the airfoil cord length with constant thickness of 1.19% of cord length which equal to (1mm) the plain Gurney flap have different heights of (1.1.9, 2.3, 3.34, 4.44 and 5.6 percent of cord length) which equal to (1mm, 2mm, 3mm, 4mm, 5mm) respectively **.** The serrated Gurney flap was also based on airfoil cord length, the 5.6% C (5mm) Gurney flap was serrated, the serration came into three shapes**,** the triangular shape which has two heights (2.87, 3.9 %C) which equal to 2.5 mm and 3.5 mm respectively, rectangular shape of 3.9 % C (3.5 mm) and Semicircular shape which has radius of 1.95 %C (1.75 mm). Fig. 4. Shows the wing with Gurney flap inside test section.

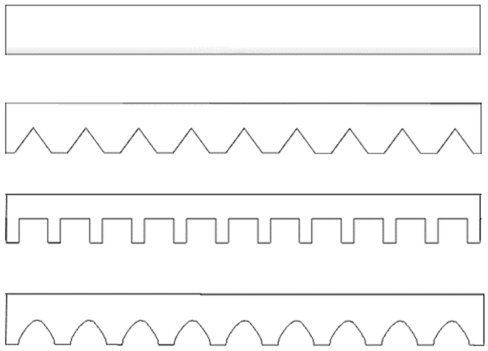

**Fig. 3. different Gurney flap configurations**

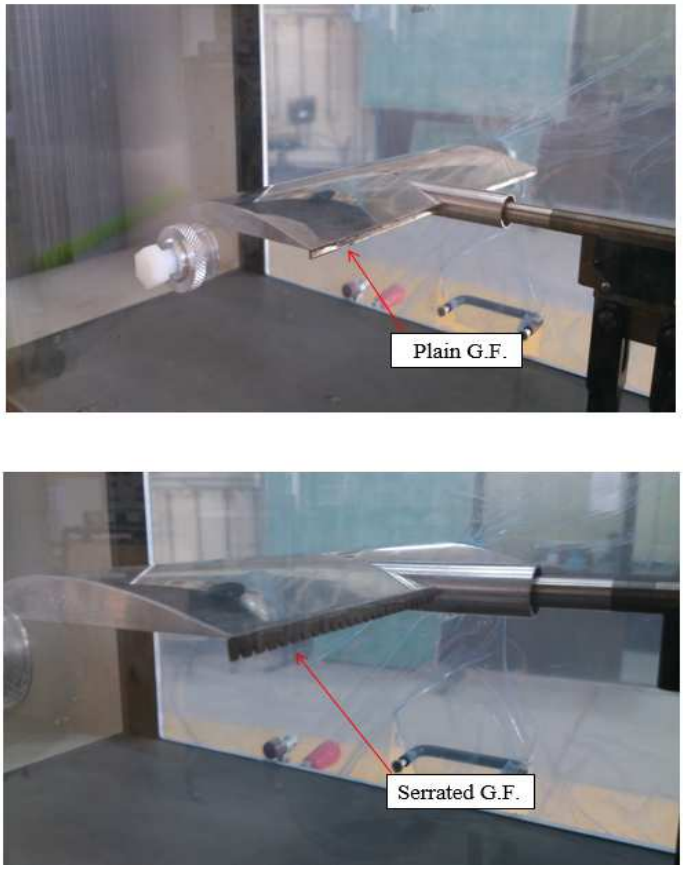


**Fig. 4. Gurney flaps**

## 3 RESULTS AND DISCUTION

Plain Gurney flap increase the lift coefficient of Clark y-14 airfoil wing section compared with clean wing as in Fig. 5 Which shows lift coefficient against angle of attack, these results indicate that Gurney flap increase the effective camber of the wing. Table 1. shows the percent increase of maximum lift coefficient, stalling angle for all plain Gurney flap heights. The increase in lift obtained with Gurney flap comes at the price of increased drag as shown in Fig. 6, where the Gurney flaps produce more drag than the clean wing, the drag is greater with the larger-size Gurney flap, table 2 show the percent of experimental drag increase at all heights of Gurney flap. Figure 7 show the drag polar for all cases of plain Gurney flap heights it is clearly that Gurney flap shift the polar to the right for low and moderate lift coefficient except the 1mm G.F. where it shift the polar to the right because of it is have lower drag coefficient than other G.F. heights. Figure 8 show the lift coefficient to drag coefficient ratio versus angle of attack, it is show that 1mm G.F. has better efficiency than clean wing and other heights of Gurney flaps, the increase in the maximum lift coefficient to drag coefficient ratio by (5.31%) at angle of attack ($\alpha$=1) compared with clean wing.

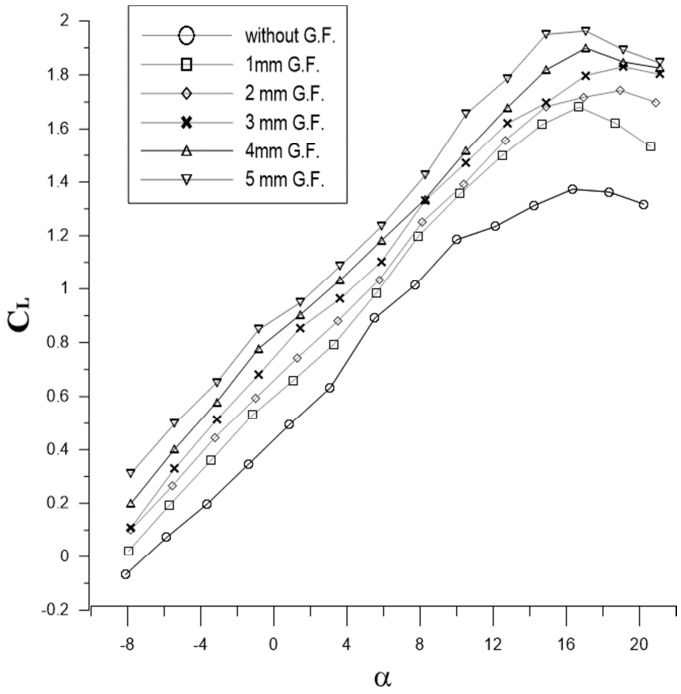


**Fig. 5. Lift coefficient ($C_L$) versus angle of attack (α) for plain G.F.**

**Table 1. Percent increase in the experimental maximum lift coefficient and the stall angle and zero lift angle of attack.**

| G.F. heights | without | 1mmG.F. | 2mm G.F. | 3mm G.F. | 4mm G.F. | 5mm G.F. |
|---|---|---|---|---|---|---|
| % Increase of maximum lift coefficient | - | 22.62 | 24.81 | 30.65 | 37.95 | 43.06 |
| Stall angle | 16 | 17 | 18 | 19 | 17 | 17 |

**Table (2): percent increase in the maximum drag coefficient**

| G.F. heights | 1mm G.F. | 2mm G.F. | 3mm G.F. | 4mm G.F. | 5mm G.F. |
|---|---|---|---|---|---|
| % Increase of maximum drag coefficient | 15.3 | 57.9 | 73.5 | 84.6 | 88.46 |

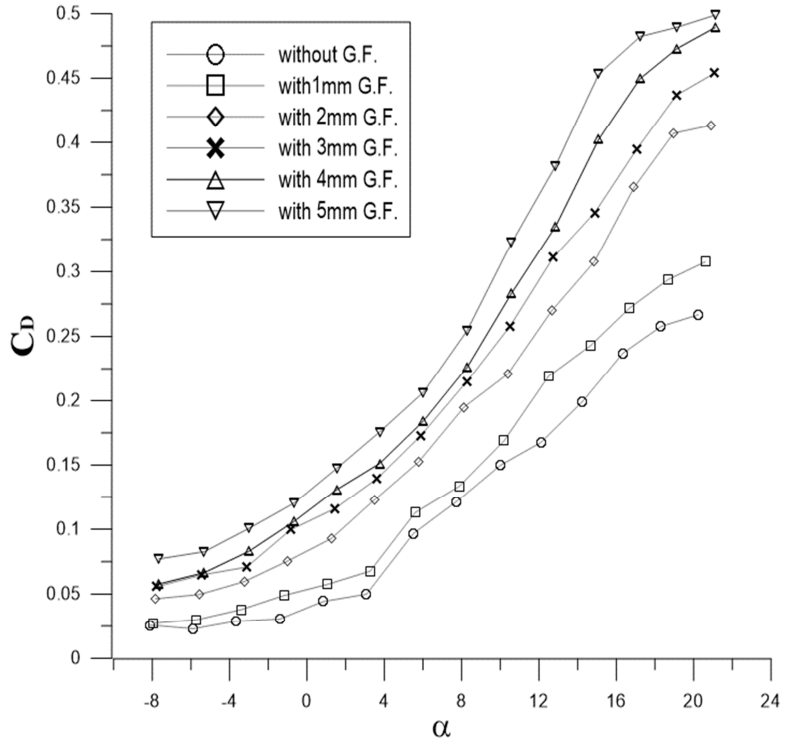


**Fig. 6. Drag coefficient ($C_D$) versus angle of attack (α) for plain G.F.**

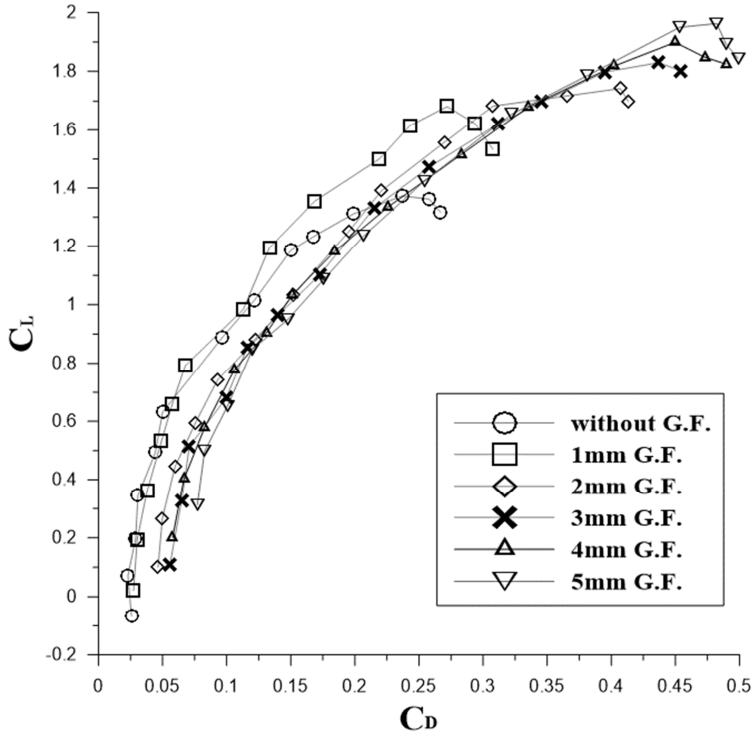


**Fig. 7. Lift coefficient ($C_L$) versus Drag coefficient ($C_D$) for plain G.F.**

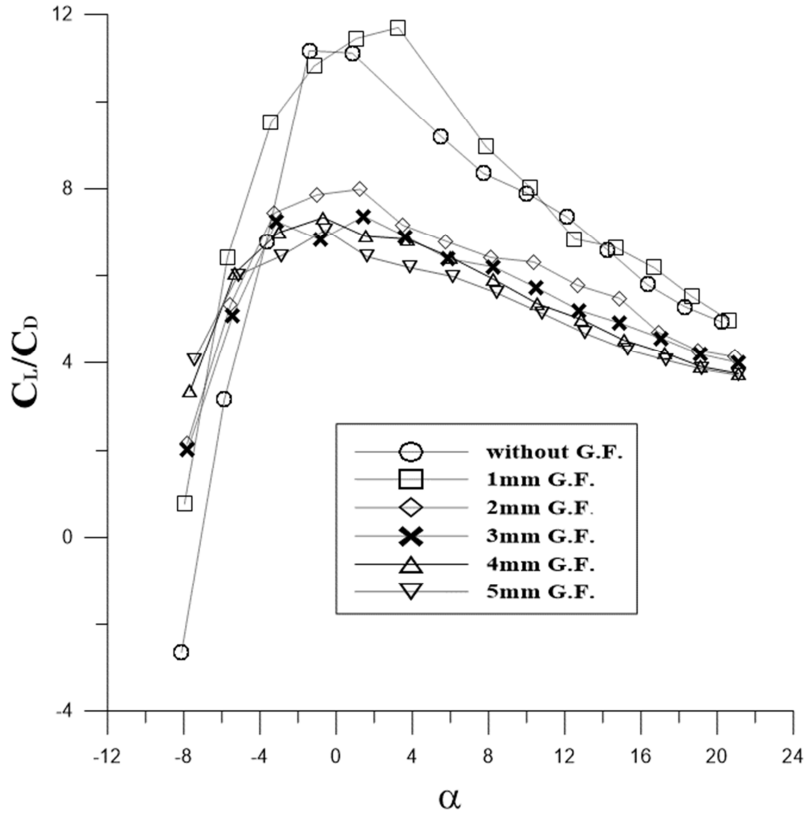


**Fig. 8. Ratio of Lift coefficient to drag coefficient ($C_L/C_D$) versus angle of attack (α) for plain G.F**.

After review of the plain Gurney flap results it can be clearly show there is an increase in the drag of the plain Gurney flaps proportional with the increase in the Gurney flaps height, the 5mm G.F. has drag higher than other flaps then this flap serrated for width of 2.5mm and 3.5mm in triangular shape with the aim of making drag reduction. Both serrated flap reduce the lift coefficient gained by the 5mm plain flap as in Fig. 9 which shows the lift coefficient against angle of attack for 5mm G.F. and the two triangular serrated Gurney flaps (T.S.G.F.), the 2.5mm serrated G.F. reduce the maximum lift coefficient by (6.63%) experimentally, the 3.5mm serrated G.F. have a (8.51) of reduction. The serration make a remarkable reduction in the drag coefficient as in Fig. 10 Which shows the drag coefficient against angle of attack for 5mm G.F. and the two serrated flap. The 2.5 mm serrated G.F. decrease the drag coefficient by (5%), the 3.5 mm serrated G.F. decrease the drag coefficient by (7.9%). Figure 11 shows lift coefficient against drag coefficient, the figure shows that serrated Gurney flaps shift the polar to the left especially at low and moderate lift coefficient because it reduce the drag coefficient. The 2.5mm and 3.5mm serrated G.F. improve the efficiency of 5mm plain Gurney flaps as in Fig. 12 Which show the lift coefficient to drag coefficient ratio versus angle of attack, it is show that. The 2.5mm serrated G.F. increase the maximum lift coefficient to drag coefficient ratio by (8.45%) and 3.5mm serrated G.F. increase the maximum lift to drag ratio by (15.5%) compared with 5mm Gurney flap.

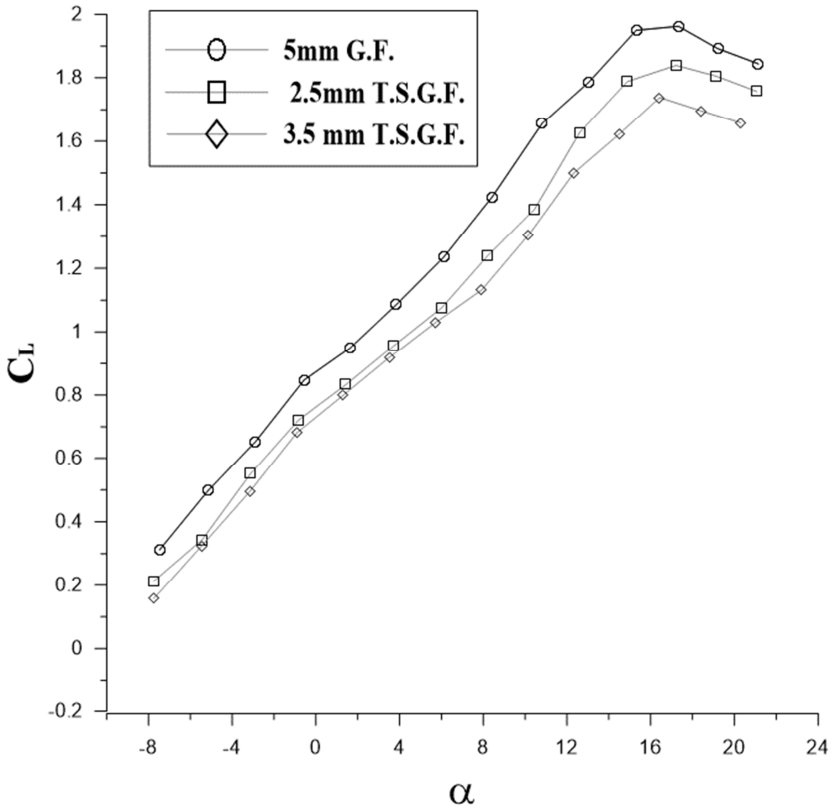


**Fig. 9. Lift coefficient ($C_L$) versus angle of attack (α) for serrated G.F.**

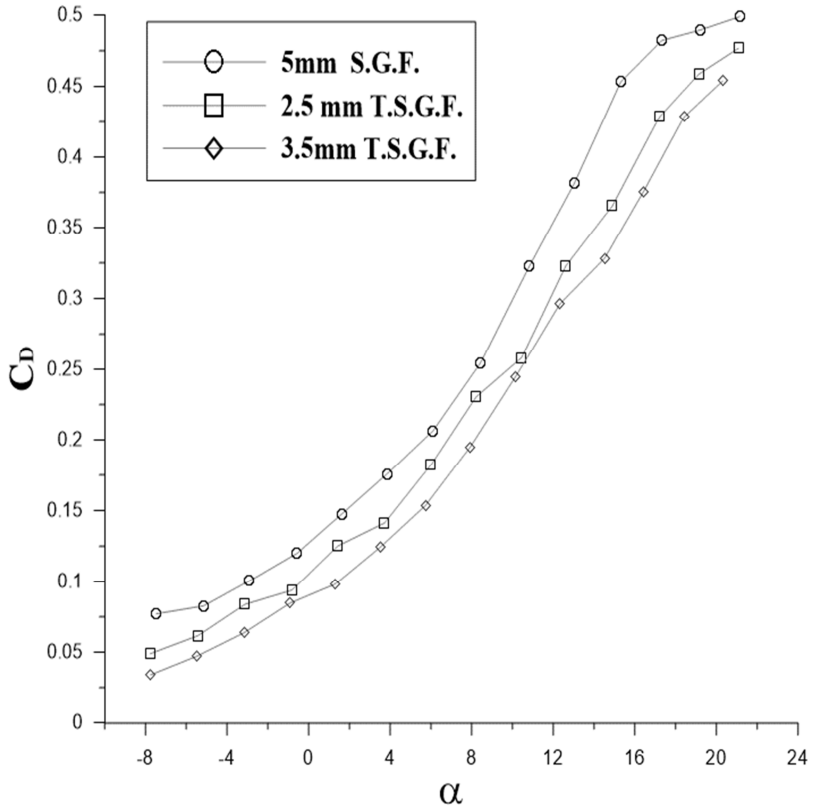


**Fig. 10. Drag coefficient ($C_D$) versus angle of attack (α) for serrated G.F.**

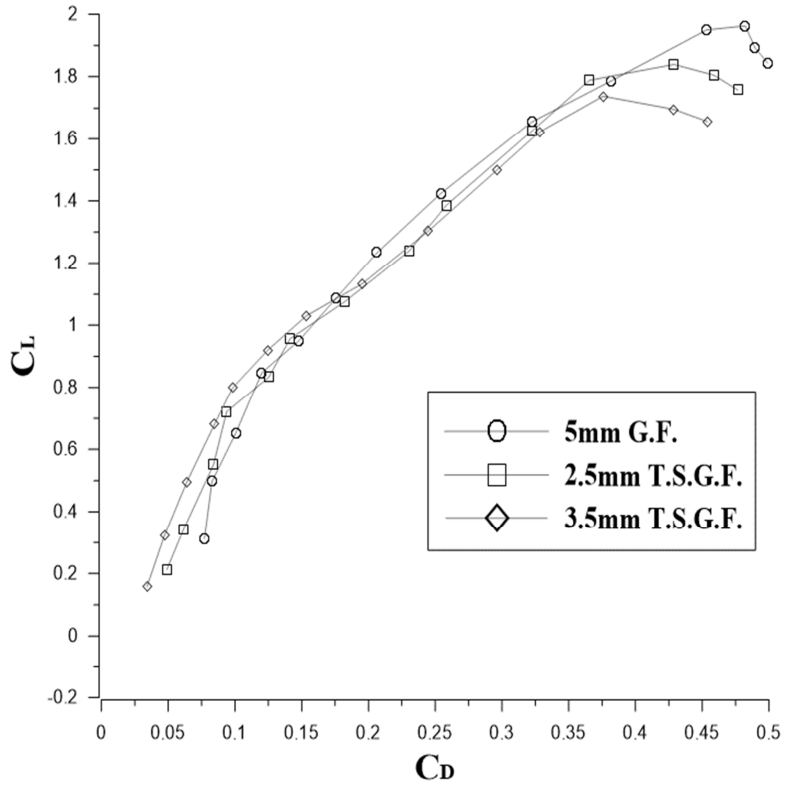


**Fig. 11. Lift coefficient ($C_L$) versus Drag coefficient ($C_D$) for serrated G.F.**

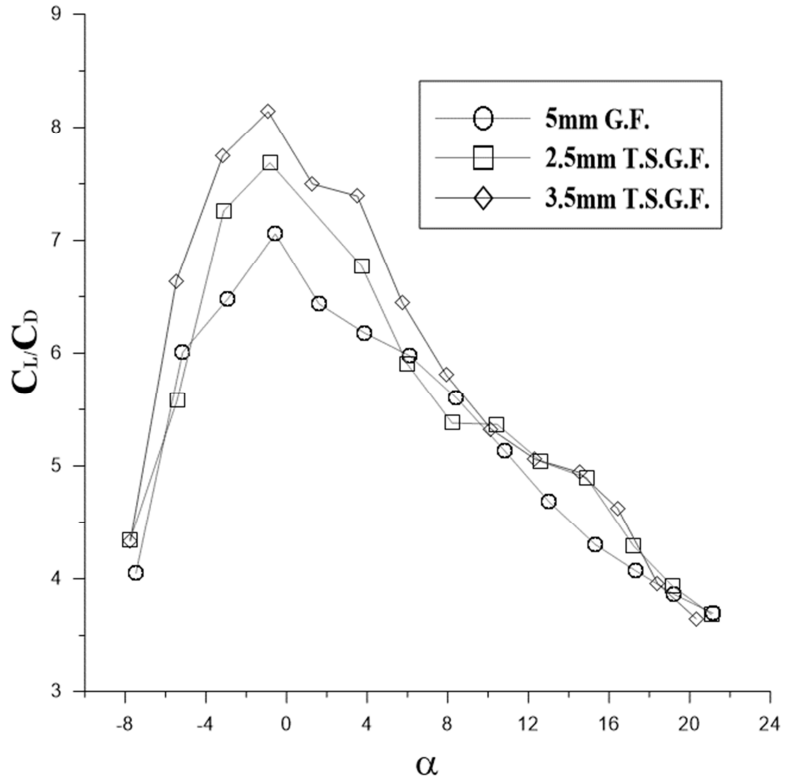


**Fig. 12. Ratio of Lift coefficient to drag coefficient ($C_L/C_D$) versus angle of attack (α) for triangular serrated G.F.**

After we have better efficiency by 3.5mm triangle G.F. then two configurations have been conducted, the first one is the rectangular serrated Gurney flap (R.S.G.F.) which have (2.5mm×3.5 mm) and the second is a semi-circle serrated Gurney flap (S.C.S.G.F) of 1.75 mm radius in order to see it's effect compare with plain G.F., figure 13 shows the lift coefficient against angle of attack for three different configurations of 3.5mm triangle serrated G.F., rectangular serrated G.F. and semi-circle serrated G.F. compared with plain 5mm G.F., the semi-circle serrated G.F. reduce maximum lift coefficient by (23.4%) while rectangular serrated G.F. reduce it by (26.53%), Rectangular serrated G.F. and semi-circle serrated G.F. reduce the drag coefficient more than triangular serrated G.F., figure 14 shows the drag coefficient against angle of attack for three different configurations of 3.5mm triangle serrated G.F., rectangular serrated G.F. and semi-circle serrated G.F., the semi-circle serrated G.F. reduce drag coefficient by (18%) while rectangular serrated G.F. reduce it by (25%). Figure 15 shows lift coefficient against drag coefficient, the figure shows that serrated Gurney flap shift the polar to the right especially at low and moderate lift coefficient because it reduce the drag coefficient. The semi-circle serrated G.F. and rectangular serrated G.F. has better efficiency than wing with 3.5mm triangle serrated G.F as in Fig. 16 Which shows the lift to drag ratio versus angle of attack, it is show that the semi-circle serrated G.F. increase lift to drag ratio by (28.57%) while rectangular serrated G.F. increase lift to drag ratio by (42.8%) compared with 5mm Gurney flap. From above we find that the most beneficial Gurney flap is not the 5mm Gurney flap, but the 1mm Gurney flap as shown in Fig. 8. This explain why the most beneficial Gurney flap, the rectangular serrated Gurney flap, provides a lift to drag ratio higher than other serrated Gurney flap. The result reveals that the main factor effecting the performance of Gurney flap is not the height but the effective area of Gurney flap.

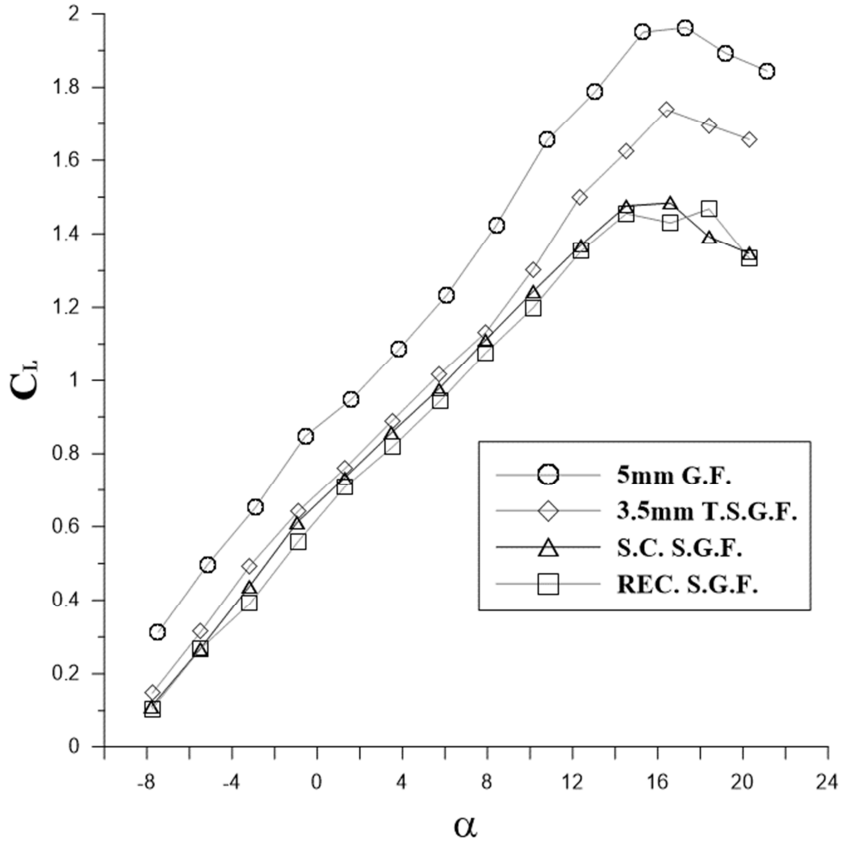


**Fig. 13. Lift coefficient ($C_L$) versus angle of attack (α) for serrated G.F.**

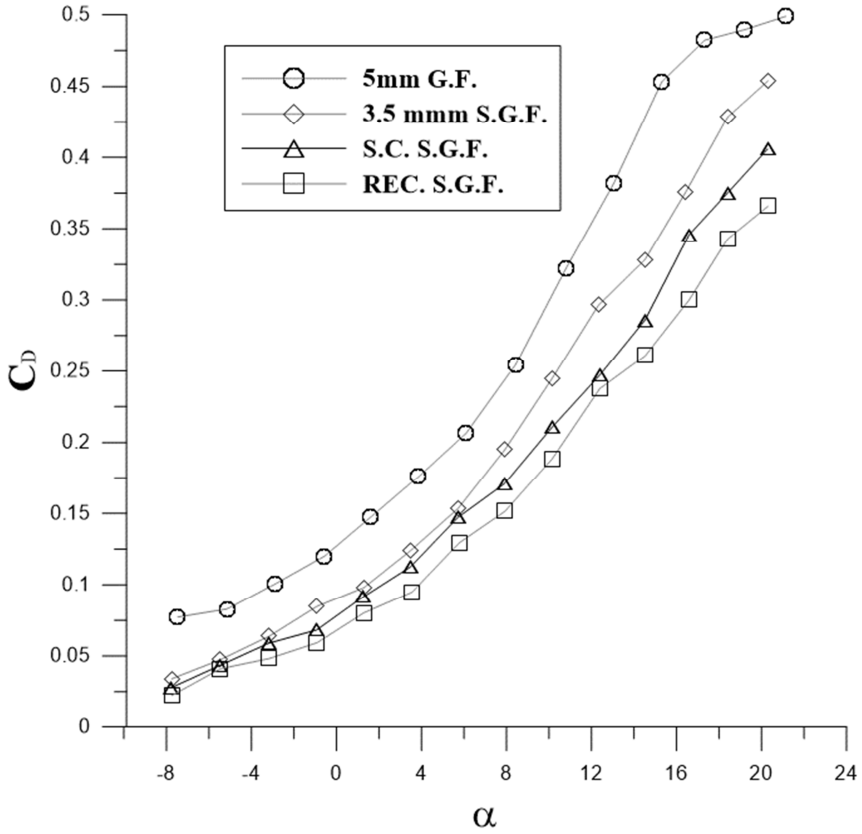


**Fig. 14. Drag coefficient ($C_D$) versus angle of attack (α) for serrated G.F.**

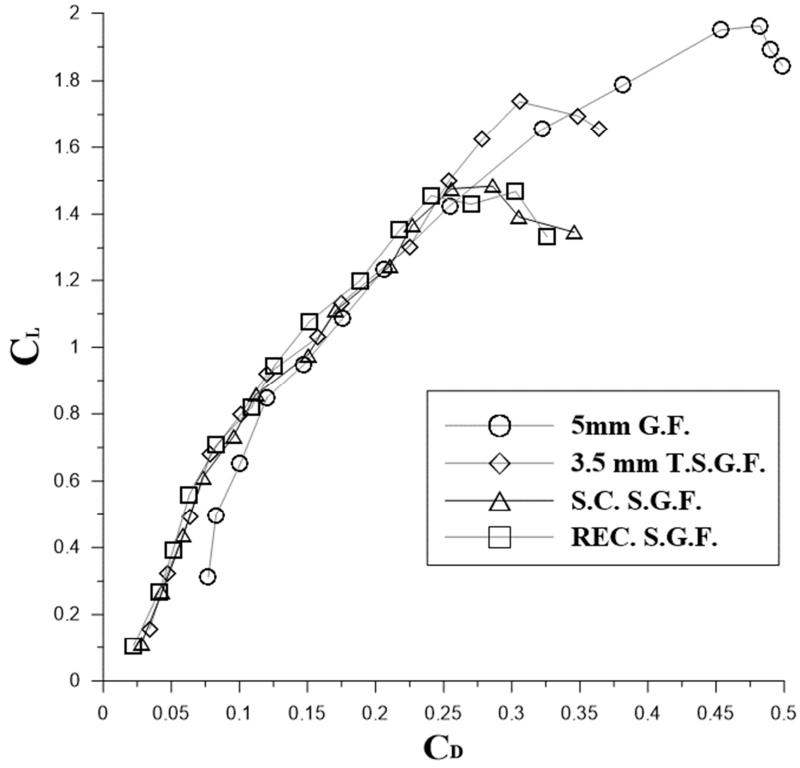


**Fig. 15. Lift coefficient ($C_L$) versus Drag coefficient ($C_D$) for serrated G.F.**

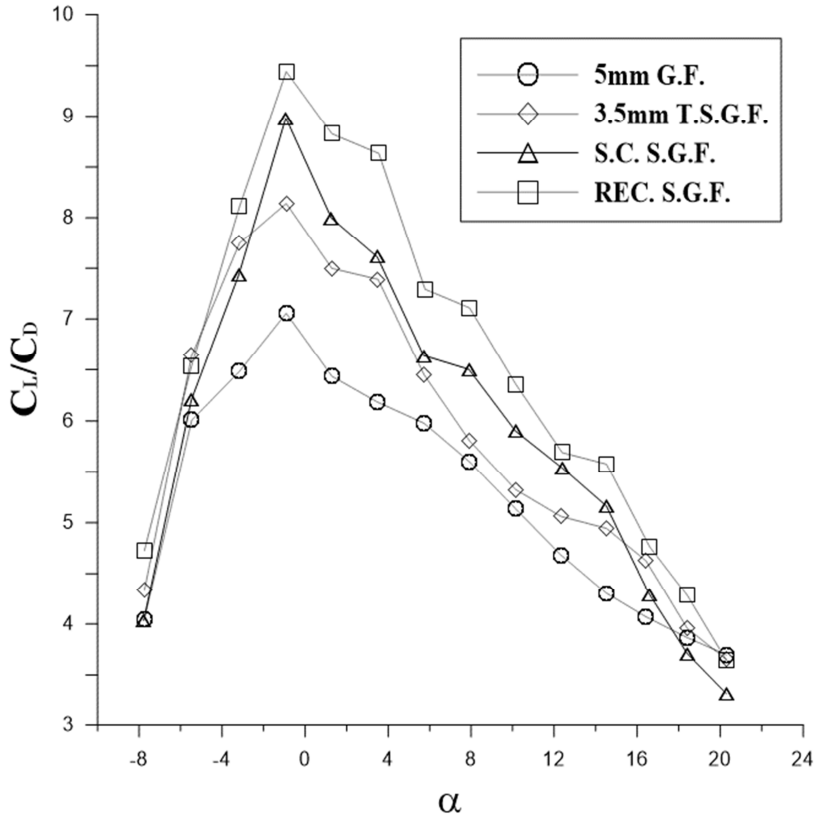


**Fig. 16. Ratio of Lift coefficient to drag coefficient ($C_L/C_D$) versus angle of attack (α) for serrated G.F.**

## 4 CONCLUSIONS

an experimental wind tunnel investigation was undertaken to determine the effect of Gurney flap on the aerodynamic characteristics of Clark y-14 airfoil wing at a Reynolds number of $2.1x10^5$ at (35.7 *m/s*).The Gurney flap improve performance of Clark y-14 airfoil wing compare with clean wing ,the Gurney flap increase lift coefficient decrease stall angle slightly and increase drag coefficient ,the most beneficial Gurney flap is about (1mm) which increase maximum lift to drag ratio to (5.31%) compared with clean wing . The 2.5mm serrated G.F. increase the maximum lift coefficient to drag coefficient ratio by (8.45%) and the (3.5 mm) triangular serrated Gurney flap improve lift to drag ratio by (15.5%) compared with (5mm) non serrated G.F., the semi-circle serrated G.F. increase lift to drag ratio by (28.57%) while rectangular serrated G.F. increase lift to drag ratio by (42.8%) compared with 5mm Gurney flap., from these result we concluded that the serration improve lift to drag ratio but it is effect still weaker than 1mm G.F. and 1mm G.F. only the improve lift to drag ratio compared with clean wing. The result reveal that the main factor effecting the performance of Gurney flap is the effective area of the Gurney flap.

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# Systematic Status of six Mugilidae Species in the Ivorian Lagoons

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**ABSTRACT:** We applied a meristic characters and stomach shapes description approach to resolve the taxonomic status among two genera and six species (*Mugil curema* Valenciennes, 1836, Mugil *cephalus* Linnaeus, 1758, *Mugil bananensis* (Pellegrin, 1927), *Liza grandisquamis* Valenciennes, 1836, *Liza dumerili* (Steindachner, 1870), *Liza falcipinnis* (Valenciennes, 1836) of the Mugilidae family living in the Ivorian Lagoons. Moreover the systematic relationship of *M. bananensis* among other mullet species was investigated in the present study for the first time. Hierarchical cluster analyses of meristic characters in the present study were very discriminative in terms of taxonomic classification of the mullets. According to meristic data in UPGMA tree, all six species were grouped in two main branching. In the first branch, *L. falcipinnis* and *L. grandisquamis* were clustered as closest taxa, and being the sister group to the *Mugil curema*. In the second branch, *L. dumerili* and *M bananensis* were clustered as a most differentiated species respectly from all other *Liza* and *Mugil* species. *L. dumerili* described in this study was near to those described in Lower Guinea that those described in Ivory Coast. *Liza* genus is probably non-monophyletic assemblage. The stomach of the *Mugil* genus species were characterized by two pyloric caeca contrary to the species of *Liza* genus that had more than two pyloric caeca. However, stomach shapes were different between these species except to *M. curema* and *M. bananensis*.

**KEYWORDS:** Systematic, meristic, morphological, stomach, species, Mugilidae, lagoons.

## 1 INTRODUCTION

Mullets have worldwide distribution and inhabit tropical and temperate seas; a few spend their lives in freshwater [1]. Despite the ecological and economical importance of grey mullet [2], the taxonomy and evolutionary relationships among the species so far remains largely unresolved [3]. A major reason is that most morphological characters classically used in species identification and/or systematics are remarkably similar within the family **(**[4]-[5]**)**. Mugilidae taxonomy and nomenclature have still not been finalized [3], with between 14 and 20 genera being recognized as valid according to the most recent revisions ([5]**,** [6]-[1]**)**. The Integrated Taxonomic Information System recognizes 16 valid genera [7], while [8] list 20 valid genera. Most of these are included in the genera *Mugil* and *Liza*, which have 12 and 23 species respectively. These two genera currently represent 40% of the species richness within the family Mugilidae [8].

Six species of Mugilidae are signalized in West African estuaries and lagoons under different names (*M. cephalus, M. curema, M. bananensis, L. falcipinnis, L. dumerili* and *L. grandisquamis*).

In Ivory Coast, the Mugilidae are one of the highly exploited species ranking close to Cichlidae, Clupeidae and Carangidae in fisheries importance in the Aby, Ebrié and Grand-Lahou lagoon systems [9]. In spite of this, knowledge on these species in Ivory Coast remains fragmented and most fisheries statistics of Ivory Coast to not provide adequate information to allow assessment of species richness of this family in artisanal and commercial fisheries. Records from the Fisheries Department groups all species of this family under the term “mullet”, because of the difficulty of distinction of different species**.**

To date limited number of studies on morphologic between species and genera in the Mugilidae family in the Ivorian lagoons has been found [9]. These autors investigated five species (*Mugil cephalus, M. curema, L. falcipinnis, L. dumerili* and

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*L. grandisquamis*) of the Mugilidae family with morphologic data only in Ebrie lagoon. On the other hand, it appears that there is lack of systematic studies comprising all the species using morphologic, morphometric and meristic data together in this lagoon. Also the systematic position of *M. bananensis* among other mullet species was investigated in the present study for the first time using meristic characters.

Meristic characters have been widely used in studies of fish populations and species. Unlike body proportions or coloration, meristic characters are fixed usually at or before metamorphosis and remain constant throughout the life of an individual [10]. Variation in meristic characters stems from both genetic variation between populations and species, and from environmental variation, which, within genetically controlled limits, can directly affect the number of parts formed in developing embryos and larvae. Some reviews of factors known to affect meristic characters in fishes include references [11], [12], [13] and [14].

The aim of this study is to contribute to the understanding of the systematic relationship of the Ivorian lagoons Mugilidae species using meristic characters and stomach description.

## 2 MATERIAL AND METHODS

### 2.1 MATERIAL

A total of 792 specimens were collected in the lagoons of Ebrie, Aby and Grand-Lahou (Figure 1): 537 specimens between February 2007 and August 2009 in the lagoon of Ebrié and 144 specimens in Grand-Lahou and 111 specimens in Aby respectively in March 2010 and September 2011. All samples were collected from commercial fishing.

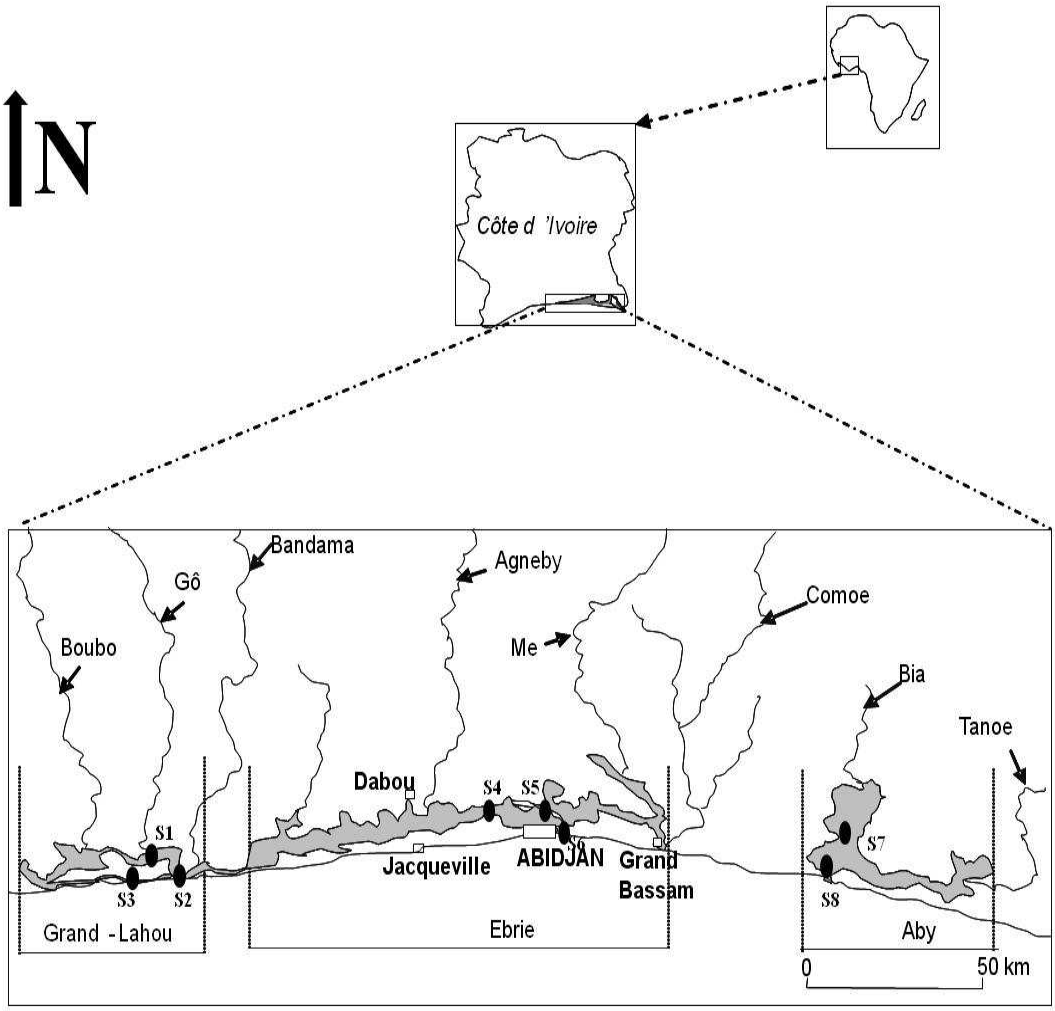


**Figure 1:** Map showing the sample sites in the different lagoon (Grand-Lahou (S1, S2, S3), Ebrie (S4, S5, S6) and Aby (S7, S8)).

Eleven meristic characters used to describe mullets were examined using the number of: first dorsal rays (DR1), second dorsal rays (DR2), pelvic soft rays (PeR), pectoral soft rays (PcR), anal soft rays (AR), anal spines (AS), scale lines (ScL), scales on longitudinal line (ScLL), branchiospines on the inferior part of the first branchial (Inf Brsp), branchiospines on the superior part of the first branchial (Sup Brsp) and microbranchiospines of the first branchial arch (MicBrsp) under a binocular microscope.

After stomach shapes description, pyloric caeca were enumerated for each species.

**Table 1.** Location and biological features of mullet species. Minimal-Maximum (Min – Max) of Standard length (SL) of each species.

| sites | Location | *Liza dumerili* | *Liza falcipinnis* | *Liza grandisquamis* | *Mugil curema* | *Mugil bananensis* | *Mugil cephalus* |
|---|---|---|---|---|---|---|---|
| S1 | 5°18' N 5°11' W | 14 | 16 | 0 | 3 | 8 | 8 |
| S2 | 5°16' N 5°02' W | 7 | 11 | 10 | 8 | 5 | 24 |
| S3 | 5°13' N 5°20' W | 11 | 9 | 6 | 0 | 16 | 6 |
| S4 | 5°30' N 4°20' W | 13 | 26 | 4 | 0 | 8 | 13 |
| S5 | 5°29' N 4°04' W | 47 | 56 | 38 | 33 | 43 | 86 |
| S6 | 5°27' N 3°95' W | 6 | 11 | 11 | 21 | 19 | 61 |
| S7 | 5°23' N 3°22' W | 3 | 12 | 0 | 0 | 24 | 7 |
| S8 | 5°14' N 3°27' W | 10 | 15 | 0 | 14 | 21 | 19 |
| **Total** | | 111 | 156 | 69 | 79 | 224 | 144 |
| **SL (Min - Max (mm))** | | 120.29 - 267.15 | 136.36 - 281 | 89.82 - 198.96 | 118.31 - 271 | 97.94 - 232.57 | 147.04 - 460 |

### 2.2 MULTIVARIATE ANALYSES

Meristic characters were used in the multivariate analyses. It was submitted to a canonical discriminant function analysis (DFA), and discriminant function (DF) scores were used in hierarchical cluster analyses using STATISTICA 7.1 statistical package program. The DFA combines a selection of meristic measures to produce a mathematical function, which can be used to classify individuals into groups. In hierarchical cluster analyses, UPGMA dendogram based on Squared Euclidean distance was constructed to monitor taxonomic relationships among the species that does not plot actual distances but rescales the distance to numbers between 0 and 100.

## 3 RESULTS

### 3.1 MERISTIC ANALYSIS

Observed meristic characters of nine mullet species (Table 2) were in the range of their description given by [1]. Highly significant ($p < 0.001$) differences between species were observed from all meristic characters. Dorsal rays (DR1), anal spines (AS) and pelvic soft rays (PcR) were constant in each group and could not be computed in the Univariate analysis.

**Table 2**. Observed meristic counts of the six mullet species.

| Species | DR2 | PcR | AR | ScL | Sup Brsp | Inf Brsp | MicBrsp | ScLL | PC |
|---|---|---|---|---|---|---|---|---|---|
| *Liza dumerili* | I 7 - 9 | 15 – 17 | III 8 – 10 | 10 – 13 | 15 – 18 | 26 – 43 | 57 – 73 | 34 – 41 | 7 |
| *Liza falcipinnis* | I 8 - 10 | 14 – 18 | III 8 – 12 | 11 – 14 | 27 – 50 | 58 – 72 | 91 – 127 | 34 – 41 | + 20 |
| *Liza grandisquamis* | I 7 - 9 | 14 - 17 | III 8 – 9 | 9 – 10 | 32 – 39 | 40 – 47 | 87 – 105 | 25 – 30 | 8 |
| *Mugil curema* | I 7 – 9 | 14 – 17 | III 9 – 10 | 11 – 13 | 26 – 44 | 50 – 70 | 103 – 123 | 36 – 40 | 2 |
| *Mugil bananensi* | I 8 - 9 | 14 – 17 | III 7 – 8 | 11 – 13 | 19 – 39 | 26 – 45 | 65 – 84 | 34 – 40 | 2 |
| *Mugil cephalus* | I 8 | 16 – 18 | III 7 – 8 | 13 – 15 | 43 – 58 | 62 – 89 | 123 – 165 | 40 – 44 | 2 |

The first discriminant function explained 50.1% of between group variability and the second, third fourth and fifth explained 33.45%, 9.5%, 6.63%, 0.32% respectively (Table 3). Component loadings showed that AR, Inf Brsp, Sup Brsp, ScLL, MicBrsp characters are playing key role to differentiate species respectively (Table 4). Variables are ordered in the table 3 by size of discriminating within the species according the test of lambda of Wilk.

**Table 3.** Contribution of meristic variables to the canonical functions. *, indicate largest correlation between each variable and any discriminant function

| Meristic | Fonction 1 | Fonction 2 | Fonction 3 | Fonction 4 | Fonction 5 |
|---|---|---|---|---|---|
| DR2 | -0.12 | -0.30 | 0.20 | -0.10 | -0.88* |
| PcR | -0.13 | -0.02 | 0.06 | -0.04 | 0.19* |
| AR | -0.21 | -0.89* | 0.07 | -0.27 | 0.20 |
| ScL | -0.34 | 0.18 | 0.33 | -0.38* | -0.02 |
| Sup Brsp | -0.30 | 0.08 | -0.72* | -0.38 | -0.01 |
| Inf Brsp | -0.63* | -0.04 | 0.22 | 0.53 | 0.15 |
| MicBrsp | -0.55* | 0.12 | -0.43 | 0.17 | -0.16 |
| ScLL | -0.30 | 0.24 | 0.41 | -0.55* | 0.20 |

The UPGMA cluster analysis did not cluster species on the bases of current meristic status of Mugilidae (Figure 4). Two main branching were produced: *Mugil bananensis* and *Liza dumerili* seen to be meristically most divergent from the other species and was branched as a first group. In the second branch, *L. falcipinnis* was clustered as a closest taxa to *L. grandisquamis*, being the sister group to *M. curema* and *M. cephalus* were branched more divergently from these two species.

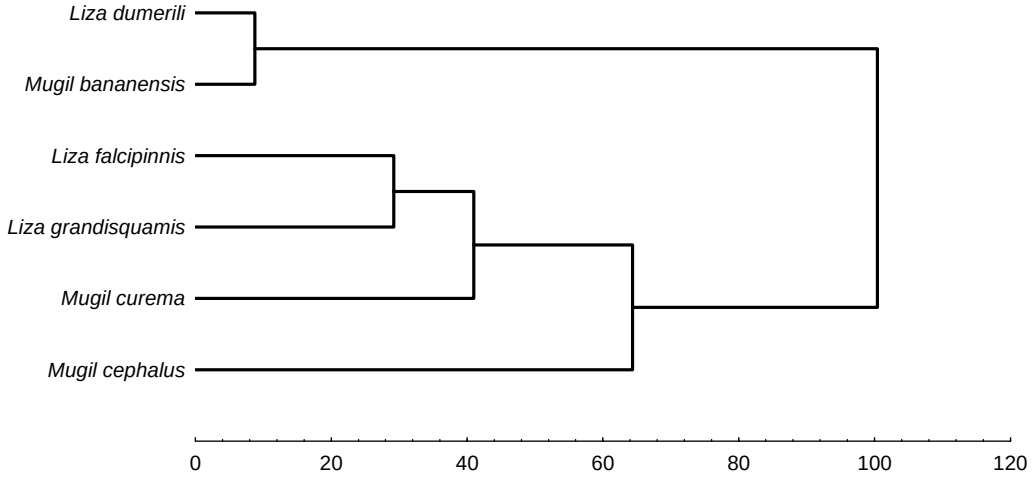


**Figure 3.** UPGMA tree of Squared Euclidiean distances based on meristic data.

**Table 3:** Discriminatory power of meristic characters retained by stepwise discriminant analysis. Variables ordered by size of discriminating within the species; ***: p<0.001.

| Meristic | ʎ-Wilk | F | dl | p |
|---|---|---|---|---|
| AR | 0,13 | 997,56 | 5 | *** |
| Inf Brsp | 0,31 | 347,16 | 5 | *** |
| Sup Brsp | 0,37 | 266,15 | 5 | *** |
| ScLL | 0,48 | 168,33 | 5 | *** |
| MicBrsp | 0,56 | 119,15 | 5 | *** |
| DR2 | 0,72 | 59,18 | 5 | *** |
| ScL | 0,73 | 57,49 | 5 | *** |
| PcR | 0,93 | 12,06 | 5 | *** |

### 3.2 STOMACH DESCRIPTIONS

The species of the *Mugil* genus were characterized by two pyloric caeca contrary to the species of *Liza* genus that had more than two pyloric caeca (Figure 4). However, stomach shapes were different between these species except to *M. curema* and *M. bananensis*.

- *Mugil cephalus*: a conical stomach with two pyloric caeca of approximately equal length.
- *M. bananensis* and *M. curema*: a stomach slightly swollen to the œsophagus-stomach junction level; with a saucer shape, stomach has two pyloric caeca of which one short and other length.
- *Liza falcipinnis: stomach with a* very muscular part and a handle less muscular with of which a pointed end. Stomach downstream side is covered in more pyloric caeca (more than twenty) arranged on two superimposed levels with.
- *Liza grandisquamis*: stomach formed to two very muscular parts with eight (8) equal length pyloric caeca.
- *Liza dumerili*: stomach slightly narrow of which the superior part had seven (7) pyloric caeca. Them size diminish progressively to the pylorus.

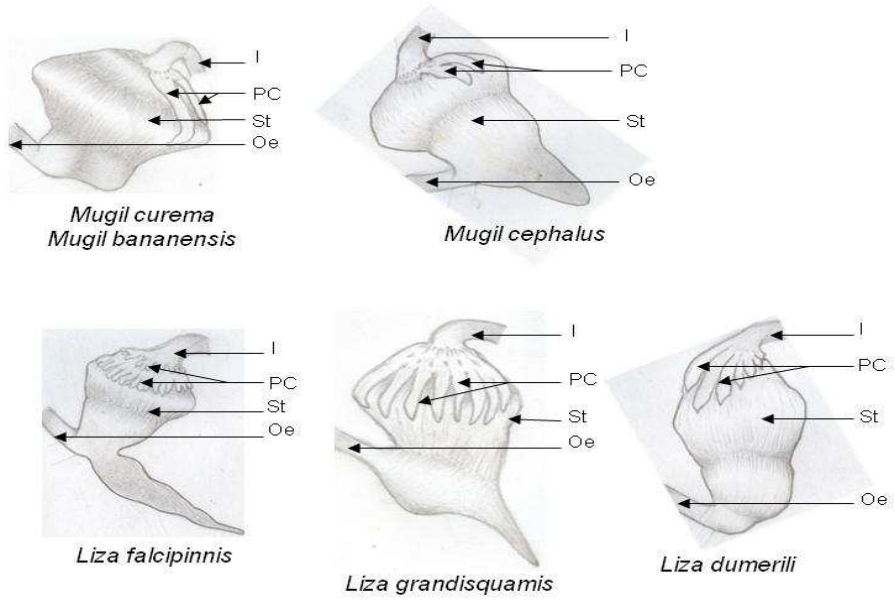


**Figure 4.** Stomach shape and the pyloric caeca of different Mugilidae species: I: Intestine, PC: pyloric caeca, Oe: oesophaga, St: stomach.

## 4 DISCUSSION

Previous investigations using various anatomical characters have provided conflicting hypotheses on the systematic relationships within the family Mugilidae **(**[6], [15]**,** [4]- [5]**)**. Taxonomic description of fishes has commonly relied on the description of unique sets of morphological characters. Meristic characters in the present study were rather more discriminative in terms of taxonomic classification of the mullets. Superior and inferior branchiospines and microbranchiospines on the first branchial arch, scales on longitudinal line, anal fins and pectoral fins, and also pyloric caeca were most discriminative characters in the present classification of mullets. Such characters are phylogenetically informative to distinguish between species of the Mugilidae. Meristic characters and stomach descriptions permit to the reference [16] to identify *Mugil soiuy* from the Aegean Coast of Turkey. The same method permit to the author [17] to characterize *Mugil cephalus*, *Liza ramada*, *Chelon labrosus, Oedalechilus labeo, Liza aurata, Liza abu, Liza saliens, Liza carinata* in the Mediterranean Sea.

The present meristic analysis within the family Mugilidae did not reveal similar pattern of morphologic results among the species. UPGMA tree splited *Liza* and *Mugil* genera species each one into two main clusters. In the first group, *M. cephalus* was clustered with its sister species *M. curema*, supporting monophyletic status of *Mugil* genera. The results revealed that *M. bananensis* was morphologically more divergent than *M. cephalus* and *M. curema* from the other Ivorian taxa. However, in a molecular systematic using phylogenetic analyses of nucleotide sequence variation at three mitochondrial loci (16S rRNA,

cytochrome oxidase I, and cytochrome b) study made by the reference [7], *M*. *curema*, *M*. *cephalus* and *M*. *bananensis* were clustered into a single, well-supported clade. According to the reference [7] in the same study, a greatest genetic differentiation was observed between *L*. *dumerili* and all the other *Liza* species studied, while *L. falcipinnis* and *L. grandisquamis* were relatively the closest taxa. This observation corroborate our result. *L*. *grandisquamis* is grouped within the *Liza* genera and sister group into *Liza falcipinnis*. However *L. dumerili* was clustered separately of the two other species of *Liza* genera. Systematic status to this species is very controversial. *L. dumerili* described in this study was near to those described by the author [18] in Lower Guinea that those described by the reference [9] in Ivory Coast. Some authors have suggested that geographically distant populations should be recognized as different subspecies. The reference [19], studying mullets from Mauritania and Senegal, recognized *L. dumerili* in two subspecies: *L. saliens dumerili* from the north with 37-42 scales in longitudinal series, and *L. saliens hoefleri* in the south with 33 - 42 scales. The reference [20] recognized two subspecies of *Liza dumerili*: *L. d. dumerili* characterized by 37- 41 branchiospines and distributed from Senegal to the Niger River; and *L. d. canaliculatus* characterized by 45-55 branchiospines and distributed from the Congo River to Mozambique. According to the reference [15], *Liza* is probably non-monophyletic assemblage and new genera are currently being split from it [21].

Our present study indicated that the three *Mugil* species were characterized by Stomach with two pyloric caeca, while those of *Liza* genus had more two. *M. cephalus* stomach shape was clearly separated from M. curema and M. bananensis that were morphologically similar. However, pyloric caeca and stomach shape of the species *Liza* genus were both clearly different from each other.

To summarize, meristic characters and stomach descriptions have been successfully used for these six species problematic identification and showed a clear distinction between them. However, except to stomach descriptions, pyloric caeca didn't discriminate each species of the *Mugil* genus. The meristic parameters were the most determinative in the differentiation of these species. For a better understanding of these species, this study should be complemented with genetic and osteological analyses to verify the morphological differences. This study showed 6 species against 5 recorded by [9]. In addition, further systematic analyses are necessary for a better description of the *Liza* genus, mostly for *Liza dumerili* species. A key to species of mugilid fishes is given as follows:

**Key to species of Mugilidae in Ivory Coast**

Genus *Mugil* Linnaeus, 1758

1. - 9 (rarely 10) anal soft rays ..... *Mugil curema*

   - 7 à 8 anal soft rays ..... **2**

**2** **-** 11 à 13 scale lines ; 26 – 45 branchiospines on the inferior part of the first branchial arch ; 19 – 39 branchiospines on the superior part of the first branchial arch ..... *Mugil bananensis*

**-** 13 à 15 scale lines ; 62 – 89 branchiospines on the inferior part of the first branchial arch ; 43 – 58 branchiospines on the superior part of the first branchial arch ; 123 à 165 microbranchiospines on the first branchial arch ..... *Mugil cephalus*

**Genre *liza*** Jordan et Swain, 1884

1. - 25 à 30 scales on longitudinal line ..... *Liza grandisquamis*

   - 34 – 41 scales on longitudinal line .....2

2. 9 (rarely 8 or 10) anal soft rays ; 26 – 43 branchiospines on the inferior part of the first branchial arch ; 15 – 28 branchiospines on the superior part of the first branchial arch ..... *Liza dumerili*

1. 11 (rarely 10 or 12) anal soft rays ; 58 – 72 branchiospines on the inferior part of the first branchial arch ; 27 – 50 branchiospines on the superior part of the first branchial arch ..... *Liza falcipinnis*

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# ESTIMATION OF TECHNICAL EFFICIENCY OF GARLIC FARMS IN DISTRICT PESHAWAR, PAKISTAN: A STOCHASTIC FRONTIER ANALYSIS

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**ABSTRACT:** This study estimated technical efficiency of garlic farms in district Peshawar, Khyber Pakhtunkhwa, Pakistan. Data for this study was collected from 110 farmers through multistage sampling technique. Cobb-Douglas frontier production function was estimated through maximum likelihood estimation technique. Stata software was used for estimation. Results indicated that the mean technical efficiency of garlic farms was 84.60 per cent ranging from 57.62 to 96.07 per cent. This implies that if the average farm in the sample was to achieve the technical efficiency level of its most efficient counterpart, then the average farm could increase garlic yield by 11.94 per cent. Similarly the most technically inefficient farm could increase garlic yield by 40.67 per cent. These results suggest that output can be improved by using available resources efficiently with the existing technology. The estimated gamma value was 0.80 implies that 80 percent variation in the production of garlic was due to inefficiency factors. Results further showed that seed rate, labor, tractor hours, FYM and irrigation have positive and statistically significant effect on the production of garlic. Experience of garlic growers plays an important role in garlic production so arrangement of training programs for farmers is a policy option for enhancement of garlic productivity. Motivation of farmers to use recommended quantity of seed for higher productivity of garlic is another recommendation.

**KEYWORDS:** Stochastic frontier, Cobb Douglas production fuction, Technical efficiency, Productivity, ML estimates, Garlic, Peshawar-Pakistan.

## 1 INTRODUCTION

Vegetables and fruits are major sources of many vitamins, minerals and other natural substances which help to protect from cancer and other chronic diseases. Fruits and vegetables are naturally low in fats and calories whose different colors gives our body a wide range of valuable nutrients, like fiber, folate, potassium, and vitamins A and C. Insufficient intake of fruits and vegetables can cause gastrointestinal cancer deaths, ischaemic heart disease deaths and stroke deaths. In Pakistan 21 different kinds of fruits and 40 types of vegetables are grown in different climatic zones round the year. These fruits and vegetables are exported to European and Middle-Eastern countries, which earns huge foreign reserves for the country. The main reason of rise in consumers' price and hidden quality loss is due to post-harvest of fruits and vegetables ranging from 25-40 percent which brings low return to growers, processors and traders and country suffers in terms of foreign exchange earnings.

Garlic (*Allium sativum*) is specie in the onion genus, *Allium* belongs to the Alliaceae family. Garlic is used as culinary as well as medicinal purposes. It is grown throughout Pakistan and because of its pungent and spicy flavor; it is consumed by most of the people. Garlic is well-known to human over 7,000 years. The area of origin is not clearly known but is probably

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originated from Central Asia and spread to the Mediterranean region. It is valued high in the Mediterranean countries that's why it is mostly cultivated there.

According to United Nation's Food and Agriculture organization (FAO), the estimated garlic production of the world is about 17.67 million metric tones (MMT). Among the world, Asia is the largest garlic producing area contributing about 80 % of the total world production. In Asia, China is the leading garlic producer which produced about 13.66 MMT in 2010, which accounts for 77 % of the world production. India produced 0.83 MMT, South Korea 0.27 MMT, Egypt 0.24 MMT, Russia 0.21 MMT, Myanmar 0.18 MMT, Ethiopia 0.18 MMT, United States 0.16 MMT, Bangladesh 0.16 MMT and Ukraine 0.15 MMT, respectively [1].

Asian countries contribute more in the trade of garlic which is about $4/5^{th}$ of the world. South Korea is on the top in the import of garlic which is 153,141 tones. $2^{nd}$ is Indonesia (361,289 tones), $3^{rd}$ is Viet Nam (122,598 tones), USA (74,554 tones), Malaysia (80,751 tones), Bangladesh (50,898 tones), Italy (26,524 tones), France (23,850 tones), Germany (19,389 tones) and Netherland (28,483 tones) respectively while Pakistan (64,223 tones) ranks $13^{th}$ in the list of importing countries. While in exporting, china leads from the front having a net export of about 1,365.18 thousand tones followed by Spain (65,802 tones), Argentina (89,265 tones), Netherlands (26,932 tones), France (10,637 tones), Italy (10,409 tones), India (24,665 tones), USA (9,483 tones), Chile (6,156 tones) and Mexico (12,370 tones) respectively [1].

Pakistan produced about 55,300 tones of garlic on an area of 16,300 hectares in 2010-11, respectively, while area under garlic in Khyber Pakhtunkhwa was 4,460 hectares and there was production of 19,500 tones in 2010-11. Area under garlic crop in Punjab, Sindh and Baluchistan was 7,650, 2,220 and 1,970 hectares having 24,300, 4,600 and 6,900 tones in 2010-11 respectively. Punjab contributes about 44 % of the total garlic production, Khyber Pakhtunkhwa 35.2 %, Balochistan 12.5 % and Sindh 8.3 % [2]. Pakistan was among the top 20 garlic importer countries of the world from 2001 to 2010 except 2001 and 2004. In 2009 and 2010 Pakistan imported 83.79 and 64.22 thousand tons of garlic [2].

Foreign exchange reserve spends on garlic imports from abroad can be saved through achieving self sufficiency in garlic production. Increase in garlic production through increased use of improved hybrid varieties has proved not to bring about the expected productivity gains. Moreover, technological development is long run phenomenon. With the efficient utilization of available resources and technological, growth in garlic productivity and output can be achieved. Literature on vegetable productivity in Pakistan from different regions revealed that inefficiency exists. Moreover, studies show that socioeconomic and human capital characteristics and farm size are the major factors that cause inefficiencies in agricultural productivity. Efficiency is measured by comparing the observed output against the maximum possible (frontier) output. The appropriate allocation of available resources and technology is the major factor that makes the improvement in efficiency. The production function describes the transformation of physical inputs (resources) into physical output.

The findings of this study will provide insights into the technical efficiency of garlic producers in district Peshawar of Khyber Pakhtunkhwa province of Pakistan. It measures the performance of garlic producers that can be used to assist them in efficient allocation and utilization of available resources and technology. The findings of this study will also be helpful for policy makers and government in formulating policies for enhancing productivity and output of garlic in the country. The main objective of this study is to estimate the farm level technical efficiency of garlic production and to identify the sources of technical inefficiency among garlic farms.

## 2 DATA AND METHODOLOGY

This study was carried out in District Peshawar of Khyber Pakhtunkhwa province. For selection of sample size multistage sampling technique was used. In the first stage, district Peshawar was purposively selected. In the second stage, 3 villages namely Attozai, Maghdarzai and Tarlazai were randomly selected. In the third stage from each randomly selected village, 110 garlic growers were selected through proportional allocation sampling technique. Primary and secondary data were used for this study. Primary data was collected from the garlic growers by using questionnaire during April-May, 2012 and secondary data was collected from various official sources.

### 2.1 CONCEPTUAL FRAMEWORK

For measuring the relationship between output and input used and the mean technical efficiency and technical inefficiency in garlic production, data was analyzed by using the ML estimates of the stochastic frontier model. Technical efficiency may be defined as the usefulness to use a given amount of inputs to produce an output. Econometricians for long time have estimated average production function. Serious considerations have been given for estimating frontier production function after the pioneering work of Farrell (1957) in order to cover space between theoretical and empirical work [3].

Aigner *et al*. (1977) developed stochastic production model. Error term of the model was composed by Meeusan and van den Broeeck (1977) [4] [5].

Stochastic frontier function can be defined as:

$Yi = f(Xi; ß) + \epsilon_i$ i = 1, 2, 3,……, n (1)

Where, $Y_i$ represents output of garlic of *ith* farm in kgs/ha, f(X; ß) is a suitable function such as Cobb-Douglas production function, $X_i$ are the inputs used in production of garlic in units/ha, $\beta_i$ are the coefficients to be estimated, $e_i$ is a composed error term that captures the error term and inefficiency component ($v_i$, $u_i$). $v_i$ is a random error having zero mean and is assumed to be having symmetrical independent distribution as N (0, $\sigma^2_v$) random variables, independent of $u_i$ and associated with those factors which is beyond the control of the farmers. The $u_i$ is assumed to be non-negative truncated half normal N (0, $\sigma^2_u$) random variables and is known as farm specific factors, which has an association with the technical inefficiency of the farm and has a value between 0 and 1.

### 2.2 EMPERICAL MODEL OF TECHNICAL EFFICIENCY

So, the specified empirical model of the Cobb-Douglas production function for the garlic production is as follows:

$$\ln Yield = \beta_0 + \beta_1 \ln Seed + \beta_2 \ln TrctrHrs + \beta_3 \ln Labor + \beta_4 \ln Fert + \beta_5 \ln FYM + \beta_6 \ln Irrig + \beta_7 \ln Weed + (v_i - u_i) \quad (2)$$

Where;

Yield = Yield of garlic in kg per hectare

Seed = Seed rate used in kgs per hectare

TrctrHrs = Total tractor hours used per hectare

Labor = Total labor man days per hectare

Fert = Fertilizers used in kgs per hectare

FYM = Farm yard manure used in kg per hectare

Irrig = Number of irrigations per season

Weed = Weedicides used in litres per hectare

$\beta_i$ = Coefficients to be estimated

vi = Random error term

ui = Farm and farmer specific error term

ln = Natural logarithm

The inefficiency model which is based on [6] was specified as follows:

$\mu_i = g(Z_i : \delta_i)$ (3)

$\mu_i = \sigma_o + \sigma_1 AGE + \sigma_2 EXP + \sigma_3 EDU + \sigma_4 FARM\ SIZE + \omega_i$ (4)

Where;

$\mu_i$ = Technical inefficiency

AGE = Age of the garlic growers in years

EXP = Farming experience of the garlic growers in years

EDU = Education of the garlic growers in years

FARM SIZE = Farm size in hectares under garlic

$\delta_i$ = Coefficients to be estimated

$\omega_i$ = Random error term.

Technical efficiency for individual farmer can be defined as the ratio between observed output and corresponding frontier output, which can be expressed as follows:

$$TE_i = Y_{ob} / Y_{fr} = f(\beta, X) + (v_i + u_i) / f(\beta, X) + (V_i) \quad (5)$$

Where, $Y_{ob}$ is the observed output produced by the individual farm and $Y_{fr}$ is the frontier output i.e., the maximum output that a farm can produce from the given resources. TE takes the value between 0 and 1.

### 2.3 TEST FOR HETEROSCEDASTICITY

In OLS regression one of the assumptions is homoscedasticity i.e., variance of each disturbance term $\mu i$ is a constant number equal to $\sigma^2$ for the chosen values of the dependent variables. It can be symbolically shown as:

$$E(\mu i^2) = \sigma^2 \quad i = 1, 2, 3, \ldots, n \quad (6)$$

When there is violation in the aforesaid assumption, it will cause the heteroscedasticity problem, which means that error term has no constant variance. Heteroscedasticity can cause coefficients of the estimates of variance of OLS to be biased, which leads to error type-I or error type-II. This means 'OLS' is not "Best Linear Unbiased Estimator" (BLUE). It is mainly the problem of cross sectional data as ours, than time series data [7]. In order to test the heteroscedasticity problem, there are several ways but we used Goldfeld Quandt test and Breusch-Pagan-Godfrey test.

#### 2.3.1 GOLDFELD QUANDT TEST FOR HETEROSCEDASTICITY

The procedure used in Goldfeld Quant test is as follows:

1. First arrange the data in ascending order according to regressors.
2. Then omit the central values 'c' and divide the data into 2 groups, each of having $(n - c)/2$ observations ( c = 20 ).

   $$LnYield_{SV} = \beta_0 + \beta_1 LnSeed + \beta_2 LnTrctrHrs + \beta_3 LnLabor + \beta_4 LnFert + \beta_5 LnFYM + \beta_6 LnIrrig + \beta_7 LnWeed + \mu_1; \quad (n = 110) \; (c = 20) \quad (7)$$

   $$LnYield_{LV} = \beta_0 + \beta_1 LnSeed + \beta_2 LnTrctrHrs + \beta_3 LnLabor + \beta_4 LnFert + \beta_5 LnFYM + \beta_6 LnIrrig + \beta_7 LnWeed + \mu_1; \quad (n = 110) \; (c = 20) \quad (8)$$

3. Run 'OLS' regressions separately for each $(n - c)/2$ observations and we get residuals sum of squares (RSS) for each regression i.e. RSS1for smaller values (small variance group) and RSS2 for larger values (large variance group). Each RSS having $(n - c - 2k)/2$ df, where k =7, is parameter numbers along with intercept term.
4. Then calculate ratio: λ = RSS2 / df ÷ RSS1 / df, if we consider assumption of normal distribution for "μi" homoscedasticity then λ for the F-distribution of above equation follow with $(n - c - 2k)/2$ df for numerator and denominator correspondingly. When value of calculated λ (= F) is greater than tabulated value of 'F' at specified significance level, so homoscedasticity hypothesis can be rejected otherwise not [7].

#### 2.3.2 BREUSCH-PAGAN-GODFREY TEST FOR HETEROSCEDASTICITY

The following model was run:

$$LnYield = \beta_0 + \beta_1 LnSeed + \beta_2 LnTrctrHrs + \beta_3 LnLabor + \beta_4 LnFert + \beta_5 LnFYM + \beta_6 LnIrrig + \beta_7 LnWeed + \mu_1; \quad (n = 110) \quad (9)$$

Suppose, the error variance ($\sigma_i^2$) is illustrated as under:

$$\sigma i^2 = f(\alpha_0 + \alpha_1 Z_1 + \alpha_2 Z_2 + \alpha_3 Z_3 + \alpha_4 Z_4 + \alpha_5 Z_5 + \alpha_6 Z_6 + \alpha_7 Z_7) \quad (10)$$

Equation (10) shows that $\sigma i^2$ is function of the Z-variables while for the above equation X's can hand out as Z's. In particular, assume that:

$$\sigma i^2 = \alpha_0 + \alpha_1 Z_1 + \alpha_2 Z_2 + \alpha_3 Z_3 + \alpha_4 Z_4 + \alpha_5 Z_5 + \alpha_6 Z_6 + \alpha_7 Z_7 \quad (11)$$

Equation (11) shows that $\sigma i^2 = \alpha 0$ is constant term while '$\sigma i^2$'is linear function of the Z, if α2= α3= …….. = α7= 0. So the basic theme behind the BPG test is we have to test the hypothesis that α1= α2= …….. = α7= 0 to examine whether $\sigma i^2$ is having constant variance (homoscedastic) or not [7].

The Procedure of Breusch-Pagan-Godfrey test is given as follows:

1. Run OLS regression of the equation (9) and obtain $\mu_1$, $\mu_2$, $\mu_3$, $\mu_4$,…… $\mu_n$ error terms.
2. Obtain $\sigma^2 = \Sigma \mu i^2/n$.
3. Construct '*pi*' by using the following equation.

   $pi = \mu i^2 / \sigma^2$
4. Run the "$p_i$" regression on Z as given.

   $pi = \alpha_0 + \alpha_1 Z_1 + \alpha_2 Z_2 + \alpha_3 Z_3 + \alpha_4 Z_4 + \alpha_5 Z_5 + \alpha_6 Z_6 + \alpha_7 Z_7 + v_i$ (12)

   '*vi*' is error term in above regression.
5. Now obtain 'ESS' (explained sum of squares) from equation (12) and compute 'Θ', as Θ = 1/ 2 ( ESS). By considering normal distribution of 'μi', when sample size *n* increases and we have no heteroscedasticity, '$\theta \sim X^2 m\text{-}1$' which shows, chi-square distribution with (m-1) df is followed by θ. Now when calculated value of Θ (= $X^2$ ) exceed the critical chi-square value at selected significance level, the hypothesis of homoscedasticity can be rejected otherwise accept it [7].

### 2.4 TEST FOR MULTICOLLINEARITY

One of the basic assumptions of the classical linear regression model (CLRM) is that, there should be no correlation between explanatory variables and if this assumption is violated then we face a problem of multicollinearity. For the detection of multicollinearity correlation matrix test is used [7].

#### 2.4.1 CORRELATION MATRIX

Correlation can be defined as the positive (direct) or negative (inverse) correlation between explanatory variables of a given model. To draw the correlation matrix for our data, *k(k-1)/2* (k = number of variables) zero order correlation coefficients must be estimated and then it can be put into "M" correlation matrix as:

$$M = \begin{bmatrix} r11\ r12\ r13 \dots \dots r17 \\ r21\ r22\ r23 \dots \dots r27 \\ \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \\ \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \\ r71 \dots \dots \dots \dots \dots \dots r77 \end{bmatrix}$$

From the above "M" matrix, we can calculate the correlation coefficients of the explanatory variables. $r_{12}$ indicates the correlation coefficient between $X_1$ and $X_2$, and so on [7].

## 3 RESULTS AND DISCUSSION

### 3.1 RESULTS OF HETEROSCEDASTICITY TEST

#### 3.1.1 RESULT OF GOLDFELD QUANDT TEST FOR HETEROSCEDASTICITY

Following procedure of the above test, at 5% of significance level the results of our data for λ is 1.60 with 7 df. At 5% significance level for 35 denominators and numerators the critical value of F is 1.69 which indicates that F (=λ) estimated value is less than tabulated. This means that results are insignificant, so the hypothesis of homoscedasticity can be accepted.

#### 3.1.2 RESULT OF BREUSCH-PAGAN-GODFREY TEST FOR HETEROSCEDASTICITY

The results of the regression model (7) and (8) are given as follows:

***Table 1 Regression results of BPG test for estimation of $\sigma^2$***

| Variables | Parameters | Co-efficients | Std. errors | t ratios |
|---|---|---|---|---|
| Constant | $B_0$ | 5.079 | -0.887 | -5.723 |
| LnSeed | $B_1$ | 0.111 | 0.055 | 1.986 |
| LnTrctrHrs | $B_2$ | -0.008 | -0.003 | 2.272 |
| LnLabor | $B_3$ | -0.068 | -0.027 | 2.514 |
| LnFert | $B_4$ | 0.203 | 0.065 | 3.118 |
| LnFYM | $B_5$ | 0.081 | 0.022 | 3.595 |
| LnIrrig | $B_6$ | 0.024 | 0.033 | 0.721 |
| LnWeed | $B_7$ | 0.103 | -0.085 | -1.201 |
| $R^2$ | 0.34 | | | |
| ESS | 6.154 | | | |
| Df | 91.00 | | | |
| $\sigma^2$ | 0.056 | | | |

Source: Estimated results from survey data, 2012

***Table 2 Regression results of BPG test for estimation of Θ***

| Variables | Parameters | Co-efficients | Std. errors | t ratios |
|---|---|---|---|---|
| Constant | $B_0$ | -34.512 | 6.030 | -5.723 |
| LnSeed | $B_1$ | 1.104 | 0.555 | 1.986 |
| LnTrctrHrs | $B_2$ | 1.075 | 0.473 | 2.272 |
| LnLabor | $B_3$ | 1.599 | 0.636 | 2.514 |
| LnFert | $B_4$ | 1.706 | 0.547 | 3.118 |
| LnFYM | $B_5$ | 1.298 | 0.361 | 3.595 |
| LnIrrig | $B_6$ | 0.294 | 0.407 | 0.721 |
| LnWeed | $B_7$ | -0.731 | 0.608 | -1.201 |
| $R^2$ | 0.37 | | | |
| ESS | 4.220 | | | |
| Df | 91 | | | |
| Θ | 2.110 | | | |

Source: Estimated from survey data, 2012.

So the tabulated Θ results were 14.0671. Now the critical "$X^2$" value at 5% with 7 df is 2.110 which is greater than our calculated value, so the hypothesis of homoscedasticity is accepted.

### 3.2 RESULT OF CORRELATION MATRIX

The results of correlation matrix are shown in table 3. These results of correlation matrix between explanatory variables shows that there is a positive correlation of FYM with Labor (0.950) while a negative correlation of Tractor with Labor (-0.970) and FYM (-0.961). It means that there is violation of the basic assumption of multicollinearity and there exist multicollinearity problem amongst these explanatory variables.

*Table 3 Results of correlation matrix*

| | lnSeed | lnLabor | lnFert | lnFYM | lnTrac | lnIrri | LnWeed |
|---|---|---|---|---|---|---|---|
| **lnSeed** | 1.000 | | | | | | |
| **lnLabor** | -0.280 | 1.000 | | | | | |
| **lnFert** | -0.142 | 0.441 | 1.000 | | | | |
| **lnFYM** | -0.271 | 0.950 | 0.424 | 1.000 | | | |
| **lnTracHrs** | 0.307 | -0.970 | -0.362 | -0.961 | 1.000 | | |
| **lnIrri** | -0.011 | 0.575 | 0.515 | 0.545 | -0.498 | 1.000 | |
| **lnWeed** | 0.015 | 0.503 | 0.525 | 0.554 | -0.415 | 0.659 | 1.000 |

Source: Estimated from survey data, 2012.

### 3.2.1 REMEDIAL MEASURES FOR MULTICOLLINEARITY

One of the remedial measures of multicollinearity is to drop the most correlated variables. But it is not an easy task to drop the relevant variables from the model as the economic model do not permit, due to which it may cause specification error which is a more serious problem than that of multicollinearity [7].

It is also suggested to transform the data into log form which reduces the problem to some extent. But after log transformation there still exist the problem of multicollinearity. So here in our study we do nothing which is the last option for the rule of thumb.

### 3.3 SUMMARY STATISTICS OF THE VARIABLES USED IN THE STOCHASTIC FRONTIER ANALYSIS

Table 4 shows summary statistics of inputs and output variables collected from a sample of 110 farmers which were implicated in the stochastic frontier production analysis. The estimated mean yield was 3600.60 kg/hectare having a standard deviation of 2540.90 which shows that the farmers have a large variability. Their minimum yield per hectare was 700 kg and maximum yield was 13650 kg.

*Table 4 Summary statistics of the survey variables used in the stochastic frontier production analysis*

| Variables | Unit | Mean | Std. dev. | Minimum | Maximum |
|---|---|---|---|---|---|
| Yield | Kgs | 3600.60 | 2540.90 | 1700.00 | 9650.00 |
| Farm Size | Hectares | 0.44 | 0.33 | 0.05 | 1.82 |
| Labor | MD | 130.06 | 80.93 | 70.00 | 276.00 |
| Seed | Kgs | 243.80 | 207.73 | 168.00 | 600.00 |
| Fertilizer | Kgs | 173.54 | 170.60 | 126.00 | 532.00 |
| FYM | Kgs | 5376.00 | 4022.11 | 00 | 18000 |
| Weedicide | Liters | 1.01 | 0.55 | 00 | 2.50 |
| Tractor Hours | Hours | 2.97 | 1.66 | 0.33 | 8.00 |
| Age of farmer | Years | 46.36 | 9.40 | 25.00 | 70.00 |
| Level of education | Years | 4.48 | 3.68 | 0.00 | 12.00 |
| Farming experience | Years | 10.80 | 6.33 | 2.00 | 31.00 |

Source: Estimated from survey data, 2012.

*Table 5 Maximum likelihood estimates of the stochastic frontier production function for garlic*

*(Dependent variable = Log yield of garlic in kg/ha)*

| Variables | Parameters | Co-efficients | Standard error | t ratios |
|---|---|---|---|---|
| Constant | $B_0$ | 3.6096 | 0.7898 | 4.5700 |
| Seed rate | $B_1$ | 0.1812 | 0.0739 | 2.4526* |
| Labor | $B_2$ | 0.1001 | 0.0617 | 1.6212*** |
| Fertilizer | $B_3$ | 0.1000 | 0.0786 | 1.2722 |
| FYM | $B_4$ | 0.2599 | 0.0680 | 3.8196* |
| Tractor Hours | $B_5$ | 0.1695 | 0.0507 | 3.3415* |
| Irrigation | $B_6$ | 0.1002 | 0.0540 | 1.8548** |
| Weedicides | $B_7$ | 0.0365 | 0.0752 | 0.4851 |
| Inefficiency Effect Model | | | | |
| Constant | $\sigma_0$ | 1.9787 | 0.7574 | 2.6123 |
| Age | $\sigma_1$ | -1.5951 | 0.6341 | -2.5155* |
| Experience | $\sigma_2$ | -0.0367 | 1.7718 | -2.0705* |
| Education | $\sigma_3$ | -0.0084 | 1.4323 | -0.5922 |
| Farm Size | $\sigma_4$ | -0.0096 | 1.2510 | -0.7671 |
| Sigma square | $\sigma^2$ | 0.1727 | 0.0582 | 2.9640* |
| Gamma | Γ | 0.8066 | 0.1126 | 7.1635* |
| Mean efficiency | X | 0.8460 | ----- | ---- |

Source: Estimated from survey data, 2012.

Note: *, **, *** are significant at 1, 5 and10% level respectively.

Their mean farm size was 0.444 hectares having a minimum farm size 0.050 and maximum farm size 1.82 hectares having a 0.32 standard deviation. On average, employed human labor, both family and hired labors were 130.6 man days/hectare having 80.93 man days/hectare of standard deviation. The minimum man days were 25.0 and maximum man days 376.0 per hectare. Farmers used seed of 243.8 kg/ hectare, fertilizer 170.6 kg/ hectare, FYM 5376.0 kg/ hectare and weedicides 1.01 liter/hectare on average. The average age of the farmers in the study area was 46.36 years having a standard deviation of 9.40, the level of education of the farmers were 3.68 years on average having 4.48 standard deviation and the experience of the farmers was 10.80 years having a standard deviation of 6.33.

### 3.4 MAXIMUM LIKELIHOOD ESTIMATES OF THE STOCHASTIC FRONTIER PRODUCTION FUNCTION FOR GARLIC

Table 5 shows maximum likelihood estimates of Cobb-Douglas frontier production frontier along with technical inefficiency factors affecting technical efficiency of garlic growers in the study area. Results revealed that seed rate, FYM and tractor hours were positively affecting garlic yield and were found statistically significant at 1 per cent level. The coefficient of Irrigation was statistically significant at 5 per cent level of significance with positive coefficient. The estimated coefficient of labor was positive and statistically significant at 10 per cent level of significance. Chemical fertilizer and weedicides were positively affecting garlic yield but statistically insignificant.

Technical inefficiency model is presented in lower part of table 5. Results indicated that age of farmers and experience of garlic farming were negatively related with technical inefficiency and were found statistically significant at 1 per cent level of significance. This implies that technical efficiency increases with the increase in age of farmers and experience of garlic farming. The estimated coefficients of education and farm size were found statistically insignificant. The value of gamma (γ) was 0.8066 and significant at 1% level of significance. This implies that 80.66 per cent of variation was due to inefficiency factors included in the model.

The average technical efficiency was 0.8460; implies that if the average farmer in the sample was to achieve the technical efficiency level of its most efficient counterpart, then the average farmer could realize 11.94 per cent cost savings. Similarly the most technically inefficient farmer reveals cost savings of 40.67 per cent. Comparing average technical efficiency of this study with other studies revealed that the average technical efficiency is not far from the findings of [8], [9], [10] with an average technical efficiency of 84%, 89%, and 84% respectively. The average technical efficiency this study is higher than the one recorded by [11], [12], [13], [14] with the mean technical efficiency of 68, 67, 67 and 68% respectively.

### 3.5 FREQUENCY DISTRIBUTION OF TECHNICAL EFFICIENCY OF GARLIC GROWERS

Table 6 shows the estimated technical efficiency's frequency distribution of garlic growers. The minimum and maximum values of estimated technical efficiencies are 0.57 and 0.96, with a mean efficiency of 0.84. So these results indicate that by using the available resources efficiently and technology, garlic production can be improved.

***Table 6 Frequency distribution of technical efficiencies of garlic growers***

| Technical efficiency | Frequency | Percentage |
|---|---|---|
| < 0.57 | 2 | 1.82 |
| 0.57 - 0.67 | 7 | 6.36 |
| 0.68 - 0.78 | 12 | 10.92 |
| 0.79 - 0.90 | 53 | 48.18 |
| >0.90 | 36 | 32.72 |
| Sample size | 110 | |
| Minimum | 0.5762 | _ |
| Maximum | 0.9607 | _ |
| Mean | 0.8460 | _ |

Source: Estimated from survey data, 2012.

## 4 CONCLUSION AND RECOMMENDATIONS

Stochastic frontier Cobb Douglas production function was applied for the estimation of technical efficiency of garlic growers in the study area. Results fevealed that seed rate, FYM and tractor hours were positively affecting garlic yield and were found statistically significant at 1 per cent level. The coefficient of Irrigation was statistically significant at 5 per cent level of significance with positive coefficient. The estimated coefficient of labor was positive and statistically significant at 10 per cent level of significance. Chemical fertilizer and weedicides were positively affecting garlic yield but statistically insignificant. The socio-economic characters such as age, and experience significantly and negatively affected technical inefficiency while education and farm size were found to be statistically insignificant. Results further revealed that the mean technical efficiency was 84.60 percent; implies that if the average farmer in the sample was to achieve the technical efficiency level of its most efficient counterpart, then the average farmer could realize 11.94 per cent cost savings. Similarly the most technically inefficient farmer reveals cost savings of 40.67 per cent.

Based upon these results most of the farmers were appling small amount of seed due to lesser experience which resulted in low production. So the government should motivate the farmers to use recommended quantity of seed for higher productivity. Garlic farming is labor intensive so there is an intense requisite of latest technology to replace labor in production of garlic. Experience of garlic growers plays an important role in garlic production so training programs need to organized for enhancement of garlic productivity.

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# Autonomous Navigation of a Robotic Metal Detector

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**ABSTRACT:** A practical and simplified approach is applied to the implementation of an Autonomous Robotic Metal Detector (ARMED). The literature gives detailed information of the basic concepts and design strategies used to design the metal detector. The Robot is controlled by a microcontroller. Infra-red sensors detect the presence of objects and the microcontroller activates the required search algorithm to detect the metallic property of the metal sensed. The metal detector makes use of a Colpitts Oscillator design to detect metals.

**KEYWORDS:** Colpitts Oscillator, Microcontroller, Metal Detector, Algorithm, Obstacle Avoidance.

## 1 INTRODUCTION

In the 21st century the impact of robotics has left a significant impact in the day to day affairs of man. The robotic metal detector is no exception, as it makes use of basic principles of robotics to detect metals without any human control. This form of metal detection is very important due to its effectiveness as compared to later forms of metal detection techniques which are manually operated and very slow in carrying out metal detection effectively. Robot controlled metal detectors play important roles in detecting land mines and metals in airports, sea ports, banks, etc.

The design of the robotic metal detector involved the application of microprocessor based programming to provide a more effective form of metal detection; various microprocessors were studied in order to narrow down a simpler, economical and more flexible microprocessor to meet with the challenging task. The robot was designed to be adaptive to reprograming in order to fit into various tasks depending on the nature of the task in question. In the design of the program, the sequence of operation of the metal detector was simplified to reduce system complexity.

## 2 PROBLEM STATEMENT

The ability to sense for the property of metals in objects has been a great challenge in engineering. Various objects as well as destructive devices such as landmines, improvised Explosive Devices (IEDs) etc. In space exploration, where human inhabitation is almost impossible, robotic systems are capable of executing such detection and observatory routines.

## 3 PREVIOUS WORK

In early days of metal detection, *Hughes et al* demonstrated a manually operated induction balance metal detector. It purpose was to study the metallic structure of metals and alloys.

A more advanced approach developed in later years adapted a robot controlled metal/mine detection robot (RCMD). This approach quantitatively addressed the relationship between the detection performance and controlling the gap and attitude of the sensor head to the ground surface. The RCMD adapted 3-D high speed mapping of the ground surface and can generate trajectories of the sensor head with 3-D stereovision camera and Laser camera. Image processing algorithms were

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applied for vegetation recognition. The controlled object of this approach is called Controlled Metal Detector (CMD). It consists of the two-coil metal detector and a 3-DOF mechanical manipulation mechanism driven by electric motors.

## 4 PROPOSED APPROACH

The design makes use of a single and robust microcontroller 16f84A. The robot comprises of four geared stepper motors to provide easy navigation. A Colpitts oscillator is integrated in to the robot for metal detection. The design was developed to showcase an easy yet effective approach for metal detection to enhance academic research and real-time simulation of test scenarios. This approach compared to other methods proved to be economical yet effective for small/medium scale metal detection.

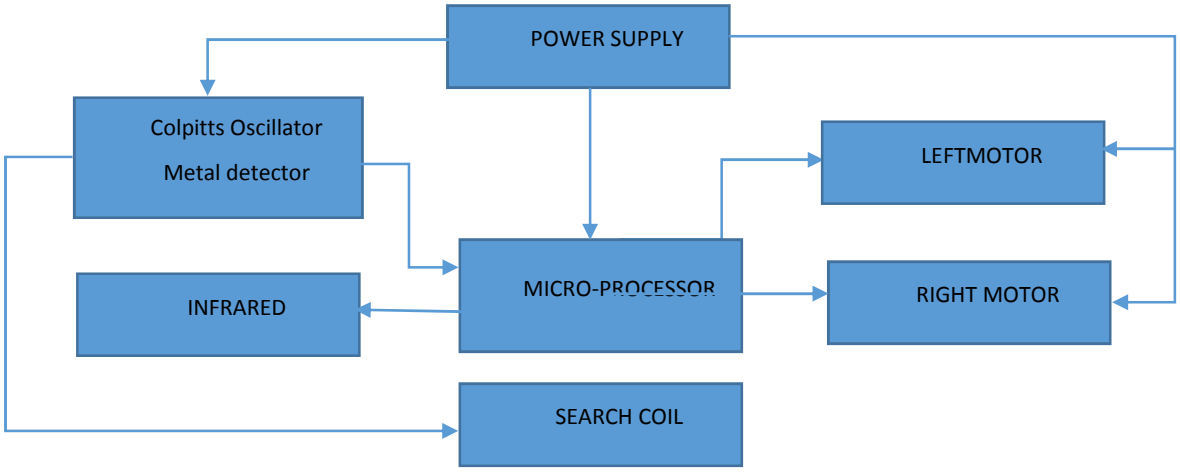


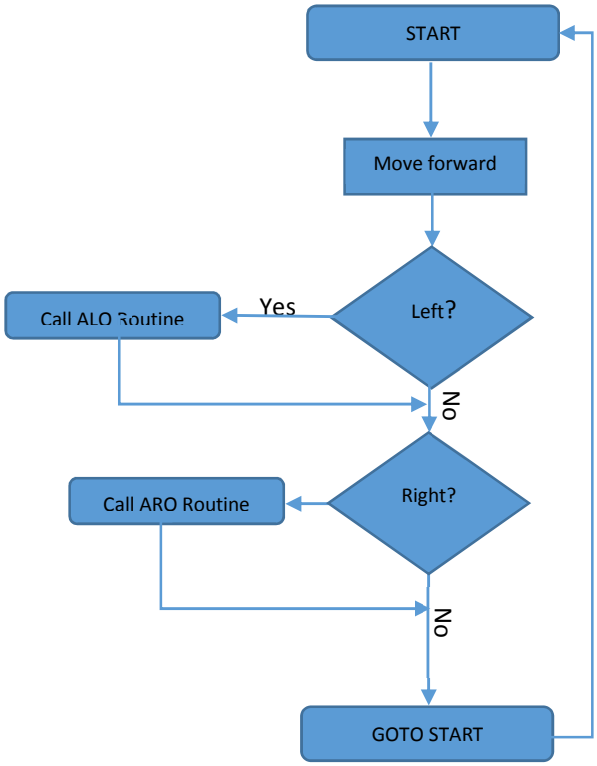

**Fig 1.0. The Proposed System block diagram**

## 5 AUTOMATION AND CONTROL ALGORITHM

The Autonomous Robotic Metal Detector (ARMED) is controlled by an obstacle avoidance algorithm that responds to signals from an array of infrared detectors. The signals from the sensors are used to initiate various routines to approach an object, detect the metallic property of objects along its path and finally assumes another orientation for further detection.

The three routines are divided into three main algorithms (Avoid Left Obstacle [ALO], Avoid Right Obstacle [ARO] and Metal Detection Routine [MDR]) that caters for 180 degrees object avoidance routine and metal detector drive control.

**AUTONOMOUS CONTROL ROUTINE FLOW CHART**




**Main Control Program Snippet**

```
Scan Infrared ports {
 If (object == left)
          Call ALO routine () {
 Start MDR ()
          }
else
 Call ARO routine () {
          Start MDR ();
                    }
end;

}
```

**Fig 2.0 (a) Flow chart diagram of Robot Search routine (b) Control code snippet**

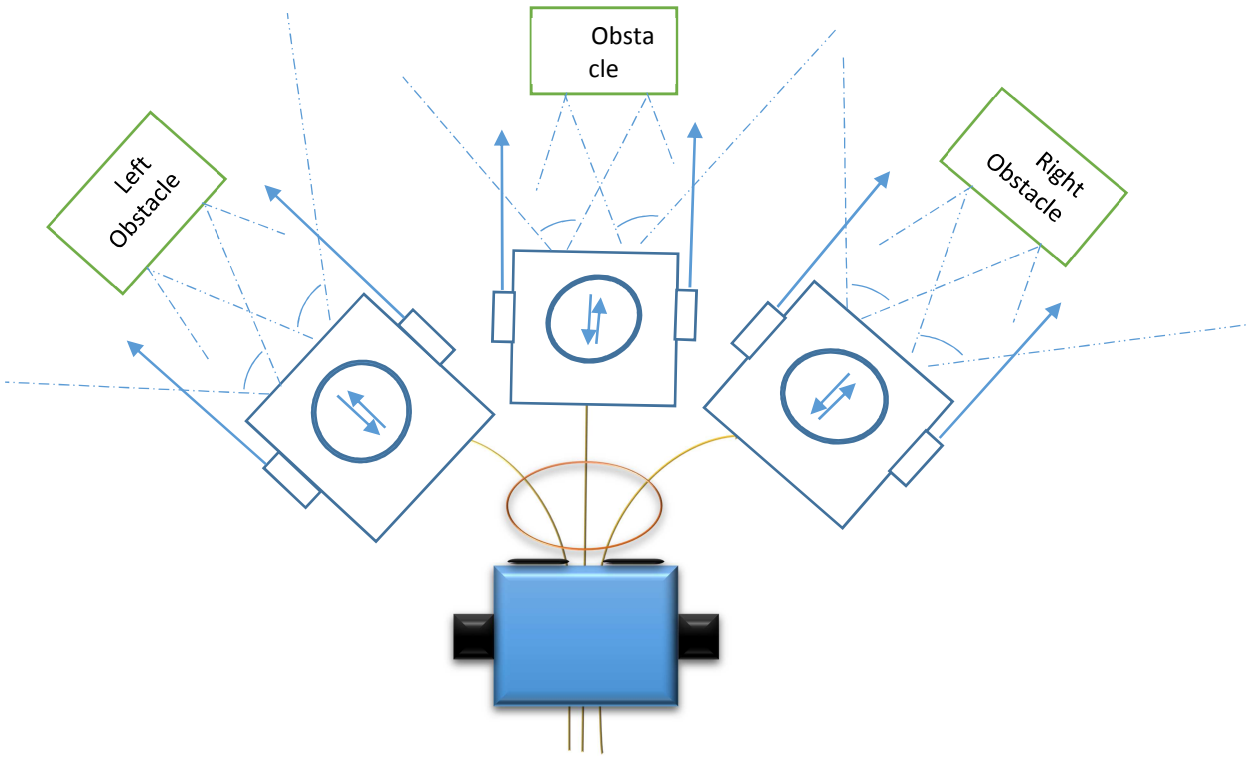



**Fig 3.0 Robot Multi directional Search path**

## 6 OBSTACLE AVOIDANCE BEHAVIOR

The obstacle avoidance detector comprises of an infrared transmitter and receiver, the infra-red transmitter was designed to oscillate at about 36 kHz (at this frequency, the infrared receiver is able to detect infra-red rays). The obstacle avoidance feature of the robot alerts the microprocessor of the presence of an object of considerable distance of about 5 – 20cm. The infrared sensors are constantly at a high state (logic I), in the situation where an object is detected, the rays are reflected back to the sensor which sends a low signal to microprocessor, at the reception of the signal, the micro-processor executes the appropriate obstacle avoidance routine as illustrated in the block diagram.

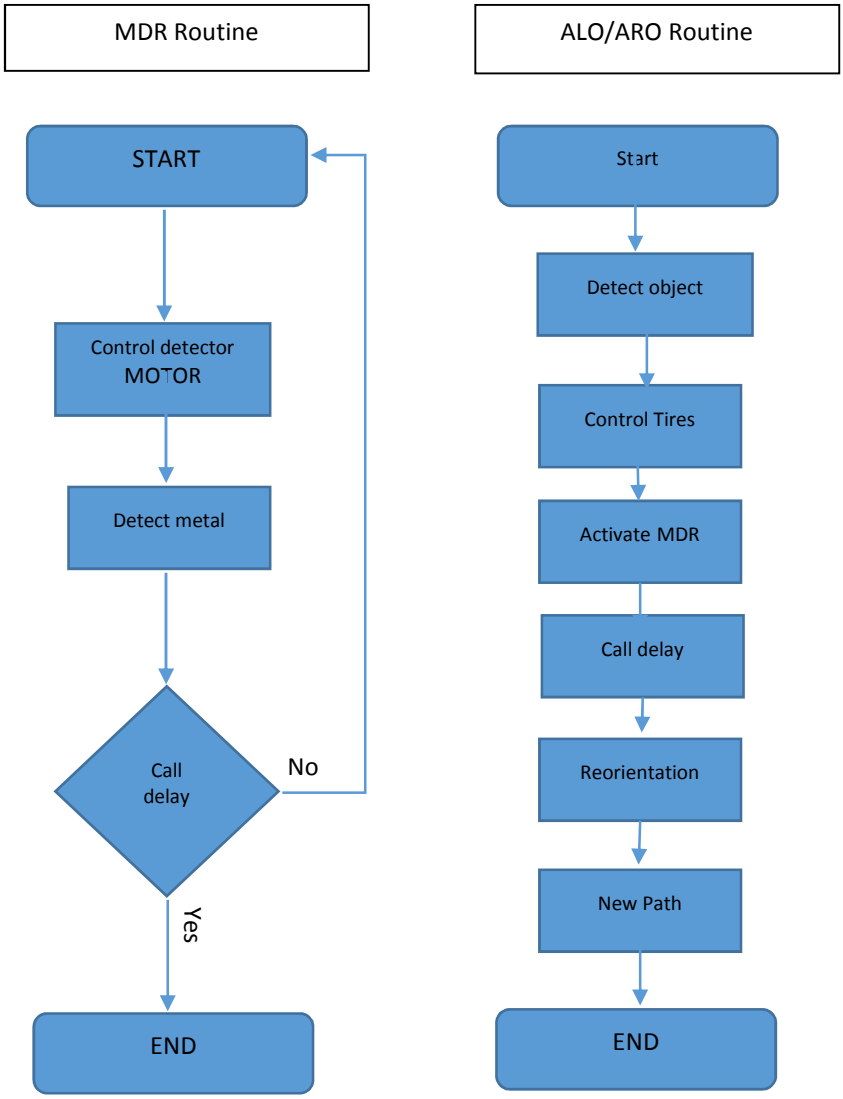



**Fig 4.0 (a) Metal Detection routine (b) Obstacle Avoidance and Coil search routine**

## 7 METAL DETECTOR

The metal detector comprises of two Colpitts oscillator coupled together to a two stage amplifier. Both oscillators are tuned to oscillate at similar frequency of about 110 – 160 kHz. One of the coils is formed into a *circular loop* of about 8 – 12 cm while the other coil of the oscillator is onboard the circuit panel in a smaller diameter loop of about 1 – 2 cm. The coil with the wider loop acts as the searching (detector) coil to be controlled by the robot for metal detection. When the detector coil is place over any material with metallic properties, the frequency of the oscillators drops significantly, so as to cause an

imbalance in the circuit. The difference in the frequency alters the tone of a speaker or beeper connected to a two stage amplifier.

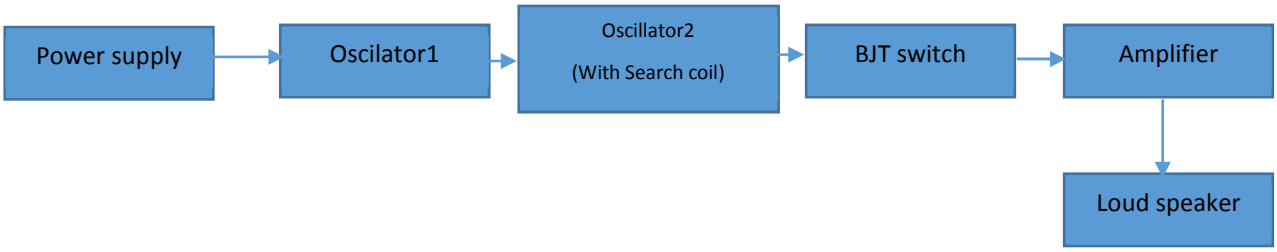



**Fig 5.0 Metal detector block diagram [4]**

### 7.1 COLPITTS OSCILLATOR

The Colpitts oscillator is an LC oscillator that can be implemented in two main configurations; common-base and common collector [3]. As earlier stated, the oscillator is unique because of its simplicity and robustness.

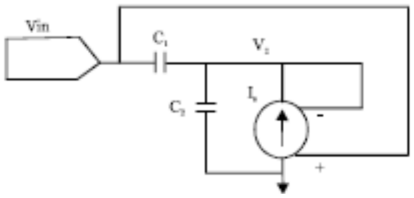



**Fig 6.0 Colpitts Oscillator Model [3]**

Eliminating all other elements, the Ideal frequency of oscillation is:

$$f_0 = \frac{1}{2\pi\sqrt{L\frac{C_1C_2}{C_1+C_2}}}$$

The input impedance is written as:

$$Z_{in} = \frac{V_1}{I_2}$$

$V_i$ Is given as:

$$V_2 = I_2Z_2$$

$Z_2$ Is the impedance of$C_2$. The current flowing into$C_2$. Is $I_2$, which the sum of two currents $I_2$

$$I_2 = I_1 + I_2$$

Where $I_s$ is the current supplied by the transistor $I_s$ is a dependent current source, as shown below

$$I_s = g_m(V_1 - V_2)$$

$g_m$ Is the Trans conductance of the transistor. The input current is written as:

$$I_s = (V_1 - V_2)/Z_1$$

Where Z is the impedance of c2, solving for V1 and substituting above yields:

$$Z_{in} = Z_1 + Z_2 + g_mZ_1Z_2$$

The input impedance appears as the two capacitors in series with an interesting term, $R_{in}$ which is proportional to the product of the two impedances, $R_{in}$ = $g_mZ_1Z_2$and in cases where $Z_1$ and $Z_2$ are complex $R_{in}$ becomes:

$$R_{in} = \frac{-g_m}{w_2C_1C_2}$$

## 8 CONCLUSION

The design and implementation of the Autonomous Robotic Metal Detector has proven to be a very important tool in the detection of metallic properties in materials. The ease at which it operates has also given the robot a very flexible approach to metal detection. As such, the robotic metal detector can be easily integrated to serve other purposes such as an obstacle avoidance robot and also for laboratory tutor purposes. Its flexibility feature is due to the fact that all the components of the robot were made in very simple modules that can easily be dismantled and reconfigured to meet the designer's specifications. The design also re-emphasizes the importance of robotic systems in solving complex tasks. Hence, robotic engineering is of paramount importance in the 21st century to meet growing challenges that requires an inter-disciplinary approach.

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# Securing Ad Hoc Networks: Trust Systems and Replicas Detection

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**ABSTRACT:** In mobile Ad-Hoc networks, each node of the network must contribute in the process of communication and routing. However, this contribution can expose the network to several types of attackers. The security of mobile ad hoc networks is an open research topic and a major in terms of their vulnerability to various attacks, such as black hole, Sybil ... etc. In this article, we analyze the attack black hole (black hole) in ad hoc networks using as AODV routing protocol. In a black hole attack, a malicious node impersonates a legitimate node, manufactures forged responses with a number of high sequence and thus forces the victim node to select it as a relay.
We are interested in a first time to study the impact of dishonest nodes on the network, and then we will simulate black hole attack using two simulator NS2 and OPNET.

**KEYWORDS:** Ad Hoc networks, Black-Hole, Attack, AODV.

## 1 INTRODUCTION

An ad hoc network [1] is an autonomous and cooperative set of mobile nodes that move and communicate via a wireless transmission that does not assume pre-existing infrastructure. The ad hoc network [1] is formed spontaneously as soon as the provisional and more mobile nodes are within radio range of each other. The nodes communicate, depending on the distance between them, two modes of communication: mobile nodes can communicate directly (in ad hoc transmission) as either they are within range, or they must use other mobile nodes as relays to route packets to their destination. Thus, each node is the end user and router to relay packets to their final destination, due to the limited coverage of the radio field available for each node once. However, due to the distributed nature of wireless nodes, there are several vulnerabilities and the black hole is one of the best known.

In this paper, we will focus on the performance of AODV [3] (Ad hoc On-Demand Distance Vector) protocol under Black hole attack. We did our simulation with OPNET [5] and NS2 [4] by implementing a new protocol, that adopts the algorithm of AODV [3] and the behavior of a Black hole attacker.

## 2 OVERVIEW OF AODV ROUTING PROTOCOL

Ad-hoc routing protocols determine the appropriate path from the source to destination and efficiently notify the network with link failure, if it occurs. These protocols are broadly divided into two categories.

- Table-driven routing protocols.
- Source-initiated on-demand driven routing protocols.

Table-driven routing protocols are also known as proactive routing protocols. These protocols desire to maintain consistent and up-to-date routing information in the network. The nodes exchange the routing information periodically and also when there is even a minor change in the network topology and thus, every node maintains one or more routing table to store routing information about every other node in the network.

As a result, these protocols are not preferred in large network. The highly dynamic network also avoids it, as there is lot of message exchanges and it will create congestion and delay in the network. The protocol evolves periodic exchanges even when there is no change in topology and this is simply the wastage of network resources. The mobile devices may also drain out their battery power sooner in such cases. In spite of several drawbacks, these protocols also have the advantage that there is no initial delay as routing information is always available.

AODV [3] is used to find a route between source and destination as needed and this routing protocol uses three significant type of messages, route request (RREQ), route reply (RREP) and route error (RERR). The source S sends its neighbors a route request RREQ (Route reqest ) which contains the address of S, the request identifier , a sequence counter , address D and the counter number of jumps with a initial value zero. The source RREP_WAIT_TIMEOUT waiting period , if a response is received then the operation of route discovery is completed, otherwise it rebroadcasts the RREQ and waits for a longer period if no response is received, it will continue the replay RREQ up a maximum number of attempts RREQ_RRTRIE S (03 attempts) , if after RREQ_RETRIE S attempts to establish road, there is no response then the process is aborted and an error message is reported to the application. After a waiting period (10s), the application requests the route and consequently the route discovery process is initiated [6]. Each node that receives the RREQ checks its local routing table if a route to node D if the node that processes the request RREQ increments the hop count and diffuse again. When the request reaches the destination D or a node that has a route to the destination, a reply RREP (Route REPly ) broadcasts on the same road of receipt of RREQ (reverse path). Reply RREP contains the source address, destination address, hop count , a destination sequence number and the life of the package. Reply RREP through the reverse route to the source node S. Thus each node on the route, writes an entry in the local routing table to the destination node before sending the packet. Once the source S receives the message, it starts to send data to D.

### *A. Route Request (RREQ) Message*

This type of message is used by AODV at first in order to locate a destination, this message contains identification of request, sequence number, destination address and also a count of hop initialized by zero.(Fig.1) [9]

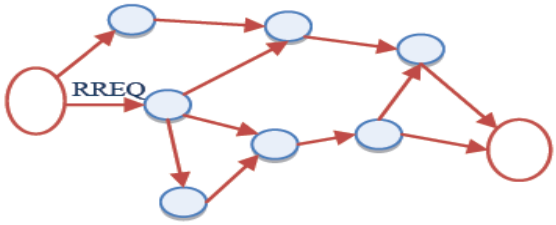


***Fig. 1. Route Request (RREQ) Message***

### *B. Route Reply (RREP) Message First*

This type of message contains the same fields like Route Request (RREQ) Message, and it sent in the same route of reception of RREQ message. When the source received this message, it mean that the destination is ready to accept information and the rout is working correctly. (Fig.2) [9]

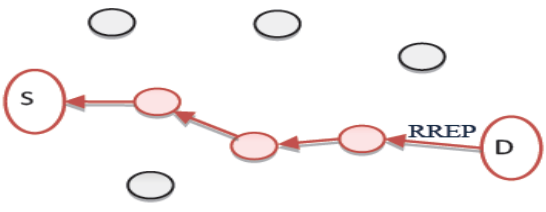


***Fig. 2. Route Reply (RREP) Message***

### *C. Route Error (RERR) Message*

Sometimes a node detect a destination node that not exists in network, in this scenario another message (Route Error RERR) is sent to the source informing that the data is not received. RERR is like an alert message used to secure table of routing. (Fig.3) [9]


***Fig. 3. Route Error (RERR) Message***

## 3 AD HOC NETWORK AND SECURITY ISSUES

In a MANET [2], all entities can participate in routing, so there are no barriers for a malicious node to cause disturbances in the circulating traffic. The interest of the attacker is essentially to compromise the confidentiality and integrity of information in transit, or more generally to disrupt the proper functioning of the routing process to dominate the network.

In MANET [2], depending on the level of intrusion actions by an attacker, there are generally two types of attacks: passive attacks and active attacks.

- Attack passive

The adversary only monitors the communication channels. Listening occurs when an attacker captures a node and studied traffic that passes through without altering the operation. The analyzed data help the intruder to act later. A passive adversary that threaten privacy.

- Active Attack

An attack is active when a node unauthorized alter routing information in transit through actions modification, deletion, or manufacturing, which leads to disturbances in the functioning of the network.

In addition, by field of membership of a node, active attacks can themselves be divided into two categories, namely internal and external attacks. While external attacks are carried out by nodes that do not belong to the network domain, internal attacks are carried out by compromised nodes that are allowed to participate in the network operation. Because attackers are already part of the network of nodes allowed, internal attacks are generally more harmful and difficult to detect than external attacks.

Some main security issues are briefly described here.

### *A. Security Issues in MANET*

1) Decentralized Connection: Unlike the traditional approach of networks having a fixed infrastructure and central points (access points), MANET [2] is connected in a decentralized manner. It works without a pre-existent infrastructure. The nodes in it work as routers and host, forwarding and receiving the data packets. Due to this absence of a central management, detecting the attacks or monitoring the traffic is very difficult in large scale or highly dynamic MANETs.

2) Uncertain Boundaries: Mobile Ad Hoc Networks [1] do not have any clear or secure boundary. As the nodes can leave or join the network anytime and can communicate with other nodes in the network, it is not possible for a MANET [2] to have certain boundaries. If a node is in the radio range of a MANET, it automatically joins it. This characteristic makes a MANET [2] more susceptible to security threats. Network or the applications running in it can be disturbed through redundancy, distortion, leakage and injection of false information.

3) Dynamic Topology: In MANET [2], nodes are free to frequently leave and join the network and move arbitrarily. Thus the routes change very often, changing the topology dynamically. These changes in nodes, routes and topologies are very frequent and unpredictable. This results as partitioning of network and cause loss of data packets affecting the integrity of information.

4) Scalability issues: Mobile Ad Hoc Networks [2] are quite different from the traditional approach of fixed networks,

where the network is created by connecting the devices through wires so that one can define the network during the initial phase of design and it does not changes during the use. On the other hand, in MANETs [2] nodes are free to move in and out of the network. Nobody can predict the number of nodes a MANET [2] had in past or can have in future.

5) Compromised Node: Compromised node is a node in MANET [2], on which the attackers get the control through unfair means with the intentions of performing malicious activities. The nodes in MANET [2] are free to move and autonomous in nature. They cannot prevent the malicious activities they are communicating with. As the nodes can join and leave the network anytime, it becomes very difficult to track or monitor the malicious activity because the compromised node changes its position too frequently.

6) Physical Security Limitations: MANET [2] often suffers with security attacks. Mobility of nodes increases this possibility and makes it more susceptible to malicious activities. These attacks include monitoring of traffic with unfair intentions, denial of service attack in which a malicious node claims to be a different node to get the sensitive information, masquerading, spoofing etc.

7) Limited resources: The nodes in a MANET [2] rely only on battery power for energy means, as they do not have any centralized management. Bandwidth constraint also affects as they have lower capacity than that of the infrastructure based networks. MANETs [2] have variable capacity links. Along with limited power, the storage capacity of a MANET [2] is also limited.

### *B. Security Issues in AODV*

AODV [3] protocol is exposed to a variety of attacks, the impact of these attacks on AODV [3] protocol are not the same. Some of these attacks can cause a breakdown of the network connectivity, increasing the end-to-end delay, increasing the number of the loss packets, or shutting down some nodes by consuming all the energy left in there batteries.

1) Wormhole attack

In this attack, an attacker records a packet, at one location in the network, tunnels the packet to another location and replays it there [8].

2) Byzantine attack

In this attack, malicious nodes individually or cooperatively carry out attacks such as creating routing loops and forwarding packets through non-optimal paths.

3) Rushing attack

Rushing attacker forwards packets quickly by skipping some of the routing processes. So, in on-demand routing protocol such as AODV [3], the route between source and destination include rushing nodes.

4) Resource consumption attack

In this attack, an attacker attempts to consume battery life of other nodes.

5) Location disclosure attack

In this attack, information relating to structure of network is revealed by attacker nodes.

6) Black hole attack

In the Black hole attack : A malicious node must be placed between two or more nodes start dropping all traffic.

This attack exploits the vulnerability of route discovery packet routing protocol by modifying the latter to control all traffic flowing between the nodes.

## 4 BLACK HOLE ATTACK

Due to these above-mentioned issues, MANET [2] is susceptible to many security attacks. Black Hole Attack is one of these attacks. It is a simple but certainly effective Denial of Service attack in which a malicious node, through its routing protocol, advertises itself for having the shortest path to the destination node or to the node whose packets it wants to intercept. It pretends to have enough of fresh routes for a certain destination. The source node assumes it true and the data packets are forwarded to a node, which actually does not exist, causing the data packets to be lost. When a source node wants to initiate the communication, it broadcasts a RREQ message for route discovery. As soon as the malicious node receives this RREQ packet, it immediately responds with a false RREP message to the respective node advertising itself as the

destination or having the shortest path for that destination. Since the malicious node needs not to check its routing table before responding to a routing request, it is often the first one to reply compared to other nodes. When the requesting node receives this RREP, it terminates its routing discovery process and ignores all other RREP messages coming from other nodes. Thus, the data packets are sent to such a "hole" from where they are not sent anywhere and absorbed by the malicious node. Often many nodes send RREQ simultaneously; the attacker node is still able to respond immediately with false RREP to all requesting nodes and thus easily takes access to all the routes. In this way source, nodes are bluffed by malicious node, which gulps a lot of network traffic to itself resulting severe loss of data. Black Hole nodes may also work as a group in a network. This kind of attack is called Collaborative Black Hole attack or Black Hole Attack with multiple malicious nodes.

The main objective of black hole attack is to drape packets and break communications between nodes, all the network's traffic is redirected to a specific node, which does not exist at all. Black hole node work with two scenarios, in the first one the node exploits all the vulnerability that exists in an ad hoc network such as announcing itself having a valid route to a destination node; the Second one, the node drupes and controls all the intercepted packets. The Black hole attack in AODV [3] protocol can be classified into two categories: black hole attack caused by RREP and black hole attack caused by RREQ.

### *A. Black hole attack caused by RREQ*

With sending fake RREQ messages, an attacker can form black hole attack as follows:

a) Set the originator IP address in RREQ to the originating node's IP address.

b) Set the destination IP address in RREQ to the destination node's IP address.

c) Set the source IP address of IP header to its own IP address.

d) Set the destination IP address of IP header to broadcast address.

e) Choose high sequence number and low hop count and put them in related fields in RREQ.

So, false information about source node is inserted to the routing table of nodes that get fake RREQ. Hence, if these nodes want to send data to the source, at first step they send it to the malicious node.

### *B. Black hole attack caused by RREP*

With sending fake RREP messages, an attacker can form black hole attack. After receiving RREQ from source node, a malicious node can generate black hole attack by sending RREP as follow:

a) Set the originator IP address in RREP to the originating node's IP address.

b) Set the destination IP address in RREP to the destination node's IP address.

c) Set the source IP address of IP header to its own IP address.

d) Set the destination IP address of IP header to the IP address of node that RREQ has been received from it.

## 5 SIMULATION OF BLACK HOLE ATTACK ON AODV PROTOCOL

Ad hoc networks [1] are a typical example of systems that require the cooperation of all participants for their good work. Any deviation from a participating authorized by the policy implemented in the system behavior negatively affect the proper functioning of the network. For example, the function of routing in ad hoc networks or sensor networks. As there is no infrastructure routing, a node is free on his handling of the packets it receives. It may decide to behave in accordance with routing rules (to properly address these packets) or to adopt a behavior contrary to the rules defined in the network. Indeed, the node may decide not to route messages from its neighbors (node adopts selfish behavior), which is the opposite of the spirit of cooperation of ad hoc networks. The node can go even further and question the integrity of the data it receives (modify packets received special control packets which are in most cases not encrypted). The node can also inject false routing information that will result in corrupting the routing tables of some nodes of the network and thereby distort the routing function.

In our simulation of the Black hole attack, we used two simulators: the first one is OPNET [5] and the second is NS2 [4].We fixed some cases where we study the impact of the crisis on the AODV [3] protocol and the entire network without knowing. The contested node or how the traffic is generated. We try to determine the number of packet loss in the network with the most real scenarios in terms of mobility and traffic generation.

### *A. Simulation in OPNET*

To study the impact of the black hole attack on mobile networks MANET [2], we will create two scenarios on OPNET [5] in the first we will simulate the network without attack and in the second we will implement the attack, then we will compare the results.

| Simulation parameters | |
|---|---|
| Simulateur | OPNET 14.5 |
| Routing Protocol | AODV |
| Number of nodes | 5 |
| Field simulation | 1000x1000 |
| MAC (wireless protocol) | 802.11 |

To observe the effect of the attack of the black hole more clearly the following metrics are added :

- Traffic received.
- Traffic sent.

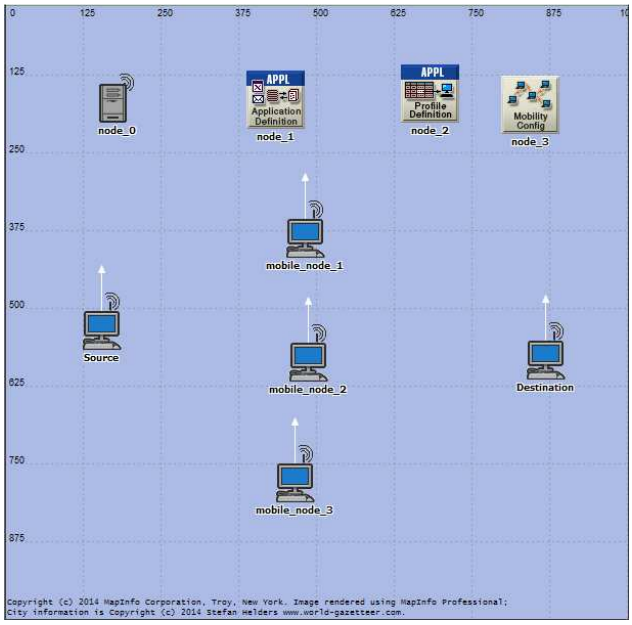


**Figure 4 : Simulation environment.**

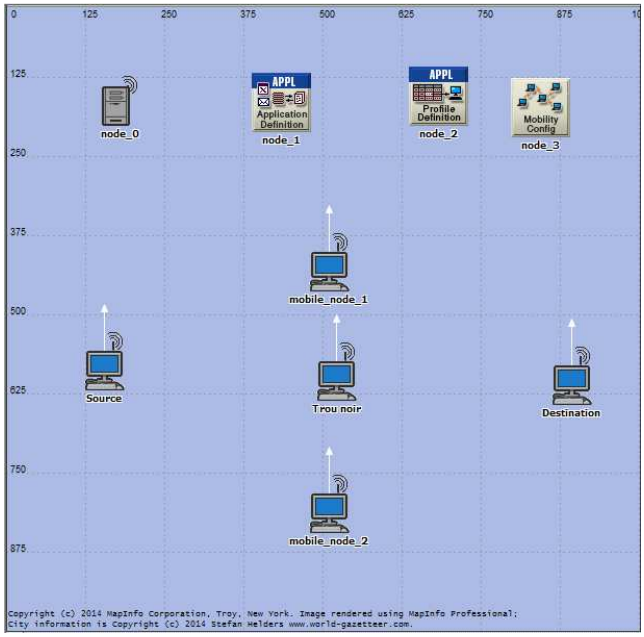


**Figure 5 : Simulation environment with black hole.**


**Figure 6 : Traffic received by the destination.**

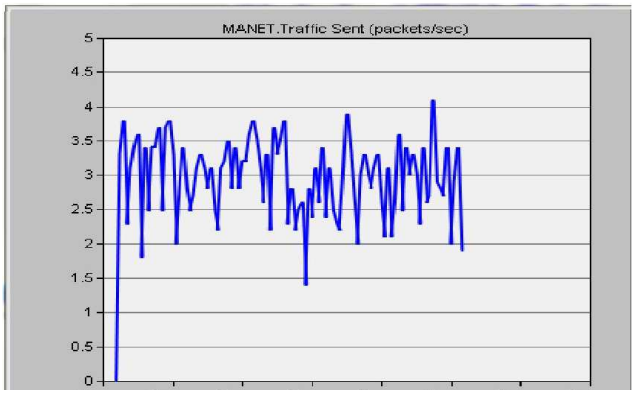


**Figure 7 : Traffic received by the black hole.**

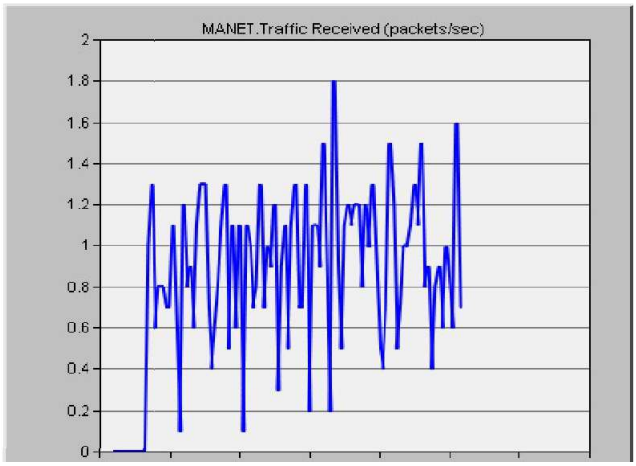


**Figure 8 : Traffic sent by the source.**

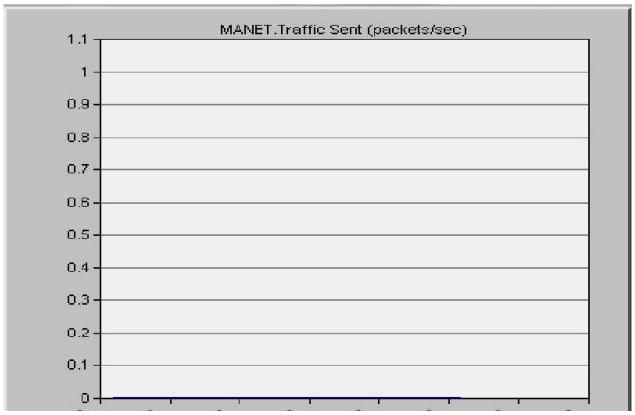


**Figure 9 : Traffic sent by the black hole.**

In Figure 8, the source node sends packets to the mobile node that sent the packet then the malicious node that keeps these packets as shown in Figure 9.

From the results, we can say that the corrupt node is its goal:

- Manage the flow of data over the network.
- Allow traffic flow itself.

***B. Simulation in NS2***

Various mobilities of nodes have been considered to measure the performance of network in presence of malicious nodes as attackers. Fig. 10 demonstrates the results in presence of only one malicious node. Fig. 11 demonstrates the results in presence of tow malicious nodes. Fig. 12 shows the results in the presence of malicious nodes to three. Fig. 13 shows the results in the presence of four malicious nodes.

| Simulation parameters | |
|---|---|
| Simulator | Ns2.34 |
| Routing Protocol | AODV |
| Nombre des nœuds totaux | 20, 40, 70, 100, 120. |
| Number of total nodes | 5, 10, 15, 20, 25. |
| Field simulation | 750 * 750 m |
| Pause Time | 1.0 |
| Max speed | 20 m/s |
| Time | 500s |
| Trafic | CBR |
| MAC ( wireless protocol ) | 802.11 |

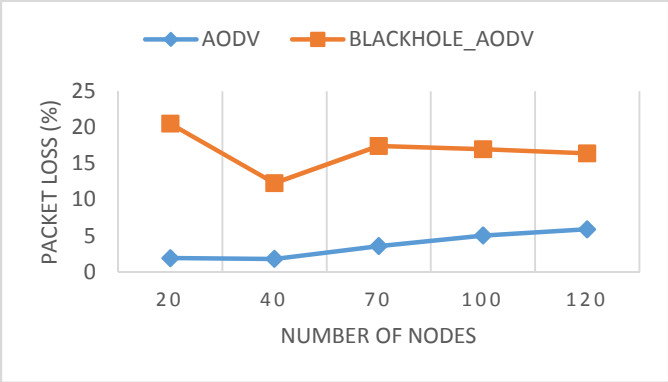


**Figure 10 : Lost packets under the impact of a single malicious node in AODV**

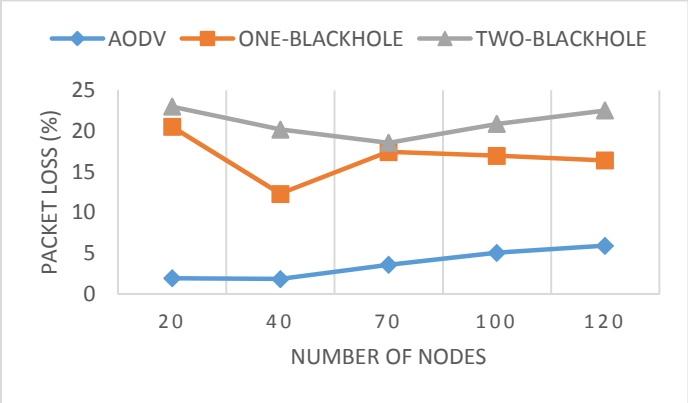


**Figure 11 : Lost packets under the impact of two malicious nodes in AODV**

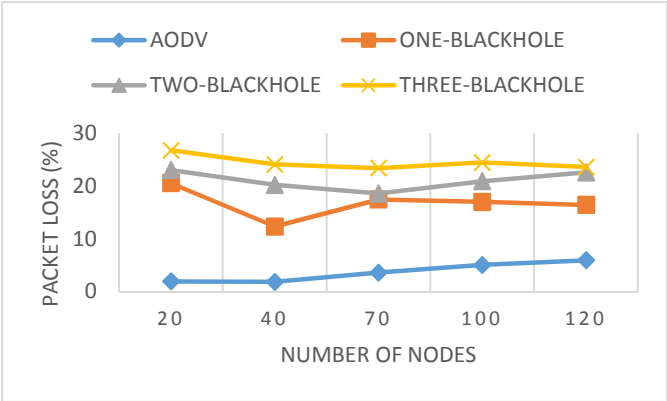


**Figure 12 : Lost packets under the impact of three malicious nodes in AODV**

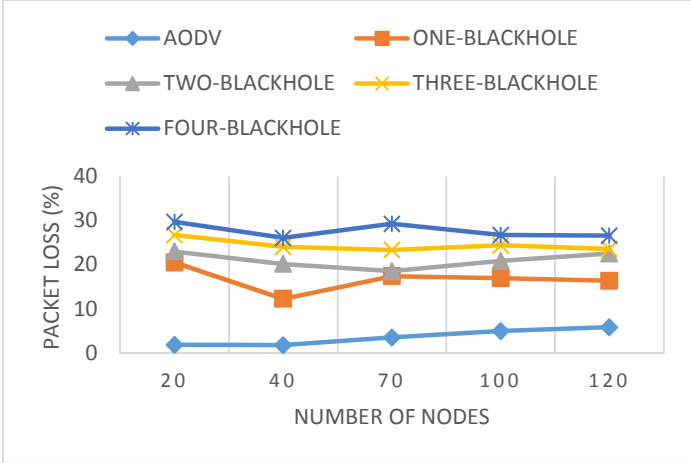


**Figure 13 : Lost packets under the impact of four malicious nodes in AODV**

From the results obtained, we can conclude that as the number of malicious nodes in the network increases more packet loss become important.

## 6 CONCLUSION

Ad Hoc Network [1] is independent of any fixed infrastructure or central management and have frequent routing updates which makes it easy to set up, low in cost, provides communication by wireless means with nodes working as routers as host.. However, with these benefits MANET [2] characteristics make it vulnerable to many attacks of active and passive safety, which affects the confidentiality, integrity and availability of data being transmitted. Black Hole Attack is one of these

The Black hole is one of the most powerful attacks on an Ad hoc network, it can cause a complete failure of the network by dropping all the traffic specially when the nodes are non-mobile. In some protocols where we use cluster heads an attacker can be placed between two cluster and cause an isolation In this article we are interested in the analysis of the black hole attack, we propose a model to measure the effect of this attack on the operation of mobile ad hoc networks [2].

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# A novel technique to fabricate occlusal surfaces for artificial resin teeth in base metal alloys

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**ABSTRACT:** *Statement of the Problem:* One of the existing problems in maintenance of balanced occlusion in complete denture prosthesis is the wear that is associated with artificial resin teeth. Wear of acrylic results in concomitant loss of vertical dimensions which later manifests in other problems like residual ridge resorption. Though there are at present certain brands which manufacture teeth with occlusal surfaces in metal, but they have not found much clinical acceptance by both dentists as well as patients.
*Purpose:* To fabricate occlusal surfaces of resin artificial teeth in base metal alloys in order to preserve the integrity of balanced occlusion in the complete denture prosthesis.
*Materials and Methods:* A completely edentulous patient, artificial prefabricated resin teeth, elastomeric impression material and pattern wax.
*Results:* Artificial resin teeth can be modified on the occlusal surface and transformation of occlusal surfaces in base metal alloy results in long term maintenance of occlusal contacts and thus maintains the principles of preservation of residual alveolar ridges.
*Conclusion:* Artificial resin teeth can be modified with this simple and novel technique of fabricating occlusal surfaces in base metal alloys.

**KEYWORDS:** Completely edentulous, complete denture prosthesis, balanced occlusion, adaptation, mastication.

## INTRODUCTION

Modification of the body in one form or the other has attracted attention in humans whenever attempted since early times. Body modifications in the form of body piercing, tattooing, scar designing, elongation of the neck or narrowing of the waist have been attempted with success. Some have done it to look different, whereas some have done to fulfill their traditions while some have done to enter their name in the Guinness book of world records. The human organs that have been modified in one form or the other are nose, ear, eyelids, skin, nails and teeth. Modification of natural teeth has also been reported in the form of placing anterior gold crowns, bonded diamonds, tooth tattoo etc. These modifications in natural teeth are primarily done for nonfunctional purpose. These demands lie primarily in the zone of being less harmful to the patient and if oral hygiene is maintained properly then acceptance is assured. These body modifications have prompted the prosthodontist to innovate their prosthesis as well. Over the years artificial teeth have been modified to fulfill the objectives of an effective and versatile prosthesis. These modifications have included the use of materials like gold [1], [2], [3], acrylic resin [4], [5], [6] and porcelain [7], [8], [9], [10] as artificial substitutes for natural teeth.

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Patients demand about the ability of their denture to masticate effectively is not new to any prosthodontist. Such demands are quite natural in the light of the many, varied activities which are centered in the oral cavity. It is even more understandable when one considers that mastication of food serves not only to meet the physiological limitations of swallowing but also to satisfy certain oral sensations. For a patient mastication with a denture without hesitating cultivates confidence in him for his prosthesis. The masticatory efficiency can be directly related to the overall efficiency of the selected teeth in the prosthesis. Factors related to denture that influence the masticatory performance of a denture have been studied. [11], [12], [13], [14] One of the important factors that has been found significant to masticatory efficiency is the food platform area. [15]. [16] There are many ways to increase the food platform area, [17], [18] one of which is the use of artificial teeth with steep cuspal inclines. One objective for every prosthodontist should be to maintain the food platform area throughout the life of the denture.

Among the various materials available for use as artificial teeth, resin teeth are diverse as they can be customized to the individual needs of the patient.[19] Even though the acrylic teeth do offer so many advantages they still have the drawback of not maintaining the food platform area because of wear of teeth. [4], [5] Rapid wear of artificial resin teeth leads to decreased masticatory efficiency and performance as well as problems associated with decreased vertical dimensions of the complete denture prosthesis. Acrylic teeth have been modified over the years to compensate partly for this problem. One such method is to customize the occlusal surface with gold alloy or base metal alloy. Due to the enormous increase in gold and gold related alloys it has become increasingly difficult for the common man to afford such treatment. This clinical case report describes a simple method to develop the posterior occlusal table of a complete denture in base metal alloy and a simple method to achieve balanced articulation for the same.

## CLINICAL AND LABORATORY PROCEDURE

**HISTORY** - A male patient, aged 62 years came to the Department of Prosthodontics, Subharti University with a chief complaint of inability to chew properly with his old dentures which were fabricated one year back. The patient had been edentulous for the last 7 years and was wearing his fourth denture. Medical history was non contributory. Diet history revealed that the patient is vegetarian, but has the habit of taking betel nut along with tobacco (Dilbag pan masala) since last 20 years. The consumption ranged from 8 to 25 packets in a day. The existing denture that the patient was using was fabricated approximately one year back and the posterior teeth of the complete denture were severely worn off and stained **(Fig 1)**. The patient's general, extra oral and intra oral examination revealed well formed existing maxillary and mandibular residual alveolar ridges. The patient also revealed that he had been advised to stop the habit but he was not able to do the same. His main concern was that due to the habit his all previous dentures became ineffective with time and desired a permanent solution. The patient also revealed that all his previous dentures were discarded because of the problem of wear. After evaluating the various prosthetic options, it was decided that a complete denture with modified anatomic (occlusal metal) teeth would be the prosthesis of choice.

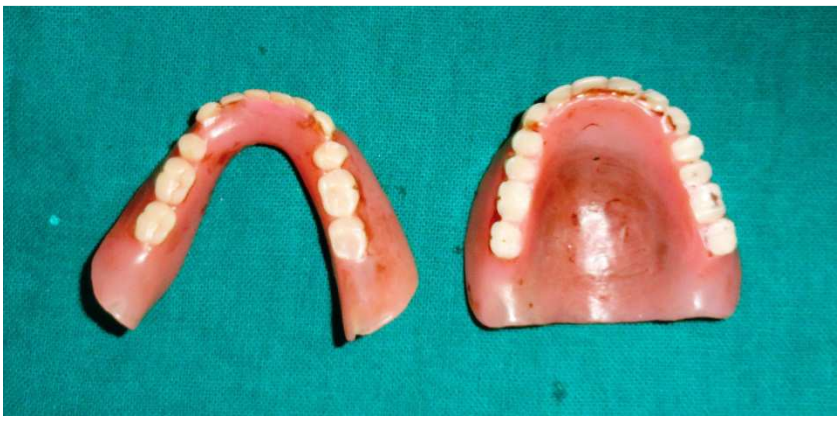

**Figure 1**

## CLINICAL PROCEDURES

Routine steps of denture fabrication were carried till jaw relations. Vertical dimension was deliberately kept towards the lower side (decreased) so as to minimize the stresses on the residual alveolar ridges. The artificial teeth were selected for

size, shape and color. Selection of posterior teeth had been already determined to be resin teeth with occlusal metal. The maxillary cast was mounted using a Hanau Widevue semi adjustable articulator (Waterpik, Ft Collins, CO, USA). The tentative centric was confirmed using an extra oral tracing device and the condylar guidance was determined by taking a protrusive interocclusal record (Take 1, Kerr, Romulus, MI, USA). The teeth were arranged after fabrication of modified artificial teeth.

### FABRICATION OF MODIFIED ARTIFICIAL TEETH

Not much has been described about the various methods to modify occlusal surfaces. Modification of non-anatomic teeth however has been described. [20] The method described here is simple, practical and inexpensive. Customization of the occlusal surfaces of resin teeth was accomplished in the following steps:-

**Step 1** – Appropriate size, shade and shape were first selected. These artificial posterior teeth were then attached individually to a plastic tab with sticky wax. Four indexes two for maxillary teeth and two for mandibular teeth were prepared using a combination of light body and putty elastomer **(Fig 2)**. The putty index so obtained is to be used for fabrication of occlusal wax patterns. The putty index was examined for any discrepancy and within each impression a line was drawn from the maximum depth of each cusp. After necessary corrections molten inlay wax was poured into the molds upto a line that was drawn on the walls of the putty index. When the wax was still soft a modified bell pin was attached at two points within each wax pattern. A sprue was also attached to the undersurface of the wax patterns which would later be sprued to a sprue former **(Fig 3)**. The attached wax patterns were later invested and cast in nickel chrome alloy **(Fig 4)**. The castings of individual occlusal surfaces were retrieved and finished.

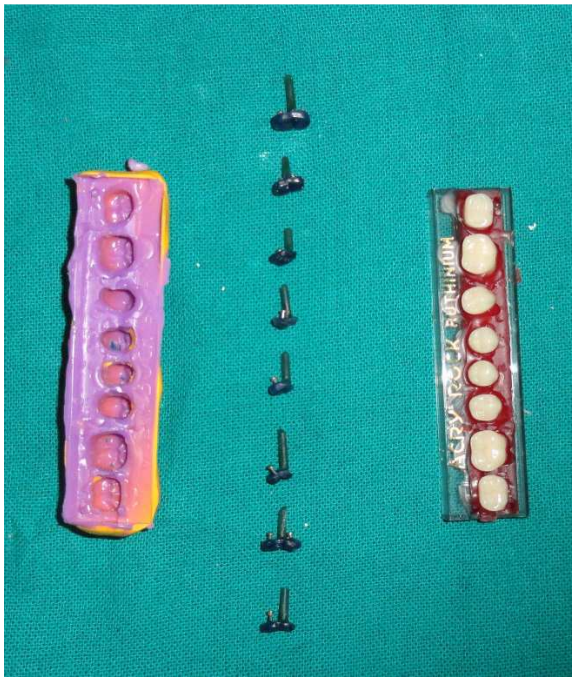

**Figure 2**

**Figure 3**

**Figure 4**

**Step 2** – All the individual castings were now placed back in the same putty index from which their wax patterns were originally formed. After evaluation of their fit within the mold, tooth colored self-cure acrylic resin of the same shade as that of anterior teeth was mixed and poured into the putty index with the individual castings of modified teeth. The self cure acrylic resin was then allowed to polymerize **(Fig.5)**. Any teeth that developed porosity of any sort were remade. The acrylic portion of the artificial modified teeth was then finished and polished with particular emphasis on the contour near the margins between the metal and acrylic.

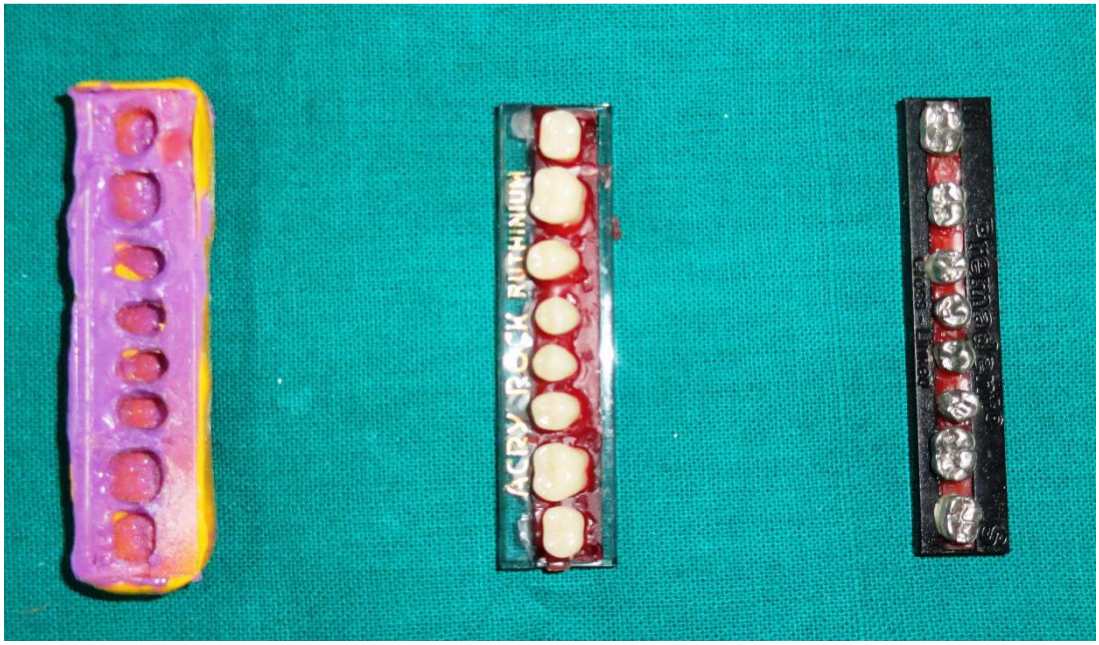


**Figure 5**

**Step 3** - All the modified posterior teeth were then arranged on the semi adjustable articulator **(Fig 6).** Individual teeth were arranged and were balanced individually against the opposing and adjacent teeth on the same side as well as contralateral side. Minor discrepancies on occlusal surfaces were removed only if the inclination of that individual tooth created esthetic imbalance**.**

**Figure 6**

**Step 4** – After the approval of the trial dentures by the patient the dentures were processed, finished and polished **(Fig 7)**. The denture was delivered to the patient after storing the dentures in water for 2 days **(Fig 8)**. On the day of denture delivery a clinical remount procedure was carried out and necessary occlusal corrections were done so as to minimize occlusal interferences. The patient was put on a follow up protocol of 1 day, 1 week, 1 month and every six months.

**Figure 7**

**Figure 8**

## DISCUSSION

Consumption of tobacco in one form or the other is widespread in north and east part of India (Dilbag pan masala). Addiction to these products is also widespread. Even elders who are above 65 yrs old consume the same due to the product being easily available and less economical. The main component of this pan masala is Areca nut. Areca catechu is the Areca palm or Areca nut palm, a species of palm, which grows in much of the tropical Pacific, Asia, and parts of east Africa. The palm is believed to have originated in either Malaysia or the Philippines. [20], [21]

The seed contains alkaloids such as arecaidine and arecoline, which, when chewed, are intoxicating and slightly addictive. The seed also contains condensed tannins (procyanidins) called arecatannins [22] and has been proven to be related to oral cancers. [23],[24],[25]

**Dilbagh** is a flavoured premium **Pan Masala**. **Dilbagh Pan Masala** (DPM) is a mixture of nuts, seeds, herbs, and spices and additives like limestone powder. The non-tobacco containing DPM is mainly served after meals in India. There are some modified versions of this pan masala that are also served in the Middle East and parts of Southeast Asia. In these places, they are served mainly as mouth fresheners. With the Indian population migration to other parts of the world, this product is available in most of the countries. Additives like limestone, lead to wear of the resin when used to wear complete dentures.

The putty index that was made should be examined for discrepancies. It is important to replicate the exact cuspal height and inclination of the artificial teeth if one is performing balancing articulation on a semi adjustable articulator. Light body

relining eliminates many such possibilities of error incorporation. In order to assure a uniform and adequate thickness of the occlusal wax patterns to accommodate finishing and polishing of the metal a line about 2 mm from the maximum depth of each cusp was put within each impression surface of the tooth index. This thickness also accommodates the modified bell pins that were placed on the poured wax so as to incorporate a mechanical lock with the resin that would be poured at a later stage. The modified bell pins were placed in the middle of the cusps where the thickness of the wax pattern was of maximum thickness.

Tooth colored self cure acrylic of appropriate and matching shade with that of anterior teeth should be poured in a fluid state rather than the acrylic dough. This allows the fluid resin to flow and engage the undercut of the head of the bell pins. Another difficulty that was encountered during resin bonding to occlusal metal was the effect of metal on the shade of the acrylic especially near the junction between the metal and acrylic. This can be overcome by either selecting a shade with lower value or adding the amount of acrylic near the junction. In this case the addition method was used and it masked the grayish tinge that was reflected in the resin. Care should be taken while trimming excess acrylic near the junction of metal with acrylic. Thin acrylic margins over the metal affect the shade of the tooth. The variety of shades that are available for self cure tooth colored acrylic resin are less, therefore it is possible that in some cases the shade discrepancy between anterior resin teeth and modified posterior teeth may arise. In such cases the occlusal surfaces of the artificial teeth should be modified.

Balanced articulation in such cases plays a very important role if one has to preserve the remaining residual alveolar ridge. The balancing of occlusion was carried in three stages. Firstly, at the time of arranging the teeth wherein balancing was achieved by incorporating compensatory curves. The balancing achieved during the arrangement of the teeth was further refined by proper laboratory remounting. The third stage involved a clinical remount balancing at the denture delivery appointment. During the last two stages refinement of occlusion was carried out by refining the metal occlusal surfaces of the completed denture.

## SUMMARY AND CONCLUSION

Present day elastomer allows Prosthodontists with a wide array of improvising benefits. The above mentioned technique is simple, inexpensive, less time consuming and does not require much skill on the part of the prosthodontist. The technique also allows one to add tooth colored acrylic to the occlusal metal as many times as one wants without affecting the accuracy of the occlusal surface. The choice of balancing the occlusion before or after the teeth have been modified lies within the choice of the operator and should be balanced after considering patients expectations and needs. The technique is open for research and studies can be conducted regarding the bond strength of metal to self cure resin, various means of mechanical attachments or the quantitative errors during balancing.

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