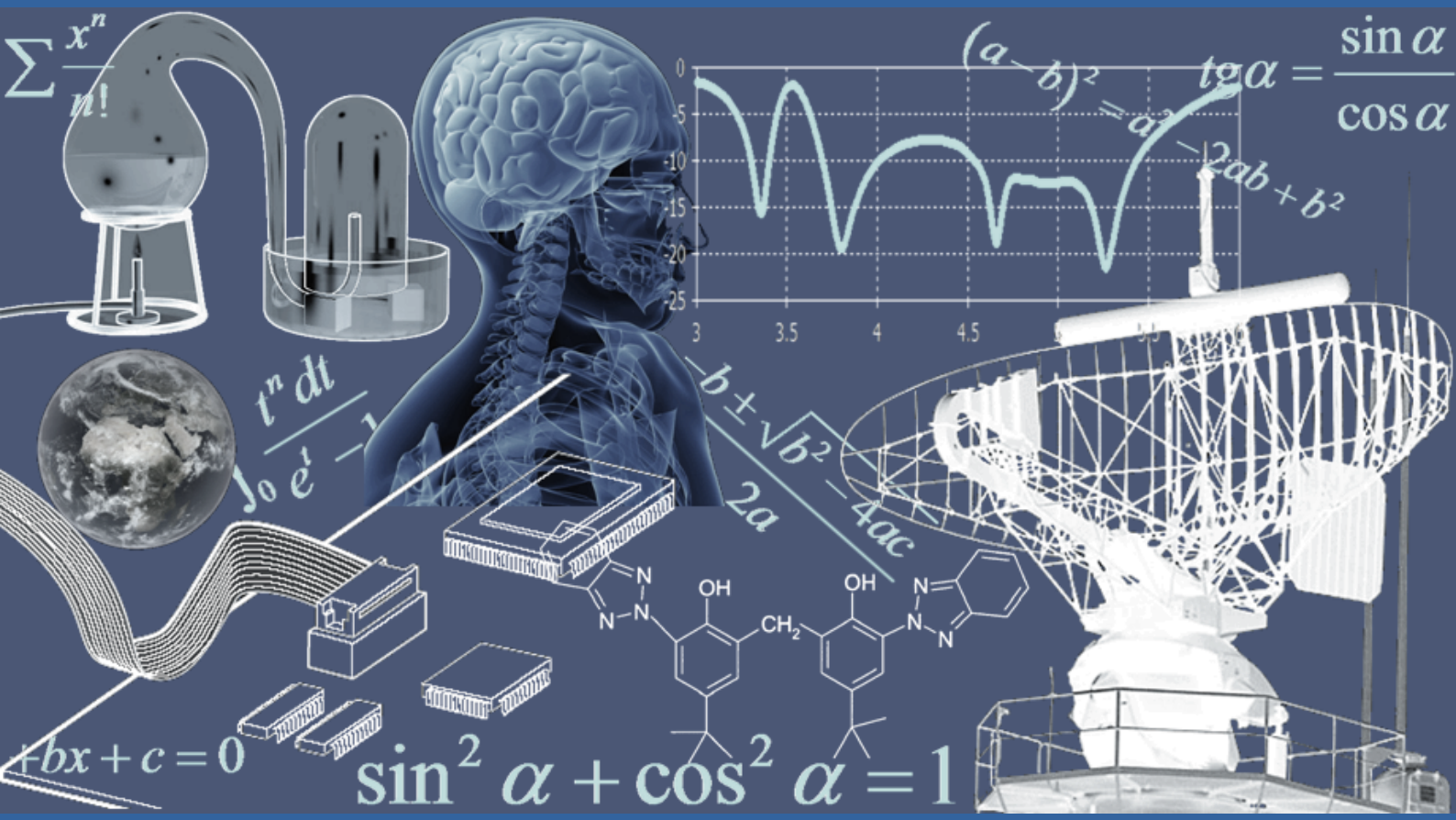
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INNOVATION REVIEW: Closed, Open, Collaborative, Disruptive, Inclusive, Nested… and soon Reverse How about the Metrics: Dream and Reality

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ABSTRACT: Innovation, a subject of massive interest:

- is multiple and subject to overlapping descriptors: Closed, Open, Collaborative, Disruptive, Inclusive, Nested… and soon Reverse.
- "Innovation is not the idea but what you do with it."
- "is the future of innovation in essence predictable?"
- "is a stronger-than-logic Creative Path based on Curiosity and Confidence."
- necessitates strong implementation discipline and clarity and has to be competitively unpredictable.
- does include the bricolage model and approach associated with trial and error, learning on the job; the question of serendipity and the role of chance.
- requires to realize that "all the best people do not work for you".
- is probably best handled by small autonomous teams, as small as 5, probably not bigger than 80, possibly 15 on average in large corporations.
- cannot be "cloned"; Innovation cultures are hardly transferable.
- "R&D spending or R&D intensity as indicators of innovation may result in either overestimates or underestimates".
- most results suggest that "raw patent data is an imperfect proxy for innovation."
- patent exploration constitutes a wealth of innovation potential, as simple as image analysis to combinatorial therefrom.
- moving towards fundamental co-creation with intense purposeful networking.
- and the advent of Big Data: "Word is worth a million images".
- … not without a business model.

Can it be measured? When and How?

Most of the above comments on innovation are introduced in this fifth chapter on Innovation, hosted by IJIAS; some are illustrated with case studies addressing disruptiveness, academia relationship, publication co-occurrence, spending, metrics, etc.
More than 80 reviews and detailed third party documented viewpoints have been cited and used to address the various subject matters; these are considerable wells of information which the readers may use for a more in depth study of one or the other particular topic.

KEYWORDS: Innovation – closed, open, collaborative, disruptive, inclusive, nested -, Big Data, visualization, visual analytics, ideation, trend analysis, neural networks, collaborative, Collaboratory™, adjacent technology analysis, ATA©, IP strategy, semantic analysis, image analysis, artificial intelligence, reverse engineering, confidence, curiosity, combinatorial, clarity, biotechnology, energy, hydrogen, HIV, AIDS, PV, photovoltaic, pharmaceutical.

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This assessment is intended to educate and raise awareness of some of the complex issues that surround the intellectual property in the field of knowledge extraction from the about 80 million patent documents available, and to assist in the development of practical skills for dealing with inventions. It does not seek to provide legal, managerial or technical advice on intellectual property related law as such. For any guidance, legal or any other, seek advice from the appropriate professionals; this study can by no mean substitute for expert legal, technical and managerial advice.
The opinions expressed by the writers in this article do not necessarily represent the viewpoints of the companies the author are employed by.

INTRODUCTION

INNOVATION

Can be closed as per the older consolidated corporate research and development practice; "but all the best people do not work for you". This was the first chapter of our series on innovation hosted by the IJIAS [1] (Rebouillat, 2013).

Can be open or based on Collaboratory™ as long as Intellectual Property (IP) is well integrated; "Is IP central to innovation or is innovation central to IP?". Then can ideation be engendered by artificial means? Those questions were raised in the second chapter of our series on innovation hosted by the IJIAS [2] (Rebouillat & Lapray-D, 2014).

Can be disruptive and "a stronger-than-logic Creative Path based on Curiosity and Confidence". In the context of bio-inspiration some examples were discussed in the third chapter of our series on innovation hosted by the IJIAS [3] (Rebouillat & Lapray-M, 2014).

Can be inclusive with the advent of bigger data. "An image is worth a thousand words" and a "word is worth a million images", as per the adage used in the fourth chapter of our series on innovation hosted by the IJIAS [4] (Lapray-D & Rebouillat, 2014).

Can it be Nested? Reverse or Trickle-up? Is academia playing a new role? Can the developing world be first before spreading it to the industrialized world? Are Combinative skills and Clarity additional dimensions of the equation? Can it be measured? How and When? These questions are part of the current fifth chapter of our series on innovation hosted by the IJIAS (Lapray-M & Rebouillat).

As per Figure 1 and 2, the initial "equation" $4C^{2©}$, then $4C^2\ 2C^©$ [1-4], and, now $4C^2\ 2Cx2C^©$ wherein Combinative skills and Clarity are bringing a multiplying dimension to the starting formula; therewith a multiplying synergism versus the usual additive synergism. The multiplying factor is the heart of the DNA of most disruptive innovators; Clarity being part of their questioning ability and reformulating art.

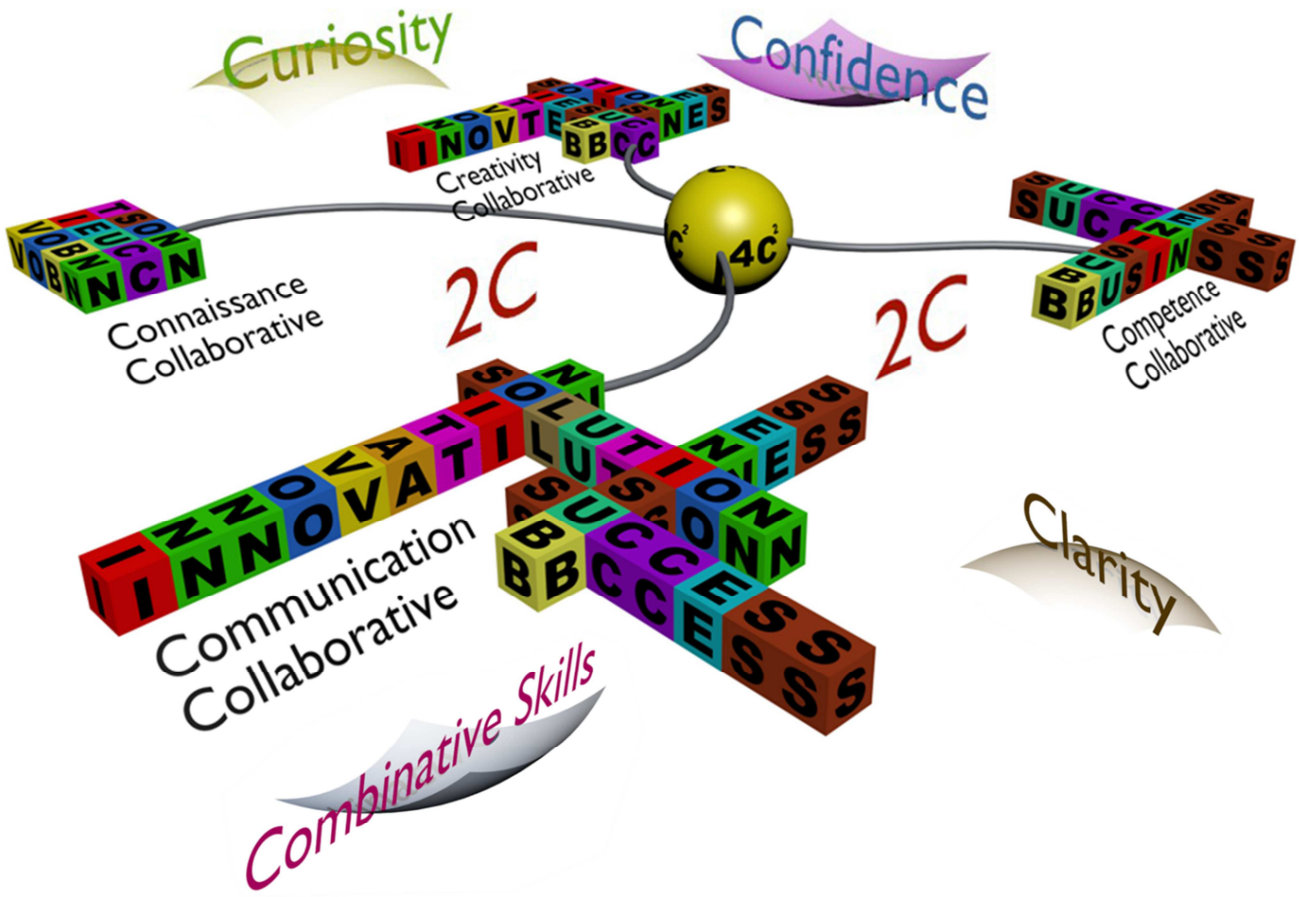


Figure 1 The Multiplying Dimensions of the Innovator, at large technical, science and business, now amount to $4C^2$ 2Cx2C© [1]–[4](Rebouillat, 2013; Rebouillat & Lapray-D, 2014; Rebouillat & Lapray-M, 2014; Lapray-D & Rebouillat, 2014).

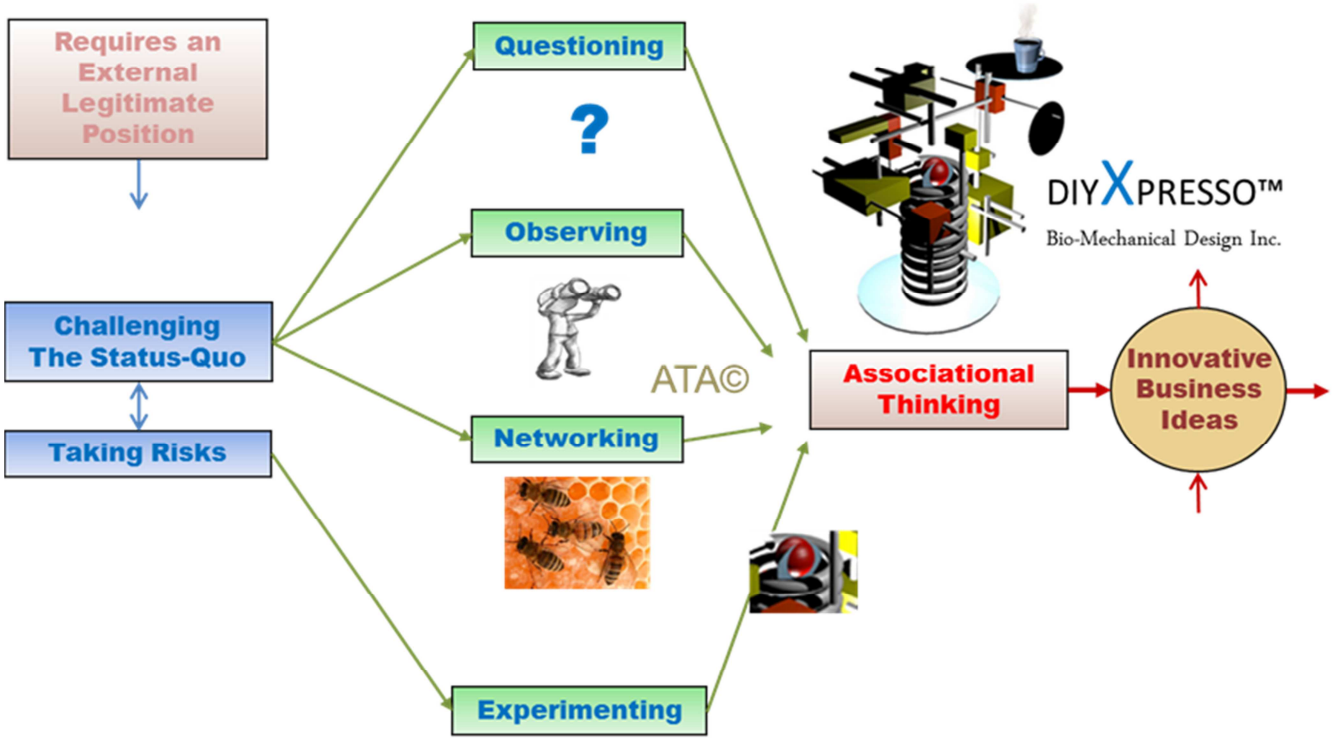


Figure 2 The stereotypical disruptive innovator profile. Combinative Skills in the "Big data" context are getting bigger than human conceptual Imagination [1]-[4] (Rebouillat, 2013; Rebouillat & Lapray-D, 2014; Rebouillat & Lapray-M, 2014; Lapray-D & Rebouillat, 2014).

Innovation majorly draws from Combinative/Associational skills in a boundary-less manner…

Figure 3 self explains the associational ability which grows with each individuals and multiply itself as Curiosity and Confidence unfold within organizations of various sizes.

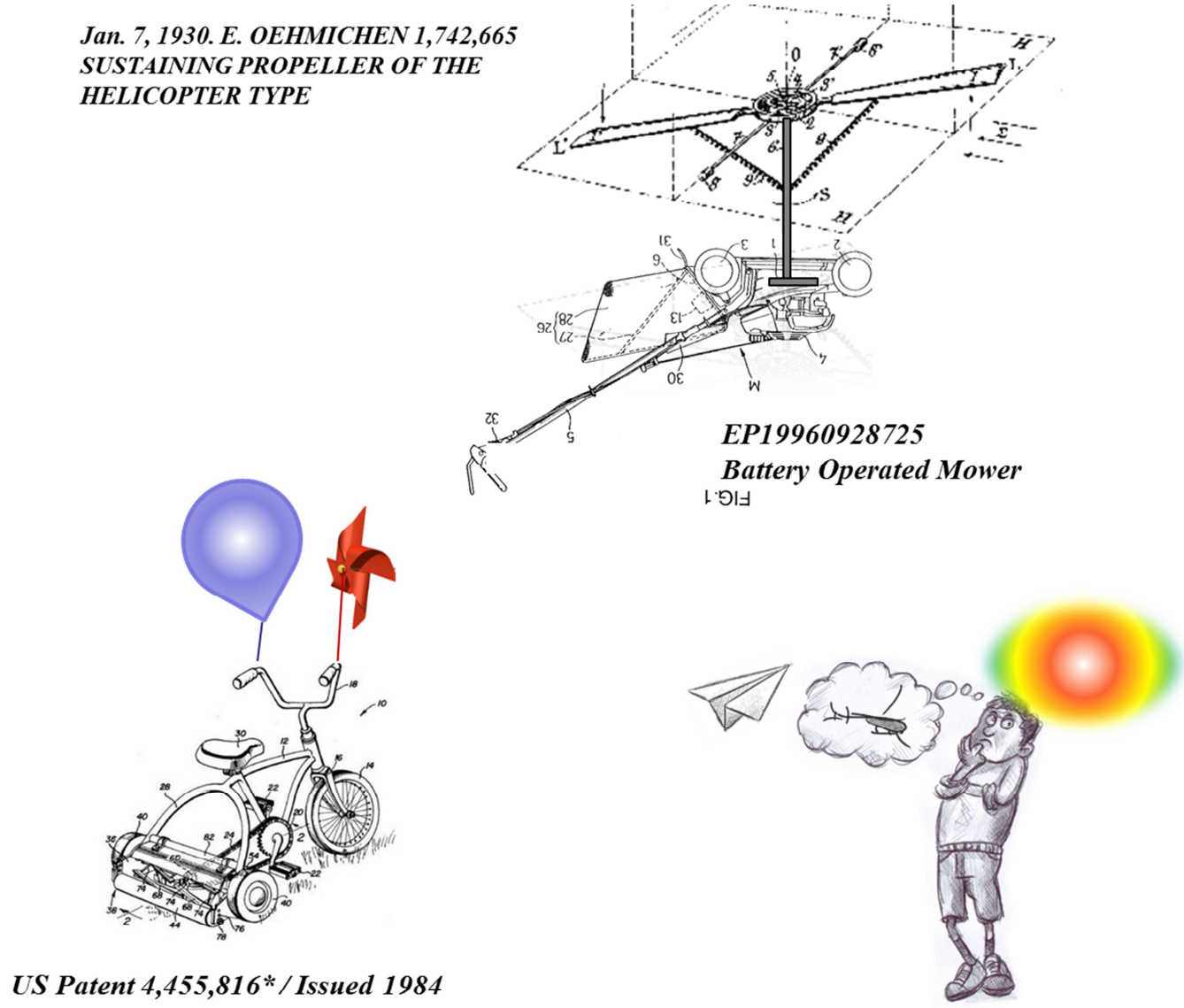


Figure 3 Boundary-less Innovation is Inclusive;
"Innovation is not the idea, but what you do with it". The Imaginary "Helico Air Mower" by Rebouillat (1998 ©)

Can Innovation be measured is certainly a long lasting question. Many attempts have been probed throughout years; such as in an industrial/business context [5] (Kaplan, 2006),

- "Annual R&D budget as a percentage of annual sales
- Number of patents filed in the past year
- Total R&D headcount or budget as a percentage of sales
- Number of active projects
- Number of ideas submitted by employees
- Percentage of sales from products introduced in the past X year(s)"

have all been used.

Generating a "family of metrics" for ensuring a balanced portfolio of measurements/metrics, counting both "input metrics" and "output metrics" to ensure the best management of resource allocation and capability development, as well as

and above all the return on investment for all "societal" components, is essential to surround some aspect of metric necessity.

Innovation does require a process discipline such as illustrated on Figure 4; the latter provides opportunities to implement harmonized metrics at each and every Input and Output phases. These are sometime missing in the checking list of some business development processes. As pointed out on Figure 4 none of these metrics have the same weight and foundation therefore rendering the metric global equation more complex; as well more powerful pending on how analytics are developed and interpreted.

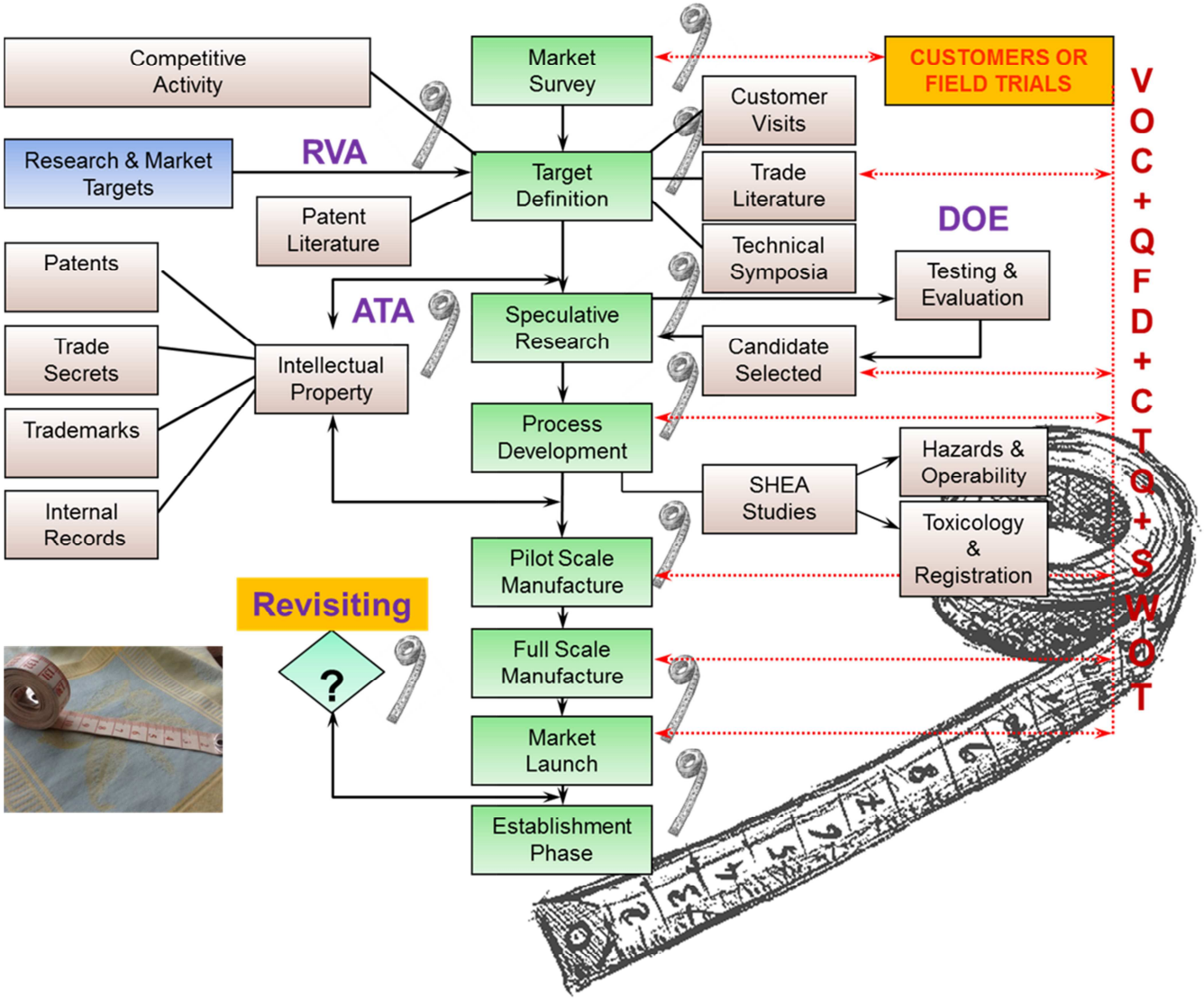


Figure 4 The opportunity to develop a harmonized portfolio of Metrics. The Z-Process, above, combines multiple business and technology management processes [1]–[4] (Rebouillat, 2013; Rebouillat & Lapray-D, 2014; Rebouillat & Lapray-M, 2014; Lapray-D & Rebouillat, 2014).

The analysis of innovation and nested preferential moves in chess game strategy demonstrated that the probability of a new innovation path to occur, decreases a per a power law of the frequency that the corresponding situations has occurred before. Similarly decision making can be likely influenced and its dynamic may become a hindering factor to innovation in general.

The above supports the necessity to promote innovator and implementer team composition across organizations.

As a practical set of examples let's refer to "The Innovator's DNA" [6] (Dyer, Gregersen, & Christensen, 2009):

- A reasonably opinion based ranking of the first 25 innovative companies, performed in 2005, ranked Apple and Google at level 1 and 2. And renowned German and Japanese car manufacturers in position 4, 13 and 14.
- With the assistance of the HOLT approach, which includes current market value and future potential market values (developed and practiced by a division of a Swiss bank), the classification was redone keeping the same 25 players. Then Amazon appears as #1, Apple #2, Google #3. And, the car companies mentioned previously appear at the bottom of the list?
- Finally the authors chose to rerun the classification from scratch using the HOLT approach. Saleforce.com ranked #1 (the cloud disruptive approach), Intuitive Surgical #2 (surgical robots) and Amazon ranked #3. Although using the same number of companies of same class and size selection, this time no car companies are appearing in the ranking of the authors.

Innovation metric is certainly a predicting art, which has to account for current and future innovations and return promises therewith. Value for the customer and return for the company are defining innovation in the business context and likewise in a societal context with measurable wellbeing and progress.

Many attempts have been made to link IP activity and innovation rating, given the current state of the art of the work "Bigger data analysis in the field of IP" [2] (Rebouillat & Lapray-D, 2014), we would reserve our opinion to a later coming paper.

"As imperfect as data on patents and R&D are as surrogates for innovation, both are nevertheless widely used because it is so hard to measure innovation directly and there seem to be no better alternatives"[7], [8] (Cotis, 2006; Dutta, 2012).

OPEN INNOVATION

"*The Open Innovation paradigm treats R&D as an open system. Open Innovation suggests that valuable ideas can come from inside or outside the company and can go to market from inside or outside the company as well. This approach places external ideas and external paths to market on the same level of importance as that reserved for internal ideas and paths to market in the earlier era*" [9] (Chesbrough et al., 2006). This new model represents the opposite of "closed innovation model" where research and development of new products were entirely conducted within the company. This can lead to the production of innovative solutions that may, or may not be commercialized, depending on the current company's strategy. To illustrate the above, Henry Chesbrough uses the example of Xerox Palo Alto Research Center where many successful products have been developed but were not a subject of interest to management to take it to the market. Employees who have worked on these technologies set up start-up companies and some of them, such as 3Com and Adobe, became extremely successful. It is apparent that research results developed within the companies can easily cross its borders, therefore the closed innovation paradigm is not the most secured and sustainable. In other words, it shows that knowledge can travel, with increased mobility of skilled workers and academics, and develop in variety of settings that are alternative, external options for unused technologies (such as research facilities, start-ups, and academia). In an open innovation model companies can license-out the technology if they do not desire to use it, or license-in technology from other firms. In addition, companies can decide to leverage their research and find the best solutions by starting a partnership with academia or other industrial partners, or creating external joint laboratories. All of the pathways present with a very productive outsourcing potential. Another possibility is to collaborate with start-ups or acquire them. Some firms have formed internal venture groups to facilitate their own innovation process. The use of those options aims to capture more value for the companies. In other words, one may think about open innovation as a way for a company to stop working in isolation and being incorporated into an ecosystem where many ideas can merge and have additive value (Figure 5). Laursen and Salter tested the effectiveness of the open innovation based on the sample of 2707 UK manufacturing firms that answered questions about their innovation process [10] (Laursen & Salter, 2006). As suggested previously by Chesbrough [11] (Chesbrough, 2003) companies that use the external sources of knowledge have higher level of innovative performance [10] (Laursen & Salter, 2006). Nevertheless, it needs to remain to be closely managed so that the cost of knowledge search is not higher than possible gain; additionally IP aspects need attention too [10] (Laursen & Salter, 2006).

In the next paragraphs we will investigate if and how the open innovation model can be an engine for disruptive innovation? In addition, we aim to look at what is the current situation and models of cooperation between business and academia.

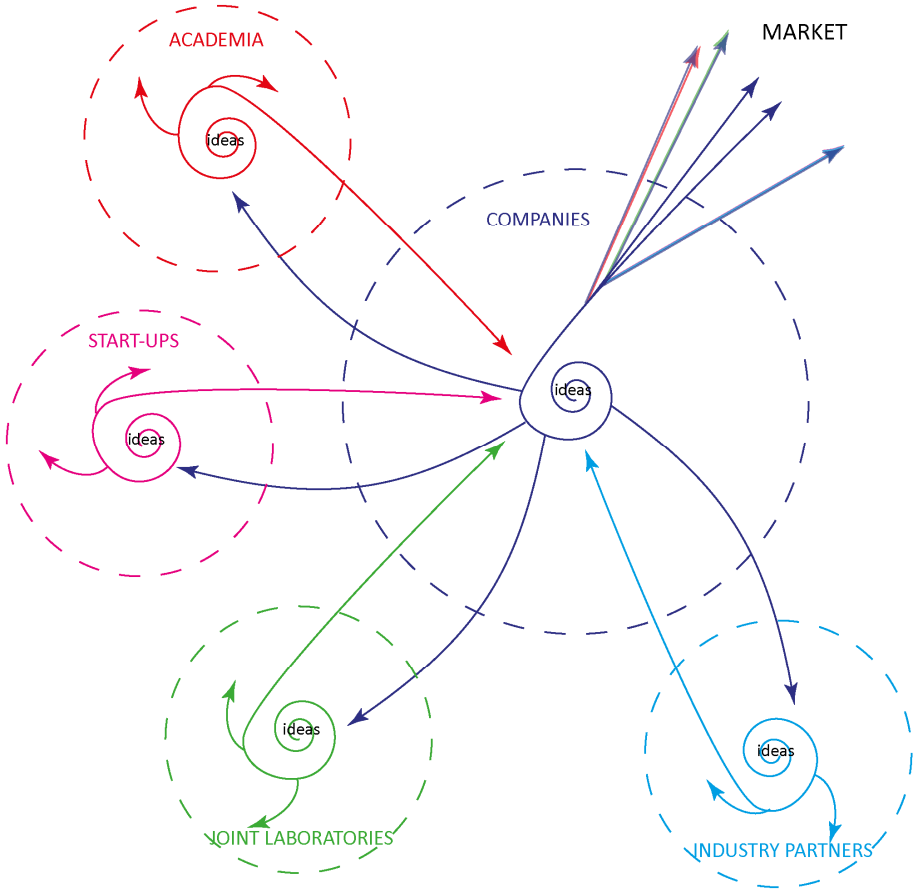


Figure 5 Knowledge circulation in an open system.

DISRUPTIVE, INCLUSIVE AND REVERSE INNOVATION OF A NEXT DECADE

Disruptive innovation is a term describing a situation when a new technology/service interrupts an existing market and value network and creates a new one. It is important to note that the term *disruptive technology* is not necessarily equivalent to *disruptive innovation*. The core idea is that a new solution has to have a potential to alter the entire market to become a true *disruptive innovation*. In other words, capacity to disrupt must be equal or exceeding its economic impact. There are multiple examples of novel technologies that completely transformed their respective markets and truly changed our culture. Several examples of disruptors are: e-mail, smartphones, digital photography etc. The theory of disruptive innovation has emerged as a result of analysis of disk drive industry. It has been chosen predominately because it faced several cycles when new technologies have emerged and have discontinued previous ones in a short time scale [12], [13] (Bower & Christensen, 1995; Christensen, 1997). Interestingly, this situation kept repeating, proving that it is not easy or obvious to catch and invest into a truly promising, novel technology. The authors of the analysis suggested that *disruptive innovation* is initially characterized as having low gross margins and target markets, and often simply don't match current customers' need. This presentation does not evoke an interest of management to invest on the negligible and therefore unattractive market. Instead their efforts are focused on satisfying clients' needs and financing improvement of a current technology. This creates a space, a niche market, for new and potentially disruptive competitors to emerge. As noted by some, this theory may just touch the surface of the complex situation and needs additional research of interrelated areas e.g. existence of more types/dimensions of technology change [14] (Danneels, 2004). An important aspect to consider when discussing disruptive innovation is its appearance as *inclusive innovation.* According to the Global Research Alliance *inclusive innovation* can be described as *"any innovation that leads to affordable access of quality goods and services creating livelihood opportunities for the excluded population, primarily at the base of the pyramid, and on a long term sustainable basis with a significant outreach"* [15] (Mashelkar).

To sum up, it is vital to be able to identify the technologies that have a true disruptive potential. There is no universal approach to complete this task. However, laying down some directives can help to identify appropriate candidates. McKinsey

global institute identified four factors that describe technologies with substantial potential for disruptive economic impact [16] (The McKinsey Global Institute, 2013). According to the report these include: (1) "*a rapid rate of change in capabilities in terms of price/performance relative to substitutes and alternative approaches, or they (disruptive technologies) experience breakthroughs that drive accelerated rates of change or discontinuous capability improvements.*"; (2) "*(…) technology must have broad reach – touching companies and industries and affecting (or given rise to) a wide range of machines, products, or services.*"; (3) "*(…) technology must have the potential to create massive economic impact.*"; (4) "*technologies that matter have the potential to dramatically change the status quo. They can transform how people live and work, create new opportunities or shift surplus for businesses, and drive growth or change comparative advantage for nations*" [16] (The McKinsey Global Institute, 2013). The analysis of currently emerging technologies according to the above criteria resulted in the list of 12 potential candidates: (1) mobile internet; (2) automation of knowledge work; (3) the internet of things; (4) cloud technology; (5) advanced robotics; (6) autonomous and near- autonomous vehicles; (7) next-generation genomics; (8) energy storage; (9) 3D printing; (10) advanced materials; (11) advanced oil and gas exploration and recovery; (12) renewable energy [16] (The McKinsey Global Institute, 2013). Together these technologies have the potential of estimated economic impact ranging from $14 to $33 trillion per year in 2025 [16] (The McKinsey Global Institute, 2013). In a similar spirit one could try to identify next disruptive innovation by analyzing specific portfolio of several companies. A useful guidance is provided by the list of "50 Disruptive Companies in 2013" chosen by MIT Technology Review [17] (MIT Technology Review). According to the authors "*Each company on this list has done something over the past year that will strengthen its hold on a market, challenge the leaders of a market, or create a new market.*" The companies are divided in 5 broad categories: biomedicine, computing and communication, energy and materials, internet and digital media, transportation [17] (MIT Technology Review). Importantly, the scope of interest of chosen companies overlap with the list of 12 technologies mentioned before.

To bring a degree of predictability and a better control over the process of innovation Christensen compiled a few principles helpful in designing the process [18] (Anthony et al., 2006). One of them is identifying and expending to disruptive market outside of the core business. Christensen isolated three possible scenarios for such a situation. The first one is to propose to customers' easy and simple solution to do an important job, in the situation when competitors are fragmented or are not responding to their need. It can start with identifying the novel application of existing product by customers, leading to uncover specific requirements and proposing a more suitable solution. Secondly, one may try to target customers at the low end of an existing market. Propose a product that is good enough to satisfy all the basic customers' needs at low price, in a situation when competitors do not focus on this segment of the market. The third scenario proposes to remove the barriers to consumption and thus expand a market, in the situation when competitors judge the market as unattractive. As a next step one has to carefully analyze the history of a market in the context of disruptive innovation principles. It helps to create a list of questions to ask when evaluating new opportunity from multiple perspectives exceeding company's core competences. This exercise helps to uncover the characteristics of the novel product and can lead to the generation of the desired idea [18] (Anthony et al., 2006).

However, the complicated ecosystem of nurturing innovative process is not easy to embrace and many companies still struggle to work out efficient tools to maintain it.

For the sake of completeness let's mention the reverse innovation process which focuses initially on developing areas and move to more industrialized market zones once established and proven as efficiently meeting customer satisfaction and investor returns. Generally the key benefit is simplification, therewith disruption of an established market and a product complexities; and resource therewith.

MANAGING THE PROCESS OF INNOVATION

The process of innovation to remain effective must be supported by an appropriate business model. Chesbrough identifies six business models depending on how openly they are capable to innovate [19] (Chesbrough, 2007). Most of the companies fall into the first type of "undifferentiated firms" that sell goods or services that are no different from competitors. On the other side of the spectrum he finds fully open and adaptive companies that take advantage of all external resources and possibilities [19] (Chesbrough, 2007). In this scenario "*some companies use corporate venture capital to explore alternative business models in small start-ups. Others create spin-offs and joint ventures to commercialize technologies outside their own business model. And there are those that create internal incubators to cultivate promising ideas that aren't yet ready for high-volume commercialization*"[19] (Chesbrough, 2007). The external incubation could be associated with the nested innovation introduced by Rebouillat earlier on. It is consequently of importance to rethink organizational processes that govern a company, and as Chesbrough points out "*(…) the potential rewards are compelling: lower cost for innovation, faster times to market, and the chance to share risks with others. These enhancements can unlock new sources of organic growth and revitalize your company*" [19] (Chesbrough, 2007). Few companies may serve as rather

remarkable examples of embracing open innovation business model, such as Philips or Cisco Systems, Inc. [20] (Cisco Internet of Things Innovation Grand Challenge, Philips Research).

The McKinsey Quarterly survey (September 2007) questioned 1458 executives, equally representing all levels of responsibility, on their approach to innovation [22] (McKinsey Quarterly, 2007). Not surprisingly, 70% indicated innovation as one of the most important factors that drive growth [22] (McKinsey Quarterly, 2007). In the subsequent edition of an online survey (July 2010; 2,240 executives) percentage of executives that share this view rose to 84 [23] (McKinsey Quarterly, 2010). On the contrary to that declaration, only 24% of the top managers in 2007 (722 of responders) control the budget set for the purpose of innovation and only 22% control performance metrics [22] (McKinsey Quarterly, 2007). Lack of governance was perceived as an obstacle, and 47% of the top managers would like to improve the process of innovation by assembling it as a core part of their agenda [22] (McKinsey Quarterly, 2007). In 2010, the main difficulties to effective innovation have not changed, 42% managers still think that more formalize and organized processes of innovation along with integrating it into company strategic planning is a necessity [23] (McKinsey Quarterly, 2010). In the same time 39% of responders say that their organization has general innovation priorities but they are not formalized [23] (McKinsey Quarterly, 2010). This set of data points out the clear direction to be taken by management and shows the need to develop more organized way to manage the process of innovation (Figure 6). At the same time it is not a practice solely based on trial and error and should have defined construction [18], [24](Anthony et al., 2006; Stage-Gate®). This has been illustrated earlier on with Rebouillat's Z-Process of figure 4, which provides clear steps and the need for tailored metrics all along that process.

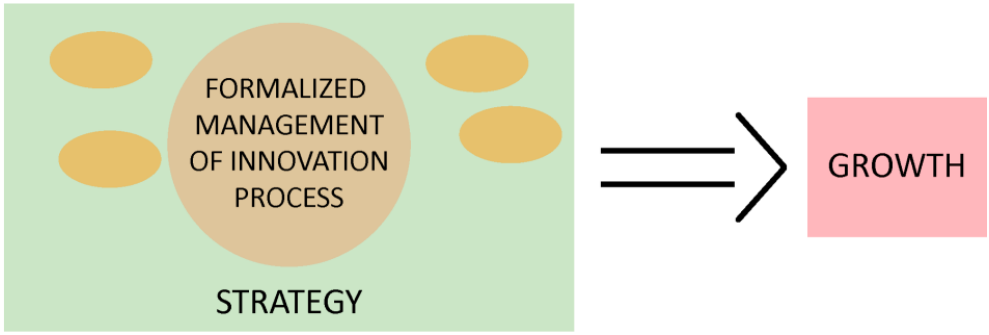


Figure 6 Management of innovation process as a key component of strategy ensuring stable company growth [22], [23] (McKinsey Quarterly, 2007, 2010).

Importantly, for the topic of this review executives also indicated the means that are currently used to develop new ideas or commercialize a new business [22] (McKinsey Quarterly, 2007). The primary source is an in-house product-development team, as indicated by 56% of top managers. Interestingly, partnerships with academia and research centers were mentioned as a second one (34%). The remaining includes: centralized innovation initiative teams (25%), centralized innovation group (20%), R&D center (17%), outsourced R&D center (14%), corporate venture capital fund (7%), other (15%) [22] (McKinsey Quarterly, 2007). It becomes clear that the majority of efforts remain centralized, as evident in figure 7. In 2010, 30% of responders assessed that their organization is extremely/very effective at using partnership and open innovation as a tactic to drive innovation, 39% rate it as somehow effective, 10% as not at all effective and 19% said they don't use it [23] (McKinsey Quarterly, 2010). Executives, pointed out centralized innovation initiatives and traditional R&D as more effective tactic used by their organization than open innovation (centralized innovation initiatives, 33% very/extremely effective and 42% - somehow effective; R&D, 31% very/extremely effective and 42% as somehow effective) [23] (McKinsey Quarterly, 2010).

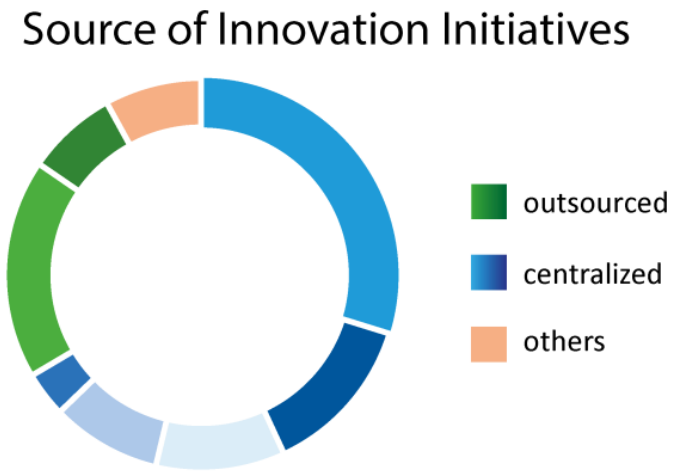


Figure 7 The use of internal vs external sources for innovation development. n=722 responders, multiple answers [22] (McKinsey Quarterly, 2007).

The pharmaceutical industry is clearly among the most innovation demanding ones and with years of experience should perfect the process of managing discoveries and bringing them to market. However, this assumption does not reflect the reality. In 2013, U.S. Food and Drug Administration's Center for Drug Evaluation and Research (FDA's CDER) approved 27 new medicines, known as new molecular entities (NMEs). This amount is below what is required for sustainable development of pharmaceutical business [25] (U.S. Food and Drug Administration, 2013). Companies themselves define that they need 2-3 NMEs per year to fulfill their growth objectives, and none of them ever reached that level [26] (Munos, 2009). Among the approved drugs (2013), 33% (9 out of 27) where shown to be innovative and have a novel mechanism of action (classified as First-in-Class NMEs). Despite ever growing investment in R&D process, the average number of accepted NMEs remains constant at the level of 26 per year from 2004 to 2012 [25] (U.S. Food and Drug Administration, 2013). Even more remarkably, this trend is stable since 1950, excluding the 90s and the peak of 1996, when 51 drugs were approved [26] (Munos, 2009). This anomaly is attributed to the change in administrative process of approval itself, which caused faster processing a backload of applications. This trend is pointing to the disappointing conclusion that any changes introduced to the process of drug discoveries did not translated into bigger output of successful drug commercialization, figure 8 [26] (Munos, 2009). Data provided by the Pharmaceutical Research and Manufacturers of America (PhRMA) can shed some light on the scale of R&D of drug development [27] (PhRMA, 2014). Average cost of successful NMEs launching, including failures, reached $1.2 billion in 2000s as compared to $800 million in 1990s and $320 million in 1980s [27] (PhRMA, 2014). In that process the numbers bluntly point out that more and more substances do not reach or pass subsequent clinical trials that translate to higher cost. Some of that can be reduced by more rigorous fundamental and pre-clinical research of new molecular entity that subsequently have higher chances of success and launch [28] (Paul et al., 2010). Only 2 out of 10 marketed drugs have revenues that match the investment cost. In the same time the total spending of PhRMA members on R&D has been growing at an average rate of 12% since 1970s to reached a total of $5.1 billion in 2013 (that equals around 20% of sales) [27] (PhRMA, 2014). In turn, this increases the prices of branded or patented products as compared to generics. An example can be 17-fold difference in price between branded and generic formulation of HIV/AIDS medicine, lamivudine. In 2001 GlaxoSmithKline US price was $3271 per patient per year as compared to Indian generic producer Cipla's price of $190. Another drug, viramune (nevirapine), was sold as branded product for $3,508 while the Cipla generic price was $340 (Khor).

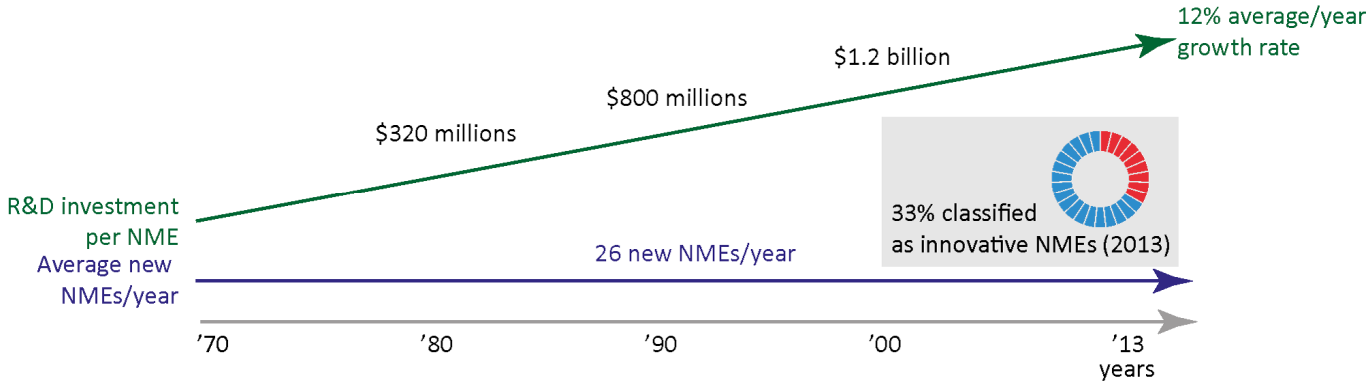


Figure 8 Increasing R&D funds for drug development vs number of novel formulations on the market

The challenges ahead of the pharmaceutical business fall in the following categories: (1) upcoming patent expirations of several high revenue generating drugs and lack of suitable replacement at hand; (2) demand from health care providers to provide evidence that treatment has a cost advantage over competitors' product; (3) increase in the amount of safety evaluation demanded by regulatory entities; (4) not sufficient number of promising drug candidates [28], [30] (Kaitin, 2010; Paul et al., 2010). Combination of all of the above push pharma business to cut costs e.g. by merging and acquiring other partners (latest examples are Pfizer-Wyeth, Merck-Schering-Plough, Roche-Genentech). However, many agree that simply reducing R&D cost will not fill in for the draining pipeline of therapeutics [28] (Paul et al., 2010). Another strategy to counteract the above situation is to move away from the model when company own and manage the entire R&D process. Instead, they move towards a network model of innovation, sometimes referred to as a fully integrated pharmaceutical network [30] (Kaitin, 2010). In that situation, to enhance the output of the process of drug development the pre-discovery and pre-clinical research is outsourced to parties with appropriate competencies, namely academia and small pharmaceutical companies [30] (Kaitin, 2010). Others propose the "quick win, fast fail" drug development paradigm where emphasis is put on discovery process itself and establishment of solid proof of concept before proceeding to a next phase [28] (Paul et al., 2010). In that model (executed and named by Eli Lilly's as "Chorus model") the aim is to increase the probability of success in later phase and thus reduce associated costs and risks [28] (Paul et al., 2010).

It seems that it is more reasonable that every effort should be directed towards effective management of fundamental research carried out by both external and internal parties, figure 9.

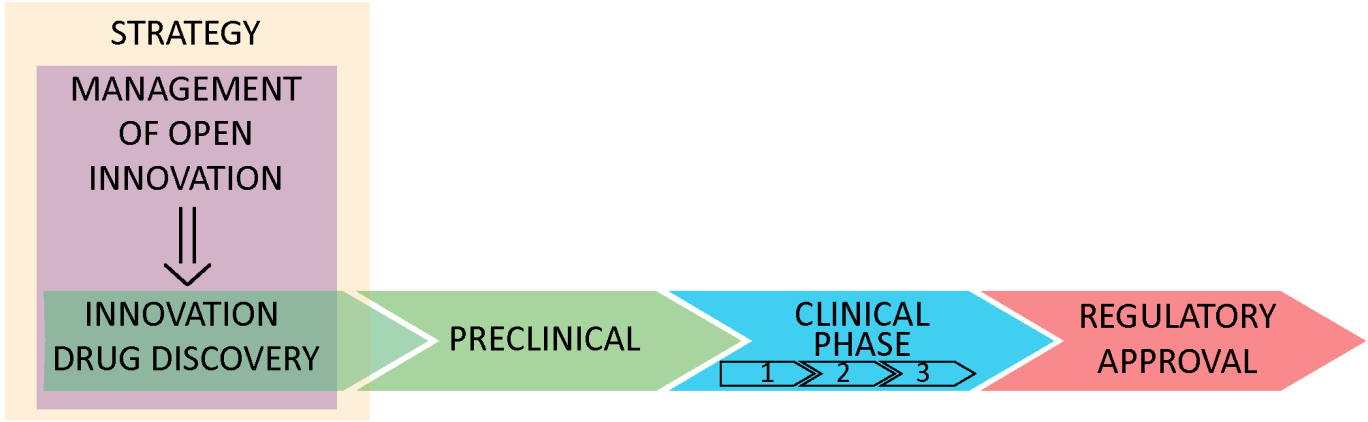


Figure 9 Management of innovation in drug development process as a key component of strategy ensuring stable company growth.

INNOVATION METRICS

Innovation is a form of business investment and in principle should be measured. Still, the process that is based on creativity, discovery and learning by definition doesn't have well defined end point, is ambiguous by nature and bear high risk. In other words, many aspects of innovation are intangible and as such are difficult to evaluate. It doesn't necessarily mean those are not prone to measurement, but require careful choice of methods and tolerance to their approximation rather than definitive values [31], [32] (BearingPoint, 2011; Morris, 2011).

The solid concept of return on investment (ROI) is a basic and useful way of evaluating many types of projects. The key in applying ROI depends on the stage of the project. ROI could be successfully used in the case of innovation-driven projects of short term or at advance stage when we have an idea of the target market and related business processes. In that case we are aware of the existing situation and can relate to it in our predictions. If the ROI measurement should be applied at very early stages of projects, especially when we have no idea about possible market, we are forced to guess based only on our biased assumptions. This process may well kill any project before it has proven its value [31] (Morris, 2011).

Another way of somehow quantitatively and retrospectively measure innovation performance, as well as its categorization as disruptive or incremental, is the use of patent database. The most accepted and advised way is to compare the number of patent citations issued for use in the same industry [33]–[35] (Albert et al., 1991; Carpenter et al., 1981; Katila, 2000). This is a measure of a quality of innovation as the amount of a patent's citations resemblance its value and impact in the field. Provided that we choose the correct time period of the analysis (e.g. amount of years after the patent was granted), such analysis can distinguish companies that focus on incremental vs disruptive solutions [33]–[35] (Albert et al., 1991; Carpenter et al., 1981; Katila, 2000).

The above measures are of retrospective approach and as such are not helpful to assess the ongoing projects. Due to the uncertainty of the innovation processes it seems that a mixture of quantitative and qualitative metrics could create a reasonable evaluation approach. All of them could be categorized as external, internal and people metrics that are extremely interconnected and will allow you to gain a more holistic view of the impact of innovation on your organization [31] (Morris, 2011). External metrics measure, for example, the output of innovation as new sales and customers, brand recognition and image, as well as growing network of external partners. Their aim is to assess the brand recognition and impact on the open innovation ecosystem. Internal metrics, for example, look on valuation of innovation portfolio as compared to prior years, increase in a number of new projects (incremental and non-incremental) in pipeline, percentage of revenues attributed to innovation within existing portfolio or growing investment opportunities available for senior management to consider. Their aim is to look at various parameters that describe growth and revenue. People metrics evaluate the level of participation in innovation process such as the quality of efforts of people involved in the project or the completion time. Langdon Morris proposes the metrics in the form of 92 questions being a mixture of quantitative/qualitative and external/internal/people measures [31] (Morris, 2011). It would be difficult to answer all proposed questions, therefore one need to make a choice adequate to the situation and time point of the innovation driven project.

FUNDAMENTAL RESEARCH AS A KEY TO DISRUPTIVE INNOVATION

There are many examples where the strong academic research was a key to produce a blockbuster drug, meaning that its annual revenue is over $1 billion. Many believe, that only better understanding of the underlying causes of human diseases and uncovering its complexity can lead as to produce effective therapeutic solutions [28] (Paul et al., 2010). An example can be a drug, currently market by Pfizer under the name Lyrica. It is a pregabalin developed by Dr. Richard Silverman, a professor of chemistry at Northwestern University (USA), that is approved as a treatment for fibromyalgia and epilepsy (Northwestern University). History of the development process of 21 drugs of high therapeutic value (introduced 1965 – 1992) shows that almost 80% of enabling discoveries were carried out by research sponsored by public money, as opposed to synthesis of the compound that was founded mostly by private sector [37] (Cockburn & Henderson, 1997). This clearly indicates that academia mission and capabilities are not in compliance to drug discovery process but their contribution to development is crucial. It leads to a new type of partnership where interdisciplinary teams work in collaboration with pharma-based scientists and managers.

Innovative Medicines Initiative (IMI) is an example of public-private partnership with a mission to support the process of discovery and development of novel drugs. It has been an undertaking by EU and the European Federation of Pharmaceutical Industries and Associations (EFPIA), with a €2 billion budget. The projects funded by IMI have a goal of boosting collaborative ecosystem for pharmaceutical R&D. As a result, in all of the 47 initiatives (June 2014) participants are the mixture of small-

and medium-sized enterprises, patients' organizations and hospitals, universities, research societies, regulatory agencies and others [38] (Innovative Medicines Initiative).

Nevertheless, some universities are experiencing decreased funding of fundamental drug research, thus they attempt to develop support systems for their researchers themselves. An example comes from increased efforts of academic institutions to self-fund early drug development research with the goal of bringing it to the market [39] (Hayden, 2014). Harvard and Oxford Universities recently raised money to support drug discoveries and subsequent commercialization. It brings the money to public institutions, gives a certain degree of freedom for researchers in deciding how to conduct experiments and may nurture, at least partially, the pipeline of new drugs [39] (Hayden, 2014).

The innovative idea in any domain can come anytime from fundamental research. Association of University Technology Managers yearly presents a report on how academic research and technology transfer have changed our way of life, a so-called Better World Project. Every report presents success stories and real impact of technology that benefit the general public in variety of domains such as novel food sources, health improvement, replenishing water supplies, and many more [40] (Association of University Technology Managers). Despite many success stories the key question remains: do universities and business sufficiently nourish their cooperation in order to boost the innovation process?

UNIVERSITIES TO BUSINESS COOPERATION

As clearly exampled in previous chapters there are two environments where innovation takes place that are research facilities set in business or public environment. It is of interest to examine if and how researchers and managers interact with each other.

Research and education is the core of university values and activities. Would it be possible to add entrepreneur activities to its portfolio by intensifying the collaboration with the industry? One can name several factors that can address why universities may and should strengthen their relation with industry. Among many reasons we can point out few such as (1) overlapping research goals, particularly similar content of fundamental research, (2) necessity to gain novel source of funding, (3) development of technologies that have the opportunity to be transformed into technological solutions and thus fulfill (4) the obligation to governmental policies to gain economic return on publicly funded projects [41] (Bercovitz & Feldmann, 2006). On the other side, we have innovation-lead businesses that by engaging with universities can benefit from (1) access to new ideas and (2) specialized pool of consultancy. In addition, they directly (3) transfer knowledge and technology by organizing internships and allowing graduate work to be carried within a company and finally recruiting graduates. Therefore, it is in their best interest to boost their relationship with academia. The academic and business are very different worlds in terms of environments they operate in, building foundation, mission etc. However, their converging interests are influencing a change of perspective for both entities and results in measurable action towards tightening collaborative work (Figure 10).

At the moment, research institutions hold some degree of interactions with industry. However, the level of this collaboration is far from being satisfactory. The biggest study on European university-business cooperation (included 6 280 responses among academics from all members and candidates of the European Union) found that the third of universities have no or very low interactions with business [42] (Science-to-Business Marketing Research Centre, 2011). Details of statistics for every country can be found on-line [42] (Science-to-Business Marketing Research Centre). One can measure the interactions in two ways looking at tangible outcomes (such as number of patents, licenses, spin-offs) and intangible (such as development of academic staff). Many studies point out those individual viewpoints, is crucial to create and maintain university-business collaboration hence making it a very important factor to monitor [41], [42] (Bercovitz & Feldmann, 2006; Science-to-Business Marketing Research Centre, 2011). Researchers of Science-to-Business Marketing Research Centre divided the interactions between universities and business into 8 categories containing both types of outcome: (1) collaboration in R&D, (2) mobility of academics, (3) mobility of students, (4) commercialization of R&D results, (5) curriculum development and delivery, (6) lifelong learning, (7) entrepreneurship, and (8) governance, defined as interaction of management level during decision making [42] (Science-to-Business Marketing Research Centre, 2011). The survey data shows that academics do not recognize the benefits of university-business cooperation neither as a drive for their research neither in terms of career development. Importantly, the study showed a strong correlation between academics perspective and level of engagement in such collaboration. The lack of funding was pointed out as the main barrier to pursue university-business cooperation. In addition, sufficient founding was not named as a main motivation to start collaboration. Instead, a mutual research interest and trust was the highest rated driver. Therefore, solely removing the obstacle of sufficient funding will not stimulate the growth of university and business collaboration. It is necessary to simultaneously change academics attitude towards the novel collaboration type by developing the awareness of possible personal benefits and supporting

interactions with industry [42] (Science-to-Business Marketing Research Centre, 2011). Despite this rather negative message of the above study, there are multiple cases of collaborative, mutually beneficial research projects undertaken by companies and universities. Such activities by example will influence both entities. One of the most active academic institutions is Massachusetts Institute of Technology (MIT) that claims to interact with 700 companies [44] (Massachusetts Institute of Technology- Collaboration with Industry). National Science Foundation ranks MIT the first in industry-sponsored research, which totaled $128 million in 2013 subsidizing to 19% of its research funding [44] (Massachusetts Institute of Technology-Collaboration with Industry). On the other hand MIT strongly promotes entrepreneurship activities among students at all levels. The Martin Trust Center for MIT provides variety of courses to teach and promote effective entrepreneurs [45] (Martin Trust Center for MIT Entrepreneurship). The common type of research collaboration between industry and academia are (1) contract or joint research, between two or more partners, (2) creation of cooperative laboratories and (3) endowments for research or professional chairs. A dual industry-academia collaborative research center may be a special source of inspiration. An example of a newly formed partnership is The Karolinska Institute - AstraZeneca Joint Research Program in Translational Science, established in 2012 for an initial period of 5 years. AstraZeneca declared to provide $4.5 million per year in funding to support Karolinska scientists at the Centre [46] (AstraZeneca and Karolinska Institute to create new Translational Sciences Centre). Overall, in 2013 biotechnology/pharmaceutical industry partnered in 301 deals (decrease by 20% from 2012) and the most active companies were AstraZeneca (14 agreements), Johnson&Johnson (11 agreements), Pfizer and GlaxoSmithKline (both 9 agreements) [47]. The above examples of success stories are contrasting to data showing that overall venture-capital funding in many domains of academic activities (media, life science, software, industrial/energy, IT services) has remain flat in the past 10 years [39] (Hayden, 2014).

Therefore, there is a need to boost existing and create new forms of interaction between academia and business, starting with a change in university and business culture that will allow formation of novel initiatives.

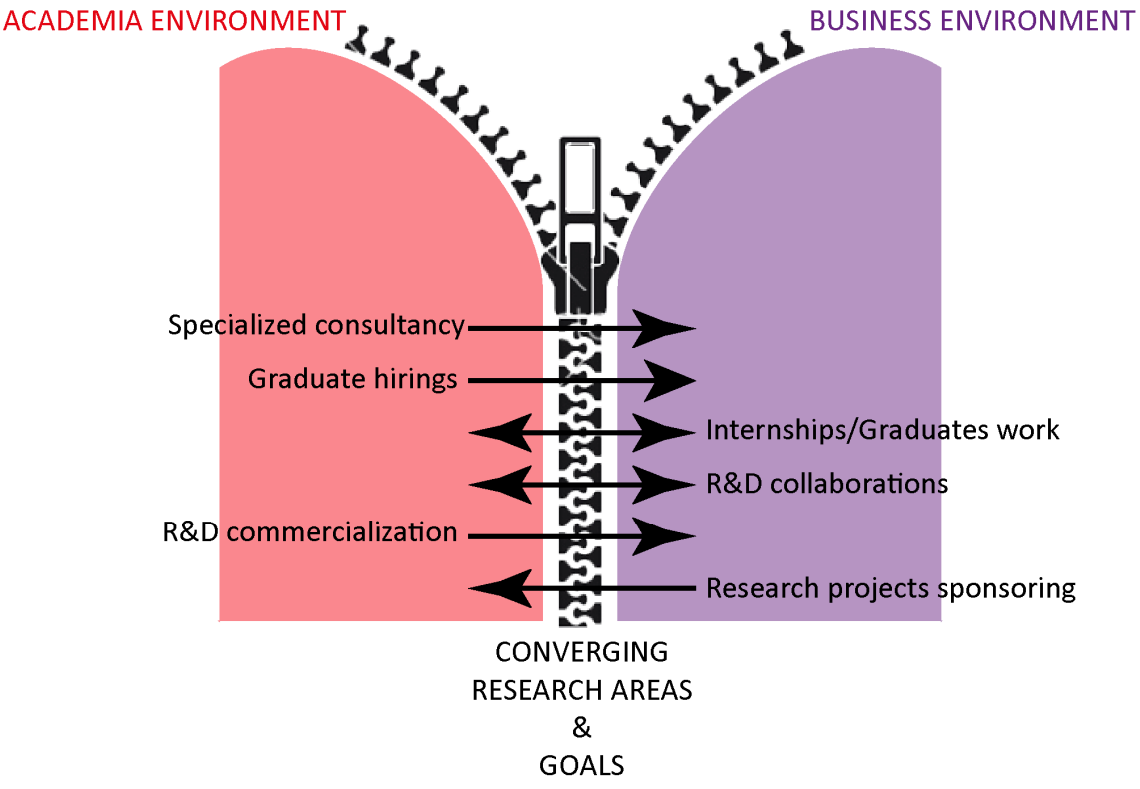


Figure 10 Converging interests of business and university cooperation

UNIVERSITY SUPPORT OF INNOVATION

In the past years many universities established Technology Transfer Organizations/Offices (TTOs). Their emergence is linked to the USA Bayh-Dole Act of 1980 that permits a university, small business, or non-profit institution to assign inventions they made using federal funding. Its role is to enable the process of translating the results of academic research into commercial products or making it more accessible for further development into new products or services [48] (Haour & Miéville, 2011). The main activities cluster around managing all forms of IP, that include overlooking the process of patent application, licensing and selling IP, and spinning off companies based on patents generated by universities [48] (Haour & Miéville, 2011). As a result, according to The Economist "*since 1980, American universities have witnessed a tenfold increase in the patents they generate, spun off more than 2,200 firms to exploit research done in their labs, created 260,000 jobs in the process, and now contribute $40 billion annually to the American economy*" [49] (Innovation's Golden Goose, 2002). The performance of TTOs receives mixed evaluations from academics that use their services, some think they were the key players in the process of establishing and licensing IP and others claim that their needs were misunderstood and it led to disruption of any further collaboration [50] (Wadman, 2008). The speculation is that it mostly depends on the number and quality of the staff working at TTOs. Most of offices have teams of 6 or fewer employees which by virtue of its size may lack expertize in all domains of technology and science represented in their university, and more experienced staff may choose to develop their career in industry [50] (Wadman, 2008). Despite the fact that few TTOs secured multimillion deals *via* the royalties paid for their inventions in most of the cases they generate only 1-5% of their respective academic institution research budget [50] (Wadman, 2008). Although the main aim of TTOs is not to make money but rather to stimulate economy by translating publicly funded research into technology, they often struggle to maintain unlicensed patents [51] (Ledford, 2013). The rationale for universities to engage in such a seemingly not beneficial activity lays in their core values and mission. According to the analysis of Haour and Miéville it's a way to disseminate the knowledge, prove its relevance to public, and reward the curiosity-driven researchers [48] (Haour & Miéville, 2011). The benefits of academic technology transfer can be grouped into several categories, following McDevitt et al, these are: revenue generation for universities, increased funding opportunities for research projects, promoting a culture of entrepreneurship, add to student exposure to translational research, benefits the society and enhance local development of economy [52] (Mcdevitt et al., 2014).

Another way to capture university innovation is a creation of spin out company based on IP generated with the help of TTO. It is a very challenging and long process starting with the phase of "incubation" when research project is transformed into venture. It consists of two critical steps: validation of proof of concept and creating a business plan [48] (Haour & Miéville, 2011). The next step is to rise funding for your business. Depending on the stage of the project these may include: bootstrapping, debt financing, grants, friends and family, "Angel Investors", factoring or venture capitalists. The big companies often choose to partner with a start-up or invest in it. There are countless examples of start-up companies that look very promising. Examples can be taken from a list created by editors of Nature Biotechnology who identified "*ten best-funded start-ups that are pursuing groundbreaking science*" [53] (Bouchie et al., 2014). Again, there are many success stories of start-ups that have further developed; some examples include NovImmune (spin-off from Geneva University), Genentech, Inc. (spin-off from University of California), Crucell N.V. (spin-off from Leiden University), Lycos, Inc. (spin-off from Carnegie Mellon University), Plastic Logic Ltd (spin-off from University of Cambridge), and many more [54], [55] (Association of University Technology Managers, 2007; The TOP 100 Swiss start-ups of 2013).

The big companies' links with universities are visible, however it is safe and reasonable to assume that the discrepancy between investments into internal R&D compared to university based research is large.

THE INNOVATION-BOOSTING ECOSYSTEM OF THE TRIPLE HELIX

Since the disruptive technology has a power to shape the global economy and ultimately society it is most important that it is accompanied by appropriate action from policy and law makers. This includes both creating environment that can help people to prosper and be protected at the same time. There are many questions that are still under consideration and require attention such as use and labeling of genetically modified organisms [56] (Frewer et al., 2013), use of gene therapy [57] (Kirkpatrick et al., 2013) or protecting our privacy [58] (Protect Your Privacy Online), to name just a few. More importantly, the recognition of the potential of disruptive technology should be accompanied by creating appropriate environment to nourish its development. It can be achieved if institutional triad of university-industry-government work together to enhance each-other performance. This model is often referred as "The Triple Helix" [59] (Etzkowitz, 2003). "*The Triple Helix thesis postulates that the interaction in university-industry-government is the key to improving the conditions for innovation in a knowledge-based society. Industry operates in the Triple Helix as the locus of production; government as the*

source of contractual relations that guarantee stable interactions and exchange; the university as a source of a new knowledge and technology, the generative principle of knowledge-based economies" [59] (Etzkowitz, 2003). Several conditions have to be fulfilled for the triple helix to fulfil its objectives. Every of the parties have to embrace additional functions, as well as to influence each other's by exchanging the ideas and knowledge. It mostly takes place on the regional level where university, government and industry recognize the specific needs and engage into the activity aiming to, for example, enhance local economy, provide tailored student training or create a translational research center. In addition, these interaction need to have some degree of formal organization, e.g. in a form of a network groups, incubators, science parks, figure 11 [59] (Etzkowitz, 2003). Switzerland is an example case of a country that invests heavily in R&D and fosters innovation-boosting environment, that in turn translates into the generation of highest number of patents (per million of citizens) in the world, attracts business and creates vivid economy [60], [61] (Swiss–American Chamber of Commerce and The Boston Consulting Group, 2008, 2012).

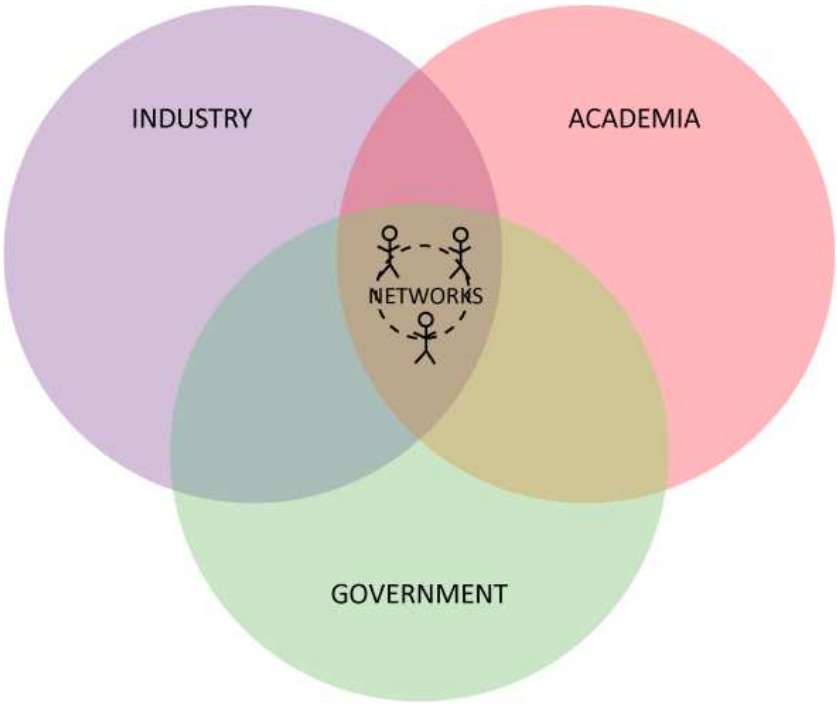


Figure 11 The innovation-boosting ecosystem of the Triple Helix

The need and the value of the knowledge transfer and its socio-economical potential has been recognized by policy makers. An example of a pro-active action taken by EU is research and innovation program named Horizon 2020 that is €80 billion of funding available over 7 years (2014 to 2020) devoted to fund research and capitalize them to the market (Horizon 2020). Another example is The Eurostars Programme sponsorising R&D carried out by small and medium enterprises [62] (The Eurostars Programme). Another example is the Swiss Commission for Technology and Innovation (CTI). This is an innovation promotion agency that supports knowledge and technology transfer by funding scientific innovations R&D projects with strong market potential and the development of start-up companies [63] (Commission for Technology and Innovation).

CASE STUDIES

The world is in need of innovation to overcome challenges in every domain of life including sustainable development, clean water, energy, etc. [64] (The Millennium Project - 15 Global Challenges). Below we present a brief description of the pathway and state of research including innovative ideas in the three cases of hydrogen energy, solar photovoltaic system and HIV treatments.

HYDROGEN ENERGY- FUEL CELLS AND BATTERIES

Hydrogen (H) is the lightest element on the periodic table yet it is the most abundant substance in the universe. On the Earth it does not occur in a pure form, but is naturally included in other substances: water and hydrocarbons, and each of them can be used to extract pure hydrogen. There are several methods of hydrogen production broadly divided into thermochemical (that uses biomass or fossil fuel) or electrolytic (from water with the use of power generated by sunlight, wind or nuclear sources). In nature some algae and bacteria produce hydrogen as a by-product of water splitting (electrolysis). Currently, the process of steam reforming, that produces hydrogen from fossil fuels remains the most cost efficient technology for commercial use. It is important to note that this process requires energy and produce CO_2. For that reason, many efforts are directed towards researching and developing economical and efficient production of hydrogen from renewable energy resources [65] (www.hydrogen.energy.gov/production.html). Hydrogen appears as a perfect energy carrier as its conversion to power is environmental friendly and does not generate any pollution. Therefore, it has been proposed to be a basis for the whole system of energy delivery called 'hydrogen economy'. Similar to any fuel, the production must be followed by its packing (by compression or liquefaction), transport (fitted vehicles or pipelines), storage and transfer. As a consequence developing and operating hydrogen economy can be very energy consuming and some suggest that it could require more energy than today's energy consumption [66] (Bossel & Eliasson). However, the efforts to overcome these obstacles are still ongoing with the short term goals *"(…) to advance hydrogen technologies to the point that industry can make commercialization decisions on hydrogen fuel cells vehicles and fuel infrastructure by 2015 so these technologies can begin to penetrate consumer markets by 2020*" [67] (DOE Hydrogen Program, 2005). A fuel cell can convert the chemical energy from hydrogen to produce electricity, heat and water. It sustains chemical reaction and produces electric power for as long as hydrogen (fuel) is supplied, therefore, they are not considered as batteries. Hydrogen fuel cells (or an energy conversion device) are a promising technology possible to use for any energy need. They could be used as stationary fuel cells (e.g. backup power; e.g. www.ballard.com) or power any type of portable devices that uses batteries (e.g. cell phones) [68] (Spare et al., 2011). Many focus on its role in transportation as a replacement for the petroleum currently used in cars and trucks. One example comes from UK's H_2Mobility project that aims to a commercial use of hydrogen fuel cell electric vehicles [69] (UK H2Mobility). Most of car manufactures have already presented prototype models of fuel cell vehicles (all types). The first cars for commercial sale are planned to be available in 2015 [70] (Green Car Congress).

On the other hand, one could also consider the use of previously mentioned hydrogen batteries, which work with the same principle. Examples of use of the nickel hydrogen battery come from NASA. The batteries were first used 1977 aboard the U.S. Navy's Navigation technology satellite-2 (NTS-2). Later on the Hubble Space Telescope was powered by nickel hydrogen batteries (during its night) for over 19 years (NASA). Other missions that have used these batteries include Mercury, Gemini, Apollo, Lunar Rover, and the International Space Station. The major supplier and producer of various types of nickel hydrogen battery is reported to be EaglePicher Technologies LLC [72] (EaglePicher Technologies).

We extracted the number of references quoting hydrogen energy using the Google Scholar search tool (Figure 12). To examine the trends in publication rates referring to the subject of hydrogen energy we used key words "hydrogen energy" (up to June 2014 it showed a total of 2710K results) and "hydrogen fuel" (total of 1590K results) and "hydrogen batteries" (total of 229K results). Both show progressive increases in the interest of the topic.

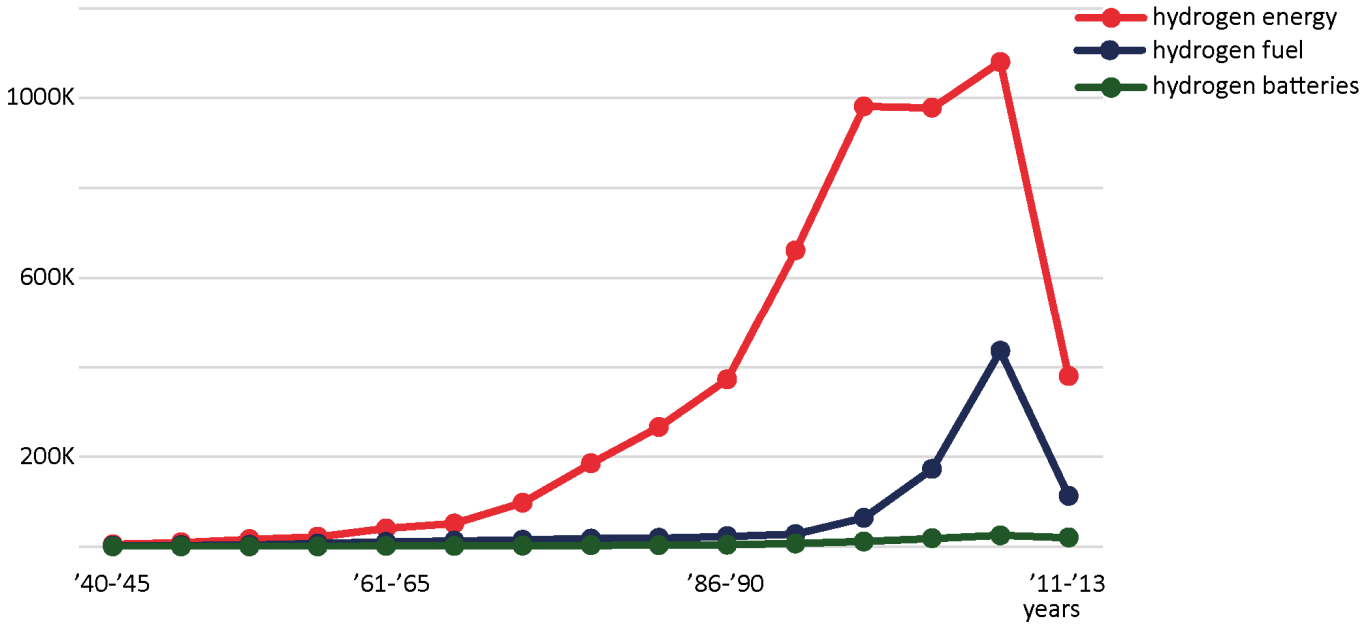


Figure 12 Trends in publication rates referring to hydrogen energy, fuel and batteries.

Using the information gathered in the above section, a search of the most pertinent about 6000 patents, published in the last 20 years, was performed using a semantic analysis with traditional patent search engines. The trend in the patent rate is provided on Figure 13.

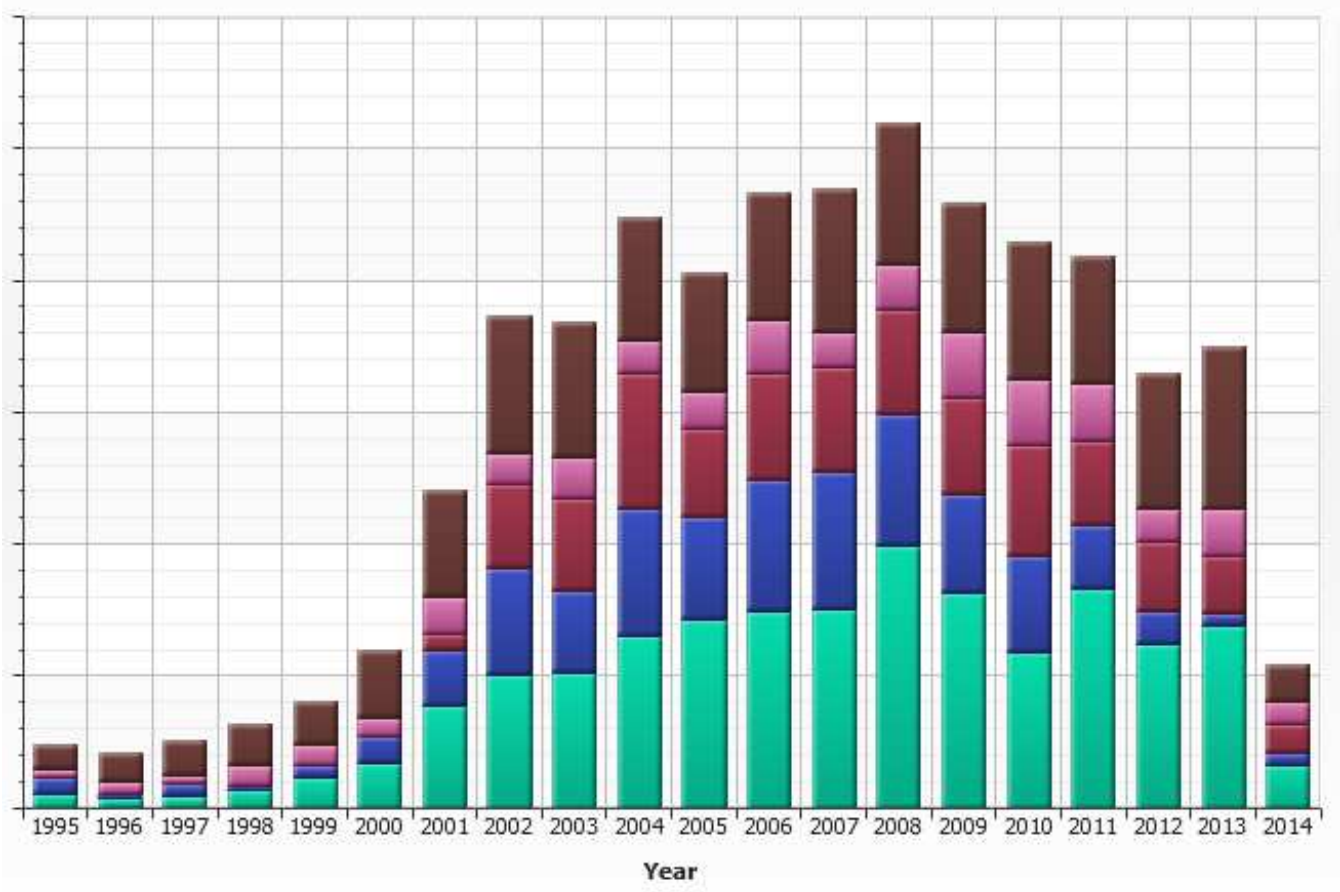


Figure 13 The number of patents per year, in the field of Hydrogen Energy, as per semantic analysis of corresponding section (6156 patents total, peak at 520 patents).

Without drawing inconsiderate conclusions one may notice a shape resemblance between the publication rate of Figure 12 and the patent rate on Figure 13, in the field of interest and for the coinciding period. A double or triple hump curve profile seems to allude to multigenerational continuous innovation.

SOLAR PHOTOVOLTAIC SYSTEM

Sunlight is one of the natural sources of renewable energy. We are constantly developing solar technologies enabling us to capture and convert it to electricity. One of the strategies is to use photovoltaic devices (PV). They use a solar energy to free electrons from materials called semiconductors and induce its flow in an electric circuit. The PV devices are called solar panels and are composed of a number of solar cells containing a photovoltaic material. Depending on its size they can be used to power any electrical devices of daily use like road signs, or sending electricity to the grid. Frequently they are used in off-grid industrial applications (e.g. in telecommunication) as an alternative to installing cable networks [73] (European Photovoltaic Industry Association, 2010). The drop in its cost made them a more competitive and thus popular solution. As a direct result 31.1GW of PV systems were installed around the world in 2012, and, was the dominant new source of electricity in Europe [74] (European Photovoltaic Industry Association, 2013). As such it covers 2.6%-5.2% of European electricity demand and affects the market and electrical system management. It has been prognosed that the global annual market could reach between 48-84GW in 2017, highly depending on policymakers' decisions [74] (European Photovoltaic Industry Association, 2013). The most popular technology, representing 90% of the market, uses crystalline silicon cells of one of three types (mono-, poly-, crystalline or ribbon sheets). Alternative technologies use thin layers of photosensitive materials (of 4 types: amorphous silicon, cadmium telluride, multi junction cells or cooper indium/gallium diselenide/disulphide) layer on glass, steel or plastic. Currently, commercially available technologies allow converting 12-17% of sunlight into electricity [73] (European Photovoltaic Industry Association, 2010). Therefore, novel developments aim to improve the solar cells efficiency by concentrating the sunlight ('concentrated photovoltaic', efficiency up to 35%). An example of novel technology comes from the start-up company, Semprius [75] (Bourzac, 2010) that has entered a list of 50 Disruptive Companies in 2013 chosen by MIT Technology Review [17] (MIT Technology Review). It is worth mentioning that a total of 4 companies focusing on photovoltaics system were included into the above list and 3 of them are start-ups (Alta Devices, BrightSource Energy, Dow Chemical, Semprius). Similarly, there are 3 companies focusing on solar panels technology that entered the list of 100 most innovative Swiss start-ups (ActLight, glass2energy, Cleantech) [55] (Top 100 - les meilleurs start-up suisses, 2013).

We extracted the number of references quoting solar panels using the Google Scholar search tool (Figure 14). To examine the trends in publication rates referring to the subject of solar energy we used key words "solar panels" (up to June 2014 it showed a total of 354K results) and "photovoltaics" (total of 143K results). Both show progressive increase in the interest of the topic.

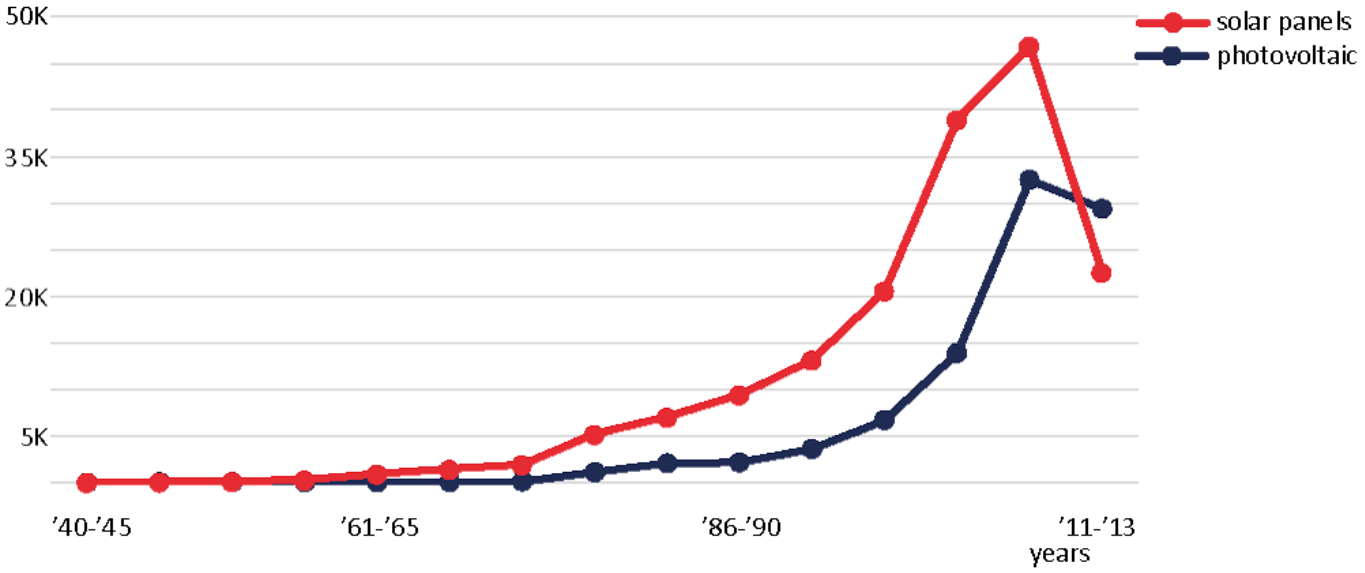


Figure 14 Trends in publication rates referring to solar panels and photovoltaic

Using the information gathered in the above section, a search of the most pertinent about 6000 patents, published in the last 20 years, was performed using a semantic analysis with traditional patent search engines. The trend in the patent rate is provided on Figure 15.

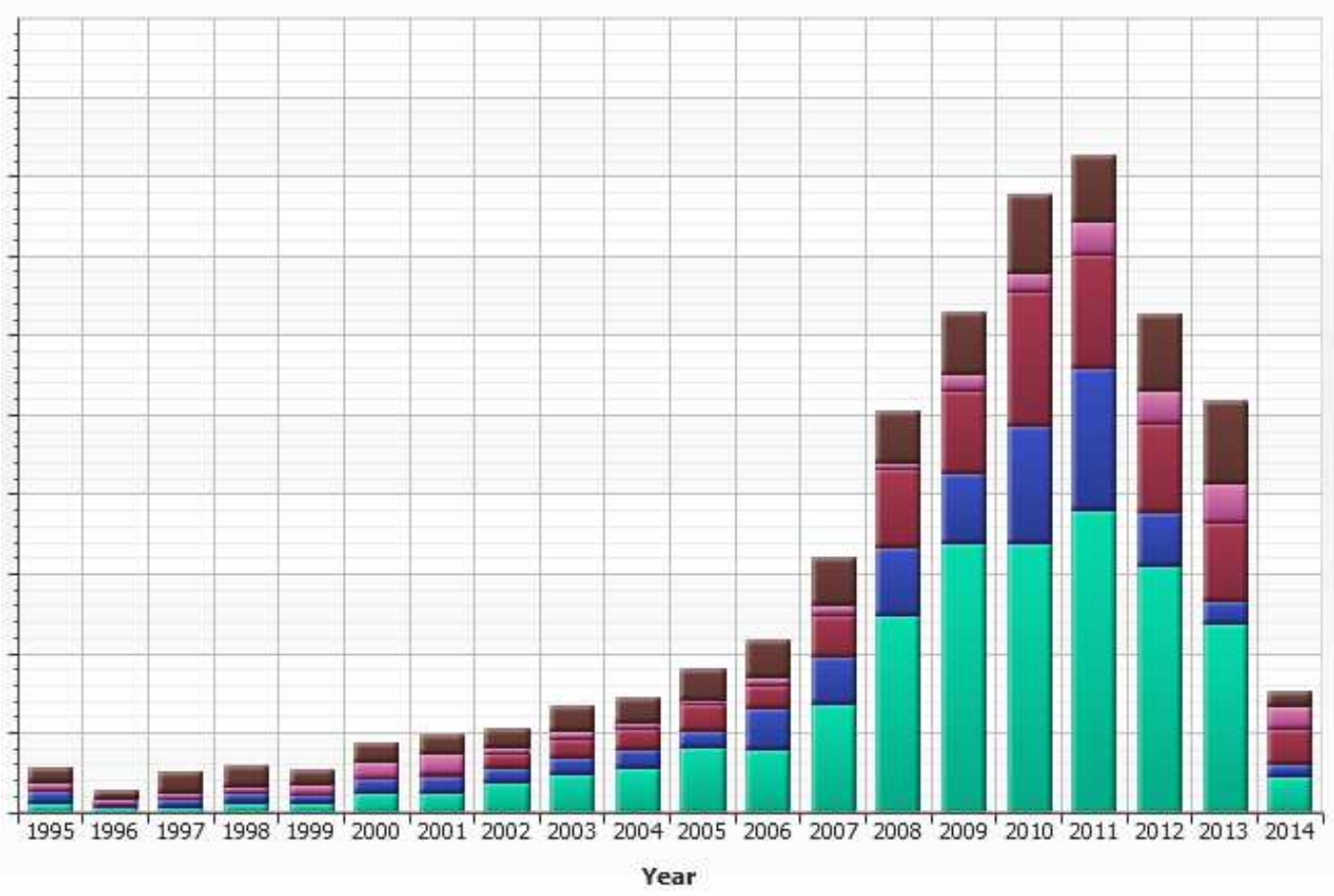


Figure 15 The number of patents per year, in the field of Solar Panels & Photovoltaic, as per semantic analysis of corresponding section (6240 patents total, peak at 830 patents).

Without drawing inconsiderate conclusions one may notice a shape resemblance between the publication rate of Figure 14 and the patent rate on Figure 15, in the field of interest and for the coinciding period. A double kinetic curve profile seems to allude to multigenerational innovation with a pretty exponential increase more recently.

HIV- CURRENT TREATMENTS

At the moment there is no treatment that can cure HIV. Since the discovery of the virus in 1983, there is about 30 drugs that have been developed to prevent the advance of HIV to AIDS and reduce the risk of virus transmission [76] (A Timeline of AIDS). The current treatment plan includes taking 3 types of drugs belonging to different groups of medication. The drugs can be called antiretrovirals and their aim is to prevent the virus replication and thus increase in the amount of HIV in the body. Depending on their specific action they can be separated into the following groups: (1) Nucleoside/Nucleotide Reverse Transcriptase Inhibitors, (2) Non-Nucleoside Reverse Transcriptase Inhibitors, (3) Protease Inhibitors, (4) Entry/Fusion Inhibitors, (5) Integrase Inhibitors. The full list of medicines approved for the treatment of HIV infection can be easily accessed in a number of web portals devoted to the HIV/AIDS [77] (FDA-Approved HIV Medicines). However, scientists agree that an HIV vaccine development would be the most effective tool to prohibit the spread of disease and help to stabilize the spread of virus in the blood from the site of infection (viremia). This is a pressing problem as according to WHO more than 40 ml people live with HIV [78] (World Health Organisation & Joint United Nations Programme on HIV/AIDS, 2005). There are several international initiatives that are raising money for research focusing on HIV vaccination [79] (International AIDS Vaccine Initiative). To raise the awareness of the challenge, every 18th of May is devoted to the discussion and bringing attention to the problem (World AIDS Vaccine Day). Due to the differences in the HIV structure, its action and disease

progression as compared to other viruses, the classical development of vaccine is not effective at the moment. It seems that only a better understanding of the mechanisms governing the virus at fundamental level could lead to the development of efficient cures. There is a pressing need for worldwide collaboration to sufficiently understand the problem. The investment into vaccination development reached a total of US$ 8bn (2001-2011: average of US$ 824 ml) [80] (HIV Vaccines & Microbicides Resource Tracking Working Group, 2012). That allowed reaching few milestones, like findings of new antibodies that could decrease the risk of infection and efficacy trials scheduled for the coming years. There are several immunological approaches that have been tested in clinical studies, details can be found in [81] (Corey et al., 2011). It is essential to produce data on vaccine efficiency in clinical trials because of the differences of human and primate lentiviral infections and lack of appropriate animal models [81] (Corey et al., 2011). At the moment there are two vaccinations scheduled for large scale-efficacy trials starting in 2016 and many others at various points of development (ranging from applied research to phase I/II clinical trial) [82] (Koff, 2014).

C chemokine receptor type 5 (referred to as CCR5 or CD195) is a protein that serves as a receptor on the surface of white blood cells, among few on a T cell type. HIV virus uses CCR5 and/or CXCR4 as co-receptors to enter a host cell. Therefore, CCR5 receptor becomes an alternative target for treatment of HIV. CCR5 receptor antagonist have been designed PRO140 (Progenics), Vicriviroc (Phase III trials were cancelled in July 2010) (Schering Plough), Aplaviroc (GW-873140) (GlaxoSmithKline) and Maraviroc (UK-427857) (Pfizer). The threat in antagonising only one co-receptor is that it may push HIV virus to evolve to use another one. However, examination of viral resistance to AD101, molecular antagonist of CCR5, indicated that resistant viruses did not switch to another co-receptor (CXCR4) but persisted in using CCR5, either through binding to alternative domains of CCR5, or by binding to the receptor at a higher affinity [83] (Trkola et al., 2002). The issue of CCR5 becomes more interesting when scientists discovered that a genetic mutation (known as CCR5-delta 32) prevents the virus from entering the cells, and hence infection [84] (Marmor et al., 2001). The turning point in the HIV therapy directions happened in Berlin due to the two patients with HIV who have received different treatments, and are known as the Berlin patients. First patient, remaining anonymous, in 1998 during acute period of infection received combination therapy that included anti-cancer drug (hydroxyurea). Remarkably, after the therapy the virus was undetectable, however the exact cause and mechanism remains unknown. It is speculated that it may be due to the genetic background of the patient himself that helped him to control the infection. However, this case, even if it didn't provide any definitive answers stimulated HIV researchers to look towards eradication and early therapy studies. Second patient, Timothy Brown, had HIV and leukaemia. To treat the cancer he underwent chemotherapy and radiation followed by two bone marrow transplants to rebuild his immune system. As it turned out, the donor was a carrier of HIV-resistant mutation CCR5-delta 32. Remarkably, Brown survived leukemia and remains HIV-free [85] (Hütter et al., 2009). This incidental discovery of possible solution is not feasible for societies in need of thereof, but yet again, this case stimulated gene therapy line of research. In yet another case, two Boston patients suffered from lymphoma (not leukemia) and in parallel were carrier of HIV. Their treatment plan included a moderate round of cancer therapy and partial bone marrow transplant without receiving stem cells with the delta 32 mutation. They received anti-retrovirals drugs after anti-cancer therapy. Similar to Timothy Brown they remained HIV-free. However, the course of action was significantly different from Berlin patients, here the immune system was not fully compromised, and they continue to take anti-retrovirals. The leading physicians of the case hypothesised that the drugs were preventing the virus from spreading, while healthy new cells from the bone-marrow transplant eliminated the old and weakened HIV-infected cells. Unfortunately, despite the initial enthusiasm when patients remained virus free four years after bone-marrow transplants, the virus was again detected in December 2013 [86] (Hayden, 2013). The described medical discoveries will most likely not be converted to standard procedures as they carry huge risk per se and are very expensive. However, the discoveries that they are associated to stimulated new lines of research and allowed to form new testable hypothesis.

We extracted the number of references quoting HIV using the Google Scholar search tool (Figure 16). To examine the trends in publication rates referring to the subject of HIV treatment we used key words "HIV" (up to June 2014 it showed a total of 1740K results) and "AIDS" (total of 2260K results). Both show a progressive increase in the interest of the topic, reaching its highest point in 2008.

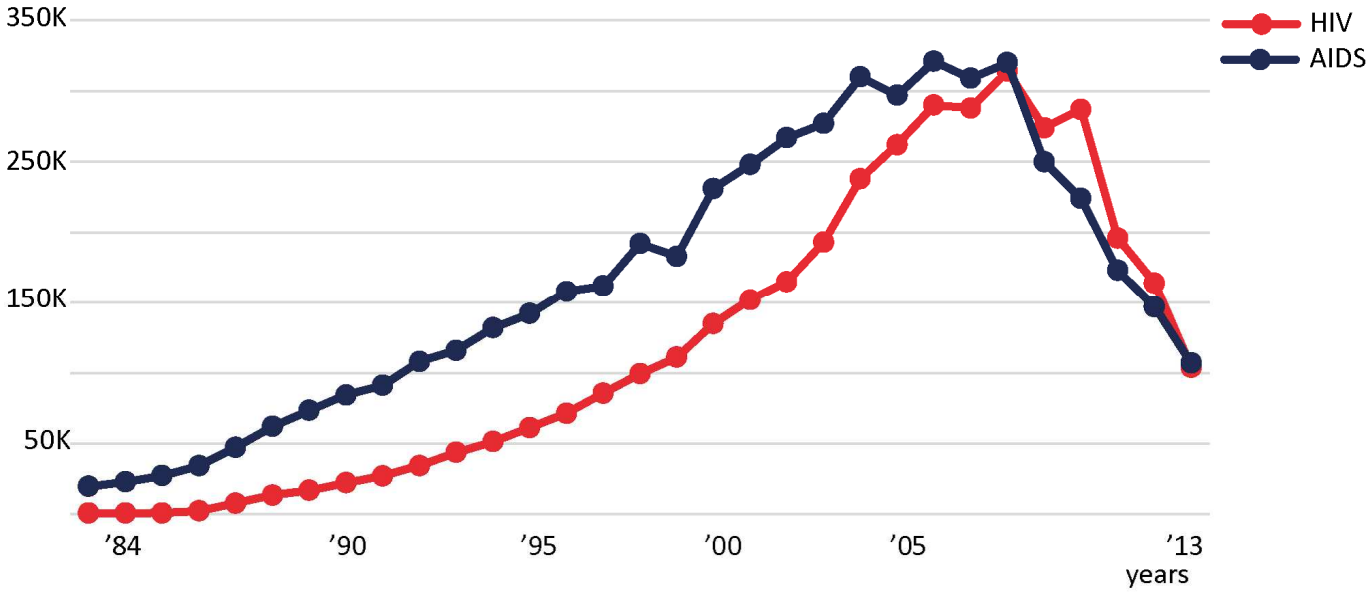


Figure 16 Trends in publication rates referring to HIV and AIDS.

Using the information gathered in the above section, a search of the most pertinent about 6000 patents, published in the last 20 years, was performed using a semantic analysis with traditional patent search engines. The trend in the patent rate is provided on Figure 17.

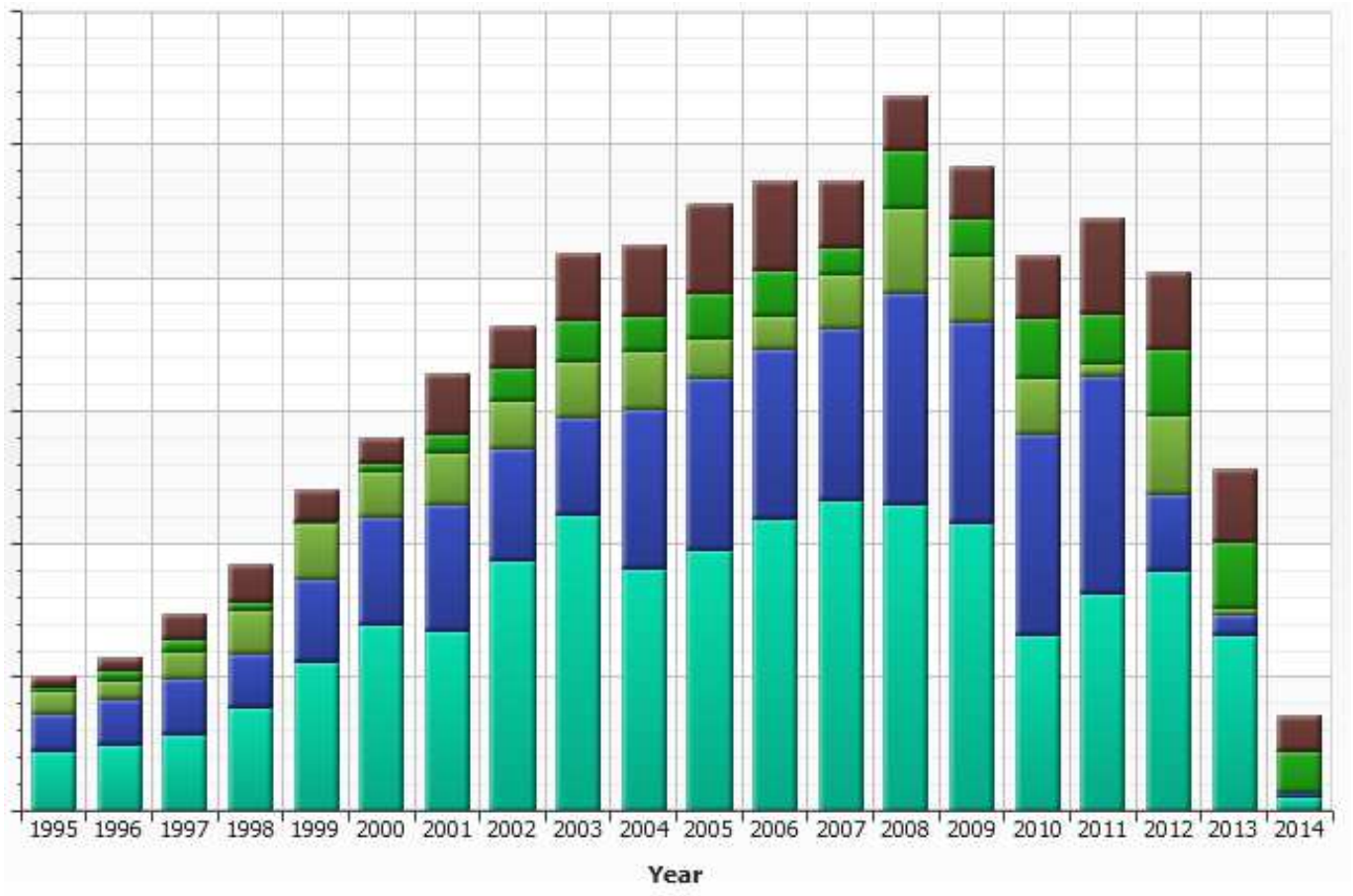


Figure 17 The number of patents per year, in the field of HIV & AIDS, as per semantic analysis of corresponding section (6951 patents total, peak at 540 patents).

Without drawing inconsiderate conclusions one may notice a shape resemblance between the publication rate of Figure 16 and the patent rate on Figure 17, in the field of interest and for the coinciding period. A more progressive curve profile seems to allude to a continuous innovation with a roughly linear initial growth profile of publications and patents.

DISRUPTIVE? TO WHAT EXTEND?

Roughly a million publications at curve peak for the Hydrogen Energy field versus 50 thousand for the Solar/PV area and 350 thousand for HIV/AIDS; this clearly states out the focus and interests vs. societal changes and remediation vs. industrial and directly predictable commercial potential. Co-current direct commercial interests and societal changes/remediation would yield maximum publications and patent productivity, therewith the highest likelihood of disruptive innovation to emerge.

A Forward-Citation measurement was conducted on the 1000 most relevant patents of the about 6000 patents selected initially for each of the three selected fields.

- ***When HIV/AIDS generates 4000 (patents) forward citations out of the most relevant 1000 selected patents, i.e. a ratio of 4/1,***
- ***Hydrogen Energy generates 8000 (patents) forward citations, ratio 8/1,***
- ***and Solar/PV generates 12000 (patents) forward citations, ratio 12/1.***

Theoretically one would attribute disruptiveness to the area which most influences the sector of interest, all things considered (product, breadth of applications, market, route to market, consumerism at large, societal benefits and wellness…). From an immediacy stand point, Solar/PV already under implementation for several years has a potential to revolutionize the energy use and consumption; likely at the condition that current solar conversion yield can be raised, "dreamily" in the range of 30% rather than current 10/15%.

A still long demanded disruptive innovation in the field of HIV/AIDS seems to be confirmed in its "relative infancy" **strictly** judging from the present work on the rate of publications, the patent rate shape over the last 20 years and the forward citation number per 1000 patents. Co-creative fundamentally disruptive approaches comprising multidisciplinary involvements, beyond the traditional pharmaceutical innovation format as described in the dedicated section, may provide more hope than currently envisioned; this from the **very limited data** used in the present work for illustrative purpose only.

CONCLUSION

From the above one may derive a few conclusions:

- Open & disruptive innovation is probably an inevitable challenge to maintain the pace of changes occurring in some technology areas. Creative confidence, Combinative skills and Clarity are to be reinstated in the broader creativity scheme which embraces a much larger range of functions than the ones generally anticipated.
- A matter of co-creativeness and Collaboratory™… When performed by enlarged teams comprising the engineer, scientist, IP strategist, business model expert, sales and marketing teams, accountant, executive and operating teams, the ATA©, adjacent technology analysis – *covered more extensively in previous reviews by Rebouillat et al.* – conducted with the depicted disruptive innovator mindset, is one way to further challenge the imperfect patent and publication exploration tools especially when dealing with open disruptive innovation.
- Semantic is, in the present study, shown as an improvement, still lacking motion and pictures and a better integration of visuals.
- Innovation and inventions can largely be transformed by visualization, images and motions in general; visual analytics being the next step. The patent language barriers can likely be reduced from new semantic analysis converting thousands of words in new pictures and thousands of pictures in new concepts; 3D animations and virtual comparisons with real situations, including patent images and schematics, hold great potential for fast and disruptive open innovation. This can be definitely stressed once more in this fifth chapter on innovation.
- In this "Bigger" Data context, developing analytics to learn from the on-going evolutionary development matters may reveal powerful, anticipatory and provide ad hoc reactiveness to redirect the efforts.

As illustrations, we described here three domains that are rapidly developing and are in the need of innovation to overcome challenges that societies face. In all of them, one sees a growing collective effort in working and developing the required technologies. It might be that, in those particular situations, disruptive innovation won't emerge suddenly but

rather will be gradual, based on the continuous discussion between many parties. As such, the moment of its emergence will be more difficult to identify, however its effect on the market will be evident and almost predictable. If this is indeed a case, what about open, inclusive and reverse innovation embedded in supporting ecosystem as a key driver to progressive disruptive innovation?

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Dielectric properties of ZnS filled polystyrene nanoparticules

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ABSTRACT: Zinc sulfide ZnS have been synthesized in reserves cores micelles in PS synthesized by emulsion polymerization. The size and morphology of ZnS/PS particles have been characterized via XRD, TEM, IR, SEM and AFM measurement. The dielectric proprieties of ZnS/PS are synthesized membrane, obtaining a water-swelling percentage around 20% and filled with ZnS nanoparticules were studied as a function of particle coating. The complex permittivity was measured with a 7600 Meter dielectric spectroscopy analyzer at applied voltage of 1 V with frequency varying between 10Hz and up to 1 KHz at different temperatures measurements are performed in dry conditions.

KEYWORDS: Zinc Sulfide, polystyrene, nanocomposites.

1 INTRODUCTION

ZnS nanoparticles are widely studied materials due to their unique electrical, electronic, and optical properties. ZnS nanoparticles need to be dispersed homogenously in various matrices for these applications and it can be synthesized by various synthetic paths in various shapes and particle sizes [1, 2, 3, 4, 5, 11]. Two approaches have been developed to prepare organic-inorganic hybrid materials. The first route is to incorporate inorganic domains into a polymer matrix by a sol –gel technique [1, 2]. Another method is to incorporate premade inorganic colloidal nanoparticules into polymer matrix [9]. Nanoparticules and nanocomposites are used in a wide range of applications in various fields, such as medicine, textiles, optics, and electrical. Nanoparticules can be incorporated into polymeric nanocomposites. Polymeric nanocomposites consisting of inorganic nanoparticules and organic polymers represent a new class of materials. Polymer nanocomposites show great promise as electrical insulation [22]. Adding just of few weight percent of nanosized fillers can have a profound effect on material Proprieties [18].

The aim of this work is to investigate the characteristic of nanocomposites and the influence of the above mentioned surface modifications and nanoparticules content on the dielectric proprieties of the nanocomposites [21].

2 EXPERIMENTAL

2.1 MATERIALS

Styrene monomers, sodium dodcyl sulfate (SDS, Aldrich, 99%) and the initiator, potassium persulfate (KPS, Aldrich, 98%), ZnS CNCs, Zinc acetate dehydrate (Zn (OAc) $_2$. 2 H_2O) (Aldrich).

2.2 SYNTHESIES OF ZNS NANOPARTICULES

To synthesise the ZnS CNCs, Zinc acetate dehydrate [Zn (OAc) $_2$. 2 H_2O) Aldrich, AR grade]), and the thiourea [21] were dissolved in diéthylène glycol and kept for 2h under continuous magnetical agitation. At the end of the reaction, the

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precipitate was centrifuged, washed several times with ethanol, and then dried in vacuum for 12 h to yield a white dry ZnS powder.

2.3 SYNTHESIES OF POLYSTYRENE

Polystyrene were prepared in batch emulsion polymerization at 80°C from styrene (Aldrich, 99%), in 200 ml of H_2O the surfactant, sodium dodcyl sulfate (SDS, Aldrich, 99%) and the initiator, potassium persulfate (Kps, Aldrich, 98%). Removing SDS and conterions from the suspension using a mixture of anionic and cationic exchange technique (DOWEX Marathon MR-3, Aldrich).

2.4 SYNTHESIES OF ZNS/PS

Ten percent of the weight of ZnS was added to 20ml of ethanol. The suspension was stirred magnetically for 1h and sonicated for 1h before 2g of PS was added. The resulting mixture was magnetically stirred for 1h and sonicated for 1h, ZnS /PS nanocomposites were synthesized by an in-situ polymerization [13].

2.5 MEASUREMENTS

The X-ray diffraction patterns of the nanocomposites were measured using the $Cuk_{\alpha 1}$ (1,5406Å) radiation in the range of 2θ=2-70º, with a step size of 0.02º.

The infrared spectroscopic absorption data were obtained with a Fourier Transform infrared spectrometer with an attenuated total reflectance accessory (FTIR-ATR).

Morphology of the materials was studied using Atomic forces microscope (AFM), Transmission Electron Microscopy (TEM), SEM images were obtained by means of microscope.

The dielectric constant for the nanoparticules ZnS, PS and nanocomposites ZnS/PS have been measured by using an L. C. R meter 7600.

3 RESULTATS AND DISSCUSSIONS

3.1 INFRARED ABSORPTION SPECTRA

3.1.1 INFRARED ABSORPTION SPECTRA OF ZNS

The infrared absorption spectra (FT-IR) of ZnS recorded in the region from 400-4000 cm^{-1}. Spectrum analysis of ZnS shows that despite of the successive washes of the powder with absolute ethanol, traces of solvent still exist which is confirmed by the presence of a broad and intense band at around 3340 cm^{-1} assigned to the vibrations of valence of OH group of 1.3 propandiol, the relative bands of the two vibrations of valences of the C-H groups at about 2970- 2860 cm^{-1} and the valence band located to 1073 cm^{-1} which is due to the vibrations of the valence bands of the polyol's CO group. It also distinguishes the presence of a band around 1600 cm^{-1} and 1400 cm^{-1} assigned to the valence vibrations of the acetate [10, 11], the vibration of the ZnS bond is confirmed by the presence of the band located around 662 cm-1 [12, 13].

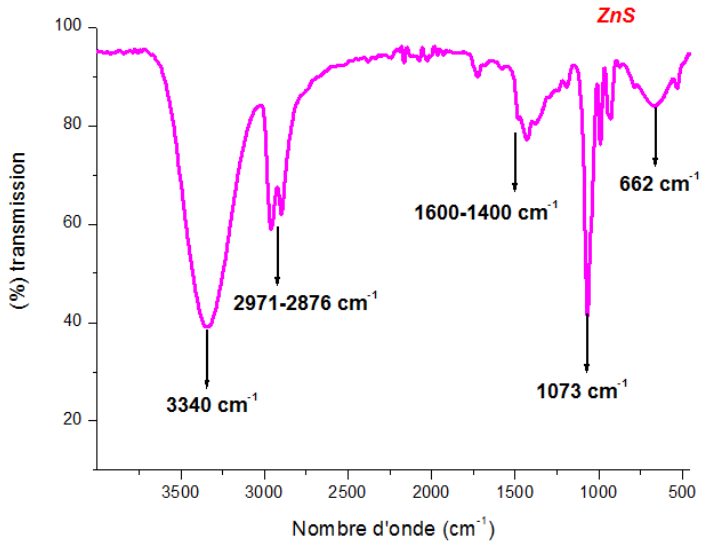


Fig.1: FTIR spectra of ZnS nanoparticles

3.1.2 INFARED ABSORPTION SPECTRA OF PS, ZNS AND PS/ZNS NANOCOMPOSITE

The Infrared absorption spectra of PS and ZnS/PS nanocomposites. The infrared of PS features bands at 3066, 3025, 2922, 2851, 1666-1945, 1491-1599, 1188-1368, 1026,698-756, and 543cm^{-1}.

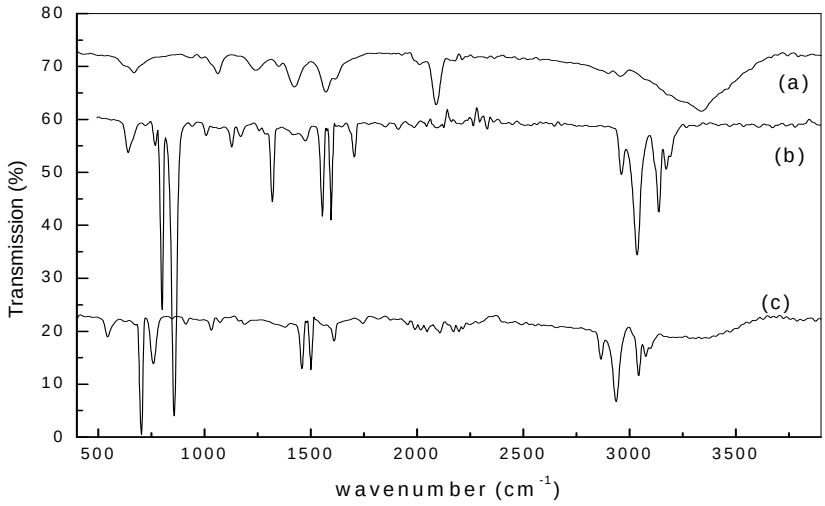


Figure.2. In situ infrared spectra of (a)PS, ZnS (b), (c) ZnS/PS nanocomposites.

3.2 X-RAY DIFFRACTION XRD

3.2.1 XRD OF ZNS

The XRD pattern of the as-synthesized revealed well-crystallized and pure ZnS particles with the cubic phase (space group F-43m, lattice constant a =5,414 Å (Figure.3). The peak broadening in the XRD pattern clearly indicates the very small nanocrystals are present in the sample. Estimated by applying the Debye-Scherer formula [4] size is about 4-5 nm.

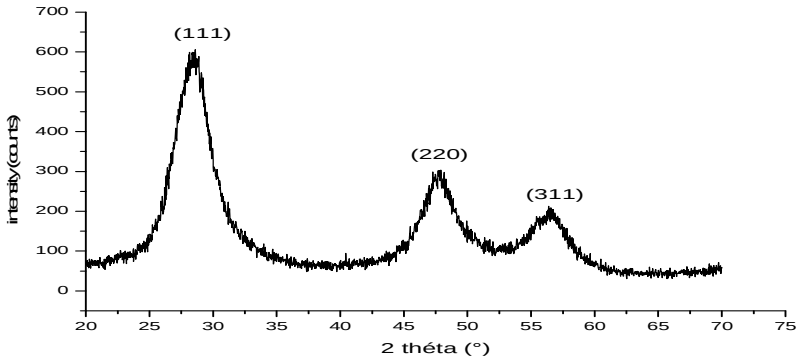


Figure. 3. X-Ray spectra of ZnS nanoparticules.

3.2.2 XRD OF ZNS/PS

X-ray the structural diffraction (XRD) measurements were also applied to analyse the characteristic of ZnS/PS nanocomposites which were prepared with 20% of ZnS. Figure. 4 show the XRD patterns of PS and ZnS/PS nanocomposites. For PS (Figure.4.a) two a broad amorphous peaks, which appeared within the range of 2 θ = (9-10) and 2 θ = (18-20) [2] can observed. For PS/ZnS nanocomposites it is clear from Figure.4.b that the crystals structures of sulfide zinc particles are not altered by the polystyrene. The final composite products have distinct coreshell morphology. As a result, XRD pattern of sulfide zinc/polystyrene composite nanospheres combines of both nanocomposites [25].

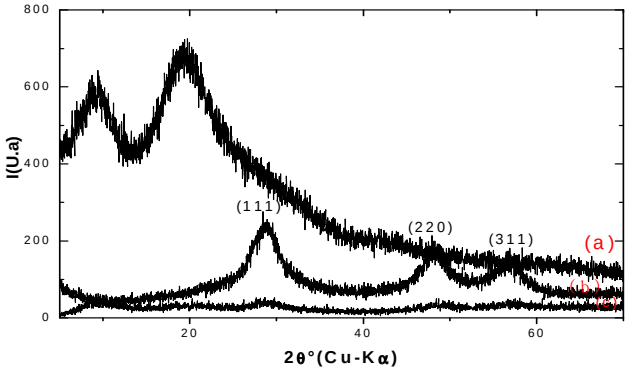
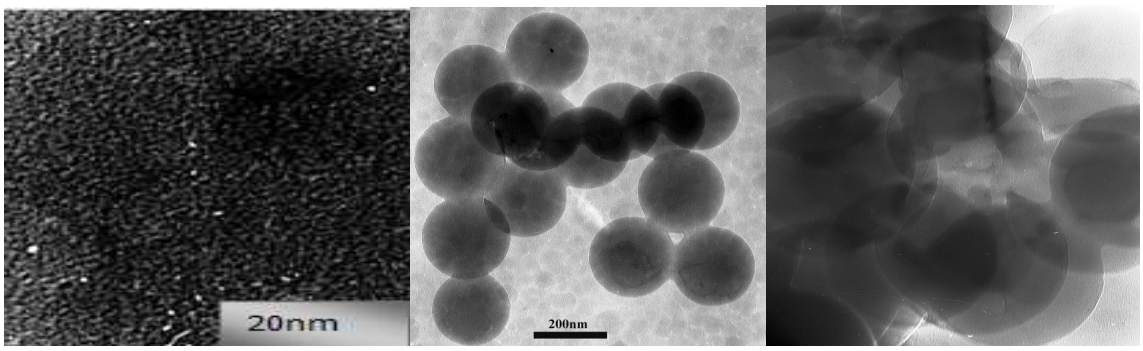


Figure. 4: X-Ray patterns of synthesized (a) PS, ZnS (b), ZnS/PS(c)

3.3 TRANSMISSION ELECTRON MICROSCOPY (TEM)

Transmission electron microscopy (TEM) provides an actual image of the ZnS/PS which permits the identification of the morphology of the nanocomposites. Thus, TEM was another method to observe evidence for the formation of the intercalated structure of the prepared nanocomposites. In Figure.5.a, presents the TEM of ZnS nanoparticules. The small nanoparticules are observed from the TEM images. The ZnS has a diameter of about 20 nm. However, Figure.5.b shows the TEM of image of PS, it has been ordered spherical. Figure.5.c reveals the typical TEM of ZnS/PS nanocomposites films with ZnS contents of 20 Wt %, it can be seen that the ZnS is uniformly dispersed in the polymeric matrix indication that the polystyrene play an important role in stabilizing and dispersing nanoparticules [12, 13, 25].

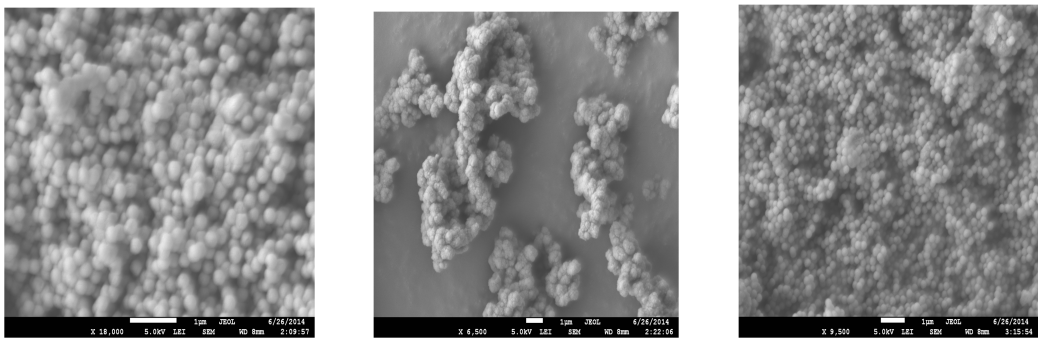


(a) (b) (c)

Figure.5. TEM particules of (a) ZnS, (b) PS, (c) ZnS/PS nanocomposites

3.4 MORPHOLOGY OF PS/ZNS COMPOSITE MICROSPHERES

The formation of Zinc sulfide/polystyrene (ZnS/PS) [6] composite microspheres can be classified as polymerization initiated by ZnS. SEM micrographs of ZnS/PS samples are shown in Figure. 6. (c) displays general images of nanocomposites microspheres, it can be clearly seen that the microspheres have ordered spherical shape and possess a good dispersion. SEM image in Figure.7.c shows the morphology of ZnS/PS microspheres under magnifications observations.



(a) (b) (c)

Fig.6. SEM images of (a)PS, (b) ZnS, (c)ZnS/PS after 1h of sonication time

3.5 ATOMIC FORCE MICROSCOPY (AFM)

The AFM images of polystyrene without and with zinc sulfide nanoparticules of 20% are shown in Figure.7, it can be seen that the polystyrene has a spherical surface (Figure. 7.a), the PS has been ordered spherical [10, 11,18]. In Figure.7.b, the spheres are assembled into closely pocked hexagonal, it can be seen that the surface of the film is very ordered; however, many small nanoparticules is around 1-4 nm. This further indicates that the ZnS nanoparticules remain their original size without aggregation at the surface of films.

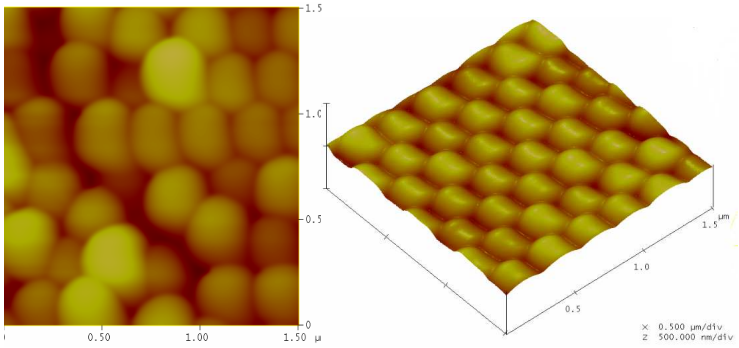


Figure.7.a. Topography AFM representing the height image (left) and the 3D image (right) of PS

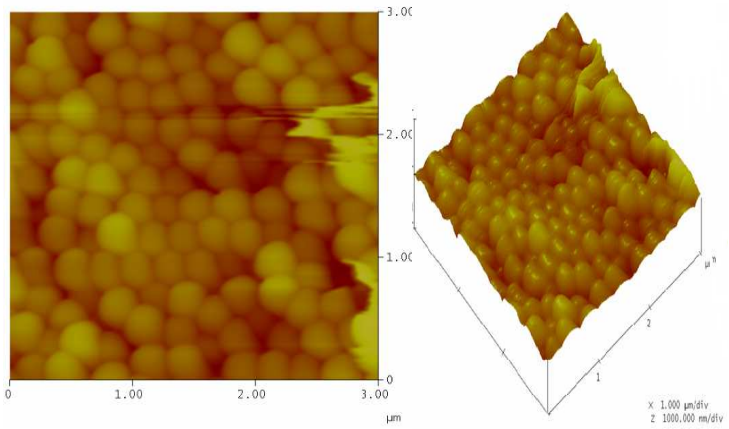
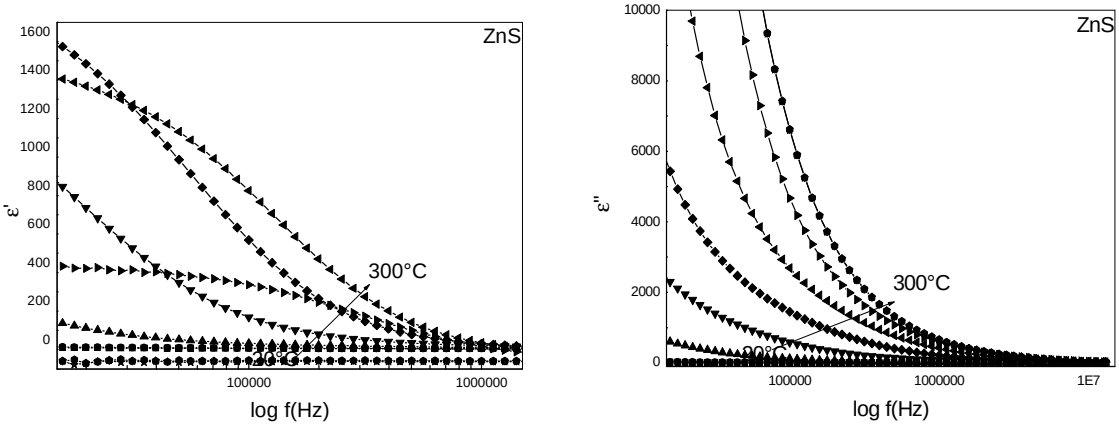


Figure.7.b. Topography AFM representing the height image (left) and the 3D image (right) of ZnS/PS.

3.6 DIELECTRIC MEASUREMENTS

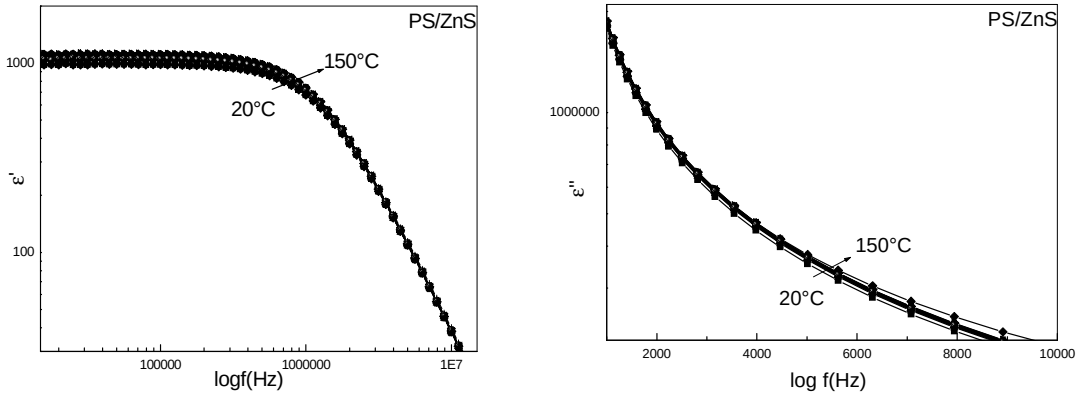
The relative dielectric permittivity ἐ and dielectric loss ἐ’ of the nanoparticules ZnS as a function of frequency of the applied ac electric is displayed respectively in Figure.8.1. The dielectric constant for the nanoparticules ZnS have been measured by using an L. C. R meter, the relative dielectric permittivity increased in low frequency and it’s values were found in the range 20-200 at higher frequencies. The large value of ἐ of ZnS nanoparticules thin film is to the fact that the nanoparticules of ZnS under of the application of electric field act as nanodipoles [21, 22, 23]. There is no dispersion at higher frequencies, the nanoparticules can not follow the rapid variations of the dielectric field and hence, they show practically no dispersion.

In Comparing dielectric constant for the nanocomposites with these for unfilled ZnS, it can be noted that the low frequency dispersion behavior changes from a Debye reponse to reponse with a less steep slope (Figure.8.2). This could be explained by nanoparticules affecting the charge transport mechanism and the net interfacial polarization. The dielectric constant seems to increase with increasing filler regardless of the surface treatment. Isotherms for dielectric constant in the frequency domain, corresponding to nanocomposites are shown in Fig. 10.2. As usual dielectric constant increase as frequency decrease reaching a plateau corresponding to the relaxed dipole [24].



(a) (b)

Fig.8.1. Relative dielectric permittivity (a) and dielectric loss (b) as a function of the frequency at temperatures between 20°C to 300°C for nanoparticules ZnS.



(a) (b)

Fig.8.2. Relative dielectric permittivity (a) and dielectric loss (b) as a function of the frequency at temperatures between 20°C to 150° for nanocomposites ZnS/PS.

4 CONCLUSIONS

An intercalate nanocomposites was formed by a free radical polymerization reaction of stay in the presence of ZnS intercalate, the high concentration of polystyrene capped ZnS nanoparticules with an average diameter of 20 nm can be seen easily immobilized into the polystyrene. The morphology (TEM, SEM, and AFM) studies suggest that the ZnS nanoparticules are uniformly dispersed in the polymer matrix. The nanocomposites exhibit excellent dielectric permittivity and dielectric loss as a function of the height frequency.

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Les effets de la proximité sur les relations technologiques - Une identification de la relation à l'aide de l'économétrie des données de Panel: Le cas des entreprises françaises

[The role of geographical proximity on firm technological linkage - An identification of the relation by means of the econometrics of the data of Panel: The case of the French companies]

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ABSTRACT: The aim of this paper is to investigate and assess the role of geographical proximity on firm technological linkages. Our results suggest that the knowledge dissemination must be supplemented by otherfactor. The econometric analysis confirms the importance of the geographical proximity in the innovation process of french firms. Facors, such as, a larger mobility of skilled labor force, higher organization size and a greater absorptive capacity of innovative firms, may also play an important role in the this process. However, the inter-firms cooperation in french and their sectoral membership don't appear to be essential to increase their innovating capacity.

KEYWORDS: proximity, cooperation, absorptive, knowledge and externalities.

RESUME: L'objet de notre travail sera d'évaluer le rôle de la proximité géographique sur les relations technologiques des entreprises, et de montrer que son rôle dans la diffusion de la connaissance doit être compléter par d'autres facteurs. Nos résultats économétriques confirment l'importance de la proximité géographique dans le processus d'innovation des firmes françaises, et montrent qu'un tel effet passe par les canaux suivants : une forte mobilité de la main d'œuvre qualifiée, une taille assez importante de l'organisation et une grande capacité d'absorption des entreprises. En revanche, la coopération entre les firmes françaises et leur appartenance sectorielle ne s'avèrent pas indispensable pour augmenter leur capacité innovatrice.

MOTS-CLEFS: proximité, coopération, capacité d'absorption, connaissances et externalités.

INTRODUCTION

L'idée que les sociétés et les systèmes productifs tirent bénéfice de la concentration spatiale de leurs activités de recherches et d'innovation, est largement acceptée de nos jours : la proximité géographique est vue comme un état essentiel pour le succès technologique, en particulier dans le cas des PME. Néanmoins, des doutes sérieux maintenant sont exprimés, quant aux caractéristiques du processus de la concentration spatiale qui a été engagé, en particulier en vue de la capacité de

transférer la connaissance qui se nomme souvent en tant que connaissance tacite, sans coût et sans effort particulier (Rallet et Torre 2001).

Zucker et al (1994) sont les premiers à montrer le rôle des interactions dans la diffusion de la connaissance, en prouvant que la proximité géographique n'est pas suffisante pour permettre de tirer bénéfice des externalités de la connaissance. Cockburn et Henderson (1998) insistent sur l'importance des interactions entre les scientifiques dans la diffusion des externalités de la R&D. Audretsch et Stephan (1998) ont confirmé ces résultats, en montrant que 70% des contacts entre les entreprises et les scientifiques ne sont pas locaux mais changent selon la nature des tâches confiées aux scientifiques (transfert de la connaissance, signal de la qualité pour des investisseurs, participation au comité scientifique des entreprises …).

Ainsi, l'analyse du processus de la transmission des externalités de la connaissance, nous mène à reconsidérer automatiquement le rôle positif de la proximité géographique dans un cadre d'interaction entre les entreprises. La proximité géographique seule est alors insuffisante, et la diffusion de la connaissance devra être organisée. C'est pourquoi il est nécessaire d'étudier l'interaction réelle entre les agents, en particulier en vue de l'acquisition de connaissances externes.

L'objet de notre travail sera d'évaluer le rôle de la proximité géographique sur les relations technologiques des entreprises, et de montrer que son rôle dans la diffusion de la connaissance doit être complété par d'autres facteurs. Il s'agit essentiellement de la coopération inter firmes, de la taille des firmes, de leur capacité d'absorption, de la mobilité de la main d'œuvre qualifiée et d'autres facteurs que nous allons exposer par la suite.

ECHANTILLON

L'ensemble des données utilisées dans cette étude sera assemblé à partir de la base de données internationale « **World Scop** » qui fournit des informations sur les dépenses de R&D de l'ensemble des entreprises de plus de 20 salariés implantées sur le territoire français. Le but est de rassembler des informations détaillées sur des activités d'innovation des sociétés françaises appartenant à tous les secteurs de l'économie. Nous avons limité notre attention au sous échantillon de sociétés de l'innovation, autrement dit, les sociétés qui ont déclaré avoir dépensé une quantité positive de ressources dans l'activité d'innovation. Nous avons complété notre base de données par des entretiens téléphoniques réalisés avec les responsables du département R&D des 300 entreprises en question.

En tout, 130 entreprises ont accepté de répondre à l'enquête. Les répondants au questionnaire ont toujours été des personnes qui avaient une excellente connaissance de leur entreprise. En effet, ils étaient dans la plupart des cas des responsables du département R&D, et dans le reste des cas, il s'agissait des directeurs, des ingénieurs ou des techniciens supérieurs, mais toujours attachés au département de recherche et développement .

MODÈLE ÉCONOMÉTRIQUE

Notre variable dépendante pour la plupart des régressions est la capacité d'innovation mesurée par les dépenses de R&D pendant la période 2007-2012. Toutes nos variables explicatives sont construites dans la même période 2007-2012. Nous avons choisi cette période de référence en raison de la disponibilité des donnés sur les dépenses de R&D des entreprises choisies.

Nous avons utilisé deux méthodes économétriques pour effectuer nos régressions :

- La première se base sur l'économétrie des données de panel largement utilisée pour la validation des propos théoriques. La particularité de ces modèles se justifie par l'efficacité et la précision des estimateurs en comparaison avec les études en séries temporelles ou en coupe transversale.
- La seconde consiste à employer des méthodes d'estimation plus appropriées, qui séparent la composante structurelle des variables, de la composante qui renvoie à l'hétérogénéité non observée. Les facteurs de cette hétérogénéité doivent être isolés puisqu'ils peuvent expliquer la variable endogène et les variables explicatives. Nous avons réalisé des estimations économétriques dans un cadre statique où deux spécifications de l'hétérogénéité individuelle sont confrontées (effet fixe et effet variable). Nous nous sommes servis des différentes approches pour le contrôle de l'effet de l'hétérogénéité non observée dans un cadre_dynamique permettant l'usage de la méthode des moments généralisés (**GMM**).

DÉFINITION DES VARIABLES

a) La variable endogène : la capacité innovatrice des entreprises

L'indicateur retenu pour mesurer la capacité innovatrice des firmes est le niveau de R&D. Dans ce cadre, nous considérons que l'innovation est d'autant plus élevée que le montant des dépenses de R&D est important. Nous pouvons, en effet, penser qu'il se produit un effet quantitatif. Plus le stock de recherche est important, plus la capacité innovatrice des firmes est favorisée.

Pour rendre compte de cette relation, nous utilisons ici un indicateur obtenu à l'aide des dépenses intérieures de R&D. L'objectif est de mesurer l'effort de recherche propre à une entreprise donnée.

Dans ce cadre, différents choix de modélisation ont pu être opérés. J. Hausman Z.Griliches et B.Hall (1984) introduisent les logarithmes des dépenses passées de R&D. Cette approche a été critiquée par E.Duguet (2004), en effet les dépenses de recherche des différentes périodes sont corrélées entre elles, d'où un problème de multicolinéarité qui produit une imprécision des estimations.

Pour éviter ce problème de multicolinéarité, E.Duguet (2004) a adopté une démarche dans laquelle il a rajouté un capital de recherche, défini comme la somme pondérée des dépenses passées de recherche. Cette somme est obtenue en considérant un taux de dépréciation en général de 10% à 15% par an (J.Mairesse et P.Mohnen, 2006). Ce taux correspond à une dépréciation physique du capital de recherche (fermeture d'un laboratoire de recherche, départ d'un chercheur…) qui fait que les connaissances disparaissent, ajoutant à cela le taux d'obsolescence lié à l'apparition de nouveaux produits ou procédés.

Notre variable dépendante qui représente la capacité innovatrice des sociétés sera mesurée par le taux de croissance des dépenses de R&D des entreprises issues de la base de données internationale **« world scope »** qui fournit des informations sur les dépenses de R&D de l'ensemble des entreprises de plus de 20 salariés implantées sur le territoire français.

Nous avons choisi les dépenses de R&D comme mesure de l'activité de R&D puisqu'il est raisonnable de supposer que cette activité est proportionnelle aux dépenses, et les données sur les dépenses de R&D sont disponibles. En outre, notre recherche ne se limitera pas seulement aux grandes entreprises qui arrivent à breveter leur résultat innovateur, c'est la raison pour laquelle nous n'avons pas choisit de travailler sur les données de brevets.

b) Les variables explicatives

1) la taille des firmes

Selon Aydalot (1985), de la simple comparaison entre les petites entreprises, plus dépendantes de leur environnement local et les grandes entreprises qui disposent des moyens financiers et techniques nécessaires pour pallier à l'effet de la distance, nous pouvons comprendre le rôle crucial que joue la taille de la firme dans l'insertion spatiale.

Il y a une évidence considérable dans la littérature à propos du rôle de la taille des sociétés dans l'activité innovatrice. Le rapport entre la taille d'une entreprise et sa capacité à capturer la valeur des investissements de R&D a été indiqué empiriquement par Cohen et Levin en 1989. Puis Gooding et Wagner (1985) ont suggéré qu'une plus grande taille d'organisation soit associée à une disponibilité et à un accès accru aux ressources critiques, qui peuvent augmenter la force innovatrice des firmes.

L'expérience britannique [excepté l'université de Cambridge Wicksteed (1985) et l'université d'Oxford Lawton (1990)] montre que les établissements universitaires préfèrent établir des rapports de coopération en matière de recherche avec des grandes entreprises, indépendamment de leur localisation géographique.

Dans le cas français**,** Christophe Carrincazeaux (2001) montre qu'en matière de R&D les collaborations en R&D sont plus fréquentes lorsque les entreprises sont de grandes tailles, et il rejette l'hypothèse d'un besoin plus marqué en ressources locales lorsque les entreprises sont de petites tailles.

2) La capacité d'absorption

Dans quelques industries, les frontières entre les sources internes et externes de la connaissance de l'organisation ont disparu. En conséquence, la surveillance des débordements externes de la connaissance et la capacité de les absorber dans l'organisation, est devenue impérative pour augmenter la capacité concurrentielle de l'entreprise (Teece, 1998).

On entend par capacité d'absorption la faculté des agents à tirer profit des externalités de connaissances. A ce niveau, se pose la question des conditions de transmission et de diffusion locale ou à distance. Contrairement à l'analyse traditionnelle

d'Arrow (1962), pour G.Dosi (1988), W.Cohen et D.Levinthal (1989), l'utilisation des connaissances technologiques produites ailleurs est une activité coûteuse qui nécessite l'existence d'un stock de savoirs et de compétences internes, nous pouvons donc dire qu'il y a une complémentarité entre les sources internes et externes de la connaissance.

Les nouvelles connaissances sont mémorisées en établissant des liens avec des connaissances préexistantes ce qui permet de leur donner un sens et de créer de nouvelles connaissances. La capacité d'absorption de la firme est fonction des capacités d'absorption des individus qui la composent et de son environnement externe comme l'expriment W.Cohen et D.Levinthal dans de nombreux travaux.

D'après les travaux empiriques réalisés par ces auteurs sur 318 firmes américaines, la capacité d'absorption d'une firme est fonction de son niveau interne de R&D. Cette étude a montré aussi l'importance de la capacité d'absorption pour capter les externalités de la recherche publique.

Cockburn et R.Henderson (1998) insistent sur l'existence d'un certain niveau de recherche interne pour pouvoir tirer profit des découvertes issues de la recherche publique.

Dans le cas américain, A.Varga (1998) montre à travers une fonction de production qu'il faut atteindre un niveau critique pour que la recherche publique puisse avoir un effet sur le nombre des innovations commercialisées. Dans le cas européen, B.Maurseth et B.Verspagen (1999) remarquent une corrélation négative entre l'écart de la productivité des régions et la citation des brevets, autrement dit, il faut que la région dispose de suffisamment de compétences internes pour pouvoir bénéficier des connaissances des régions voisines.

Dans le contexte français, d'après plusieurs travaux et études empiriques, pour qu'une entreprise soit capable de capter les externalités de la recherche de son environnement (privé ou public), il faut qu'elle effectue de la recherche interne, emploie des personnes compétentes, les rémunère sur la base de leur position dans la hiérarchie publique et enfin les encourage à établir des liens avec les personnes du secteur public. Tel est le cas de C. Autant-Bernard (2000), qui prouve que la capacité à capter les externalités locales est plus forte pour les départements à faible R&D, au contraire, les départements à forte R&D arrivent à capter des sources distantes d'externalités. L'auteur distingue deux types de départements : d'un côté les départements dont le montant de R&D est inférieur à 1 milliard de francs (les départements à faible capacité d'absorption), et de l'autre côté, les départements dont le montant de R&D est supérieur à 1 milliard de francs (les départements à forte capacité d'absorption).

Pour mesurer la capacité d'absorption, nous nous baserons sur l'intensité de la R&D interne des firmes représentée par le rapport entre les dépenses de la R&D et l'effectif total de la firme.

3) La coopération en matière de R&D

On peut observer au niveau national une forte augmentation du nombre de coopérations de R&D lors de ces dernières années. Pour l'Allemagne, König et d'autres (1994) constatent qu'en 1971 seulement 10% de tous les fabricants étaient impliqués dans des relations de coopération de R&D, 10 ans après, la part est presque montée à 50%. Vonortas (1997) prouve la même chose pour les Etats-Unis.

Röller et d'autres (1998) fournissent l'évidence empirique que la coopération en matière de R&D dépend d'un certain nombre d'effets spécifiques de l'industrie et que la plupart des collaborations dans des projets de recherche et développement se passe souvent entre des firmes qui ont la même taille.

Contrairement aux analyses économiques mentionnées ci-dessus, les analyses stratégiques de gestion se basent fortement sur des théories sociologiques et psychologiques. La coopération des firmes en matière de recherche est perçue comme l'instrument le plus important pour la production de la valeur dans une économie globale (Koleva, 2002). L'évolution de la coopération est stimulée par un but commun qui est l'échange de l'information et de la connaissance. En cumulant un avantage concurrentiel qui permet l'accès aux nouvelles technologies et savoir-faire au delà des frontières, les firmes réalisant des économies d'échelle et partageant le risque et l'incertitude (Morris (1998)).

Dans le cadre des résultats empiriques, peu d'auteurs ont explicitement recherché une théorie de coopération inter-firme en matière de R&D (Koleva, 2002). La seule exception est l'étude de Kreiner et de Schulz (1993) qui ont étudié 16 coopérations entre université et industrie, se concentrant sur la nature personnalisée de la collaboration en R&D. L'étude montre l'influence des normes de la réciprocité et du libre partage de l'information sur les rapports interpersonnels.

En outre, Dyer et Nobeoka (2000) donnent l'évidence empirique qu'au travers la coopération, les partenaires peuvent créer des règles, des normes et des codes pour le partage de la connaissance ce qui favorise les gains d'efficacité. Isfan et

Moog (2003) prouvent que les nouvelles sociétés innovatrices sont souvent en coopération entre elles, et l'absence des universités ne baisse par leur capacité innovatrice.

Dans le cadre de notre travail, nous vérifierons si l'engagement des sociétés dans des relations de coopération en matière de recherche et développement augmente leur capacité innovatrice et diminue l'incertitude.

4) L'âge de la firme

L'âge de la firme peut également jouer en faveur de sa capacité innovatrice. Les anciennes sociétés se caractérisent souvent par l'existence d'un stock d'informations et de ressources importantes. Plus d'expérience et d'expertise, plus de brevets et de produits et des rapports fréquents avec l'environnement externe.

Cependant, si on s'intéresse aux travaux de Barnett (1990), on constate qu'il existe des effets négatifs du vieillissement sur l'innovation. Des travaux récents ont étudié le rapport entre le taux de brevetage des firmes et leur âge, et ils ont montré qu'il y a des effets positifs et négatifs sur le processus d'innovation (Sorenson et Stuart, 2000). Les premiers sont justifiés par une expérience accrue qui permet de constituer une base de connaissances nécessaire pour l'acquisition de nouvelles connaissances. Les seconds sont associés aux problèmes des progrès technologiques et à l'évolution de l'environnement externe. En effet, les nouvelles sociétés sont plus pertinentes au niveau de l'innovation [Tushman et Anderson (1986), Sorenson et Stuart (2000)].

Nous allons utiliser l'âge de la firme comme une variable importante de contrôle pour montrer son rôle sur la capacité innovatrice des firmes de notre échantillon.

5) La proximité géographique

La proximité géographique joue un rôle dans le processus d'innovation et la transmission de la connaissance. Les études sur des externalités géographiques essayent de vérifier le rôle de cette proximité dans la transmission de la connaissance par le calcul de la distance maximum qu'une externalité technologique pourrait couvrir.

Pour Autant-Bernard et Massard (1999), il y a quatre méthodes pour mesurer les externalités de la connaissance :

- utiliser des brevets pour mesurer les externalités (Jaffe et Al, 1993) ;
- se baser sur la concentration géographique des innovations (Feldman (1994), Audretsch et Feldman (1996) ;
- Se servir de la coïncidence géographique (Jaffe (1989), Anselin et Al (1997))
- Mettre en évidence les interactions locales (Anselin et Al (1997), Wallsten (2001)).

Toutes ces approches arrivent à la conclusion que les externalités existent et que leur diffusion géographique est limitée, ceci explique la concentration des sociétés dans certaines zones et soutient l'idée que la proximité géographique est un facteur important dans la diffusion de la connaissance. Cependant, il y a deux facteurs qui limitent la portée de ces approches: la mesure de la diffusion géographique est encore beaucoup discutée et l'analyse des canaux de la transmission des externalités de la connaissance modifie le rôle de la proximité (Autant-Bernard, 2000).

Des études plus récentes s'appuient sur les systèmes d'information géographiques (GIS) afin de modéliser les débordements des externalités de la connaissance, et fournissent des moyens pour la mesure de la distance.

Ainsi, Wallsten (2001) se sert des GIS (les systèmes d'information géographiques) pour analyser la probabilité pour une société dont le voisin a reçu le soutien gouvernemental pour l'innovation, de tirer également bénéfice d'une telle aide. Il prouve que des sociétés recevant l'aide financière sont situées l'une près de l'autre, dans un rayon de dix milles, souvent sur la périphérie des zones urbaines. Même si ce sont des externalités stratégiques liées à l'information plutôt qu'à la R&D, elles montrent que la distance maintenue pour mesurer les effets des débordements de la connaissance changent d'un auteur à l'autre (de 50 milles à dix milles).

Pour mesurer l'effet de la proximité géographique sur la capacité innovatrice des firmes, nous nous inspirons de l'approche de Jafe (1986), nous utilisons une variable muette qui prend la valeur 1 quand la société en question est proche géographiquement[1] d'une autre société qui fait de la recherche ou d'un laboratoire de recherche privée ou public, et la

[1] On considère ici que la distance maximale qu'une externalité technologique pourrait couvrir est de 75 km l'équivalence de 50 Mille au niveau de l'étude réalisée par Jafe (1993).

valeur 0 quand la société n'est pas proche géographiquement d'une autre société effectuant de la recherche ou d'un laboratoire de recherche public ou privé. Nous nous basons ici sur les travaux d'Anselin et al (1997) et aussi sur les travaux de Jaffé et al (1993).

6) La mobilité de la main d'œuvre qualifiée

Plusieurs études principalement descriptives suggèrent que les individus sont considérés comme une source importante du transfert de la connaissance inter firme (Malecki, 1991).

Par exemple, Markusen et autres (1988) constatent que les régions avec des concentrations élevées des techniciens attirent des investissements de pointe. Dans des industries de semi-conducteur, les entrevues avec des ingénieurs indiquent que la mobilité de ces derniers est une source importante de nouvelles connaissances (Saxenian 1990, Rogers et Larsen 1984).

En outre, Song et autres (2004) démontrent cela en remarquant que pendant la première partie du développement de l'industrie coréenne, les sociétés ont embauché beaucoup de diplômés des instituts américains pour profiter des connaissances qu'ils ont acquis aux USA. Almeida (1997) et Kogut (1999) montrent que la mobilité intra régionale agit plus que la mobilité interrégionale pour plusieurs raisons.

Parmi ces raisons, il y a la culture commune, considérée comme élément important dans le contexte, car elle peut faciliter des débordements de la connaissance à travers la coopération et la mobilité de la main d'œuvre qualifiée qui facilite l'interprétation de cette connaissance. Saxenian (1994) suggère que les pratiques, la culture et la terminologie technique sont souvent particulières à une région et changent nettement à travers les régions.

En outre, le contexte commun augmente la probabilité de similitude entre les sociétés en termes de pratiques et de routines. Les théoriciens institutionnels ont remarqué que les sociétés confrontées à l'incertitude essayent de voir les entreprises géographiquement proches (Haunschild et Miner, 1997). La proximité géographique participe à la vulgarisation des routines d'organisation, et augmente la capacité d'absorption qui facilite l'interprétation des nouvelles connaissances.

Ainsi, nous proposons que quand les ouvriers qualifiés se déplacent d'une société à une autre, ils portent les connaissances et les routines qu'ils ont accumulées pendant leurs expériences.

Nous essayons de voir si la mobilité active des chercheurs facilite les débordements inter firmes de la connaissance à travers des contextes différents. Pour mesurer cette mobilité, nous allons utiliser le taux de croissance des personnes qui travaillent dans le département de recherche.

7) Le rôle de la région parisienne

La plupart des études sur l'activité de la recherche en France mentionnent le rôle majeur de la région parisienne. En effet, l'Ile de France est une région très spécialisée en R&D par rapport à l'ensemble des autres régions françaises : en 2000, elle a enregistré un indicateur de spécialisation en R&D supérieur à 1,8.

De nombreux secteurs concentrent ainsi la grande majorité de leurs effectifs de chercheurs en Ile de France. En outre, les dépenses intérieures de R&D (DIRD) -comme le montre clairement notre échantillon- indiquent que l'Ile de France réalise avec 9,2 milliards d'euros, 47,7% de la D.I.R.D des entreprises françaises en 2000. Ces dépenses représentent 2,3% du PIB régional alors que le ratio moyen DIRD/PIB régional est de 1,4% pour la France.

Pour contrôler le poids de la région parisienne sur notre échantillon, nous allons l'utiliser comme variable de contrôle. A ce niveau, nous allons construire une variable muette qui prend la valeur 1 quand l'entreprise appartient à la région parisienne et la valeur 0 quand l'entreprise en question n'appartient pas à cette région.

PRÉSENTATION DE LA RELATION À ESTIMER

Nous estimons sur l'ensemble des 130 entreprises françaises faisant de la recherche, entre 1997 et 2002 la relation suivante :

$TXD_{it} = f (TXC_{it}, TXT_{it}, PRO_{it}, REG_{it}, AGE_{it}, COP_{it}, TXA_{it}, TXP_{it})$

Où TXD_{it} est le taux de croissance des dépenses de la R&D ;

TXC : le taux de croissance du chiffre d'affaire ;

TXT : le taux de croissance du nombre des employées ;

PRO : la proximité géographique ;

REG : l'appartenance à la région parisienne ;
AGE : l'âge de la firme ;
COP : la coopération ;
TXA : le taux de croissance de la capacité d'absorption ;
TXP : le taux de croissance du personnel de la R&D.

Nos estimations seront réalisées dans deux cas : le cas statique et le cas dynamique.

ESTIMATIONS ET RÉSULTATS

I : Analyse statique

Nous estimons dans ce cadre les différents modèles en fonction de la spécification de l'hétérogénéité individuelle (Modèle sans facteurs, à effet individuel et à effet aléatoire). Par ailleurs, nous présentons les tests de l'existence et de l'indépendance de cette hétérogénéité par rapport aux variables explicatives ainsi que des estimations "GMM" robustes à l'endogénéité de l'ensemble des variables explicatives

1) Le modèle sans facteur

Dans ce modèle, nous supposons que l'échantillon étudié est parfaitement homogène. La constante est la même pour toutes les entreprises. L'estimation d'un tel modèle correspond à l'estimation de la relation suivante :

$$TXD_{it} = \alpha_0 + \alpha_1 TXC_{it} + \alpha_2 TXT_{it} + \alpha_3 PRO_{it} + \alpha_4 REG_{it} + \alpha_5 AGE_{it} +$$

$$\alpha_6 COP_{it} + \alpha_7 TXA_{it} + \alpha_8 TXP_{it} + \varepsilon_{it}$$

Les résultats de cette estimation par la méthode des moindres carrés ordinaires sont les suivants :

	Coefficient	Ecart type	T-Stat	Significativité
TXC	0.0021104	0.0024799	0.85	0.397
TXT	0.5703451	0.0468458	12.17	0.000
PRO	0.2568115	0.1488684	1.73	0.087
REG	0.0042995	0.1196786	0.04	0.971
AGE	0.0527535	0.0374869	1.41	0.162
TXA	1.062782	0.0116936	90.89	0.000
COP	0.049603	0.1229554	0.40	0.687
TXP	0.292989	0.0092535	31.66	0.000
CONST	-0.4896993	0.1854403	-2.64	0.009

Nombre d'observations = 775, Degré de liberté = 793, R2 = 0.103735, F (7,112) = 2434,48.

Les variables les plus significatives sont celles qui correspondent à la taille, à la capacité d'absorption et à la mobilité de la main d'œuvre qualifiée. La variable qui correspond à la main d'œuvre qualifiée (TXP) a le coefficient le plus élevé, suivit de la taille des firmes (TXT), de la mobilité de la main d'œuvre qualifiée et finalement de la proximité géographique (PRO). Ce résultat montre que la taille de la firme, la mobilité de la main d'œuvre qualifiée, la capacité d'absorption des entreprises et la proximité géographique ont un effet positif sur la capacité innovatrice des entreprises.

Les variables coopération en matière de R&D (COP), l'âge de la firme (AGE) et l'appartenance à la région parisienne n'ont pas d'effet significatif, leurs coefficients sont faibles par rapport aux autres variables.

Cependant, le modèle que nous venons d'estimer considère que l'échantillon étudié est parfaitement homogène et ne tient pas compte de possibles différences entre les entreprises. Cette hypothèse est forte dans la mesure où notre échantillon est composé d'entreprises différentes (différences sectorielles). Plus précisément, ce modèle ne permet pas de séparer entre la composante structurelle des variables et la composante qui renvoie à l'hétérogénéité non observée. Cette dernière peut être liée à la nature des entreprises implantées, à leurs activités de production et à la qualité de leurs ressources humaines. Les facteurs d'hétérogénéité peuvent influencer l'ensemble des variables composant notre modèle (la variable endogène et les variables explicatives). La prise en considération de cette hétérogénéité nous amène à la spécifier sous forme d'une constante (modèle à effet fixe) ou d'une composante aléatoire (modèle à effet aléatoire).

2) Le modèle à effet individuel fixe

Dans un modèle à effet fixe, l'hétérogénéité peut être individuelle ou temporelle. Ainsi, dans le premier cas, la constante varie d'une entreprise à l'autre (effet individuel fixe). En revanche, dans le second cas, elle varie d'une période à l'autre (effet temporel fixe).

En spécifiant l'hétérogénéité individuelle sous la forme d'un effet fixe, l'équation précédente s'écrit comme suit :

$TXD_{it} = \alpha_i + \alpha_1 TXC_{it} + \alpha_2 TXT_{it} + \alpha_3 PRO_{it} + \alpha_4 REG_{it} + \alpha_5 AGE_{it} + \alpha_6 COP_{it} + \alpha_7 TXA_{it} + \alpha_8 TXP_{it} + \varepsilon_{it}$

Pour estimer cette équation, il faut passer par une transformation within individuelle qui consiste à calculer pour chaque variable sa différence par rapport à la moyenne de la période pour chaque pays. L'équation précédente devient :

$$[TXD_{it} - 1/T\sum_{t=1}^{T} TXD_{it}] = \alpha_1[TXC_{it} - 1/T\sum_{t=1}^{T} TXC_{it}] + \alpha_2[TXT_{it} - 1/T\sum_{t=1}^{T} TXT_{it}] + \alpha_3[PRO_{it} - 1/T\sum_{t=1}^{T} PRO_{it}] + \alpha_4[REG_{it} - 1/T\sum_{t=1}^{T} REG_{it}] + \alpha_5[AGE_{it} - 1/T\sum_{t=1}^{T} AGE_{it}] + \alpha_6[TXA_{it} - 1/T\sum_{t=1}^{T} TXA_{it}] + \alpha_7[COP_{it} - 1/T\sum_{t=1}^{T} COP_{it}] + \alpha_8[TXP_{it} - 1/T\sum_{t=1}^{T} TXP_{it}] + [\varepsilon_{it} - 1/T\sum_{t=1}^{T} \varepsilon_{it}]$$

Le passage par ce calcul permet d'éliminer l'hétérogénéité individuelle et d'obtenir les résultats suivants en appliquant l'estimateur OLS sur cette nouvelle équation :

	Coefficient	Ecart type	T-Stat	Significativité
TXC	0.0003754	0.0052765	0.07	0.943
TXT	0.6068615	0.0568602	10.67	0.000
PRO	-	-	-	-
REG	-	-	-	-
AGE	-	-	-	-
TXA	1.054553	0.014577	72.34	0.000
COP	-	-	-	-
TXP	0.2874428	0.010833	26.53	0.000

Nombre d'observations = 775, Degré de liberté = 793, R2 = 0.109735, F (4,82) = 3071,03.

Nous obtenons le même resultat que pour le modèle sans facteur au niveau de la significativité. Pour les variables muettes, nous n'avons pas de valeurs au niveau de l'effet fixe.

Par ailleurs, malgré que le coefficient estimé de la variable représentant la taille des firmes ait légèrement diminué et que les coefficients des autres variables aient légèrement augmenté par rapport à ceux du modèle sans facteurs, nous remarquons que les changements ne sont pas significatifs. Cela renforce les prédictions théoriques qui concernent l'effet positif et significatif de la taille des firmes sur leur capacité innovatrice.

Au niveau de l'ordre des coefficients, la variable relative à la capacité d'absorption des firmes (TXA) détient le coefficient le plus élevé. Ce résultat s'accorde avec les travaux empiriques qui utilisent cette variable, comme celui de W.Cohen et D.Levinthal (1989). Ces derniers montrent sur un échantillon de 318 firmes américaines, l'importance de la capacité d'absorption pour capter les externalités de la recherche. Ainsi, une augmentation du taux de croissance de la capacité d'absorption (TXA) de 10% conduit à une augmentation du taux de croissance des dépenses de R&D de 10,5%.

Le second coefficient en termes d'importance est celui attaché au taux de croissance de la taille des firmes (TXT). Ainsi, une augmentation de 10% de cette variable conduit à une augmentation du taux de croissance des dépenses de R&D de plus de 6 %.

Finalement, le coefficient correspondant à la mobilité de la main d'œuvre qualifiée (TXP) est le troisième coefficient positif et significatif. Ainsi une augmentation de 10% de cette variable permet une augmentation du taux de croissance des dépenses de R&D de plus de 2,9%.

3) Le modèle à effet individuel aléatoire

Dans ce cas, l'hétérogénéité individuelle est incluse dans le terme d'erreur. L'estimation de ce modèle revient à estimer la relation suivante :

$TXD_{it} = \alpha + \alpha_1 TXC_{it} + \alpha_2 TXT_{it} + \alpha_3 PRO_{it} + \alpha_4 REG_{it} + \alpha_5 AGE_{it} + \alpha_6 COP_{it} + \alpha_7 TXA_{it} + \alpha_8 TXP_{it} + u_i + \varepsilon_{it}$

Où u_i représente l'hétérogénéité individuelle.

Pour estimer ce modèle, il faut appliquer l'estimateur GLS en passant par la transformation suivante[2] :

$$[TXD_{it} - (1- \theta^{1/2})1/T \sum_{t=1}^{T} TXD_{it}] = \alpha_1[TXC_{it} - (1- \theta^{1/2})1/T \sum_{t=1}^{T} TXC_{it}] + \alpha_2[TXT_{it} - (1- \theta^{1/2})1/T \sum_{t=1}^{T} TXT_{it}] + \alpha_3[PRO_{it} - (1- \theta^{1/2})1/T \sum_{t=1}^{T} PRO_{it}] + \alpha_4[REG_{it} - (1- \theta^{1/2})1/T \sum_{t=1}^{T} REG_{it}] + \alpha_5[AGE_{it} - (1- \theta^{1/2})1/T \sum_{t=1}^{T} AGE_{it}] + \alpha_6[TXA_{it} - (1- \theta^{1/2})1/T \sum_{t=1}^{T} TXA_{it}]+ \alpha_7[COP_{it} - (1- \theta^{1/2})1/T \sum_{t=1}^{T} COP_{it}] + \alpha_8[TXP_{it} - (1- \theta^{1/2})1/T \sum_{t=1}^{T} TXP_{it}]+ [\varepsilon_{it} - (1- \theta^{1/2})1/T \sum_{t=1}^{T} \varepsilon_{it}]$$

Avec $\theta = \sigma_\mu^2 / (T\sigma_\mu^2 + \sigma_\varepsilon^2)$

Les résultats de cette estimation sont les suivants :

	Coefficient	Ecart type	T-Stat	Significativité
TXC	0.0020049	0.0025104	0.80	0.425
TXT	0.5685108	0.0468965	12.12	0.000
PRO	0.2630558	0.1571293	1.67	0.094
REG	0.0356554	0.1261654	0.28	0.777
AGE	0.0004945	0.0005094	0.97	0.332
TXA	1.062729	0.0117143	90.72	0.000
COP	0.0217192	0.1287802	0.17	0.866
TXP	0.2935671	0.009246	31.75	0.000
CONST	-0.4626993	0.1854403	-2.64	0.007

Nombre d'observations = 775, Degré de liberté = 793, R2 = 0.103735, F (7,112) = 2434,48.

Les coefficients estimés et les statistiques correspondantes sont pratiquement les mêmes que ceux du modèle sans facteur. Cependant, ils changent relativement par rapport à ceux du modèle à effet fixe. En effet, le coefficient attaché à la taille des firmes baisse alors que ceux attachés aux autres variables augmentent dans le modèle à effet aléatoire par rapport à ceux du modèle à effet individuel fixe.

[2] Pour plus d'explications, voir Hanchane, S. et Balsan, D. (1999), « Estimations et tests sur données longitudinales - le cas des panels cylindrés et non-cylindrés, » Document de Travail N° 99C05, GREQAM.

Cela signifie qu'il pourrait y avoir une corrélation négative entre la taille des entreprises et l'hétérogénéité individuelle, et positive entre cette dernière et les autres variables explicatives. Cette corrélation conduirait, dans le modèle à effet individuel aléatoire, à une sous-estimation de l'effet de la taille et à une surestimation de l'effet des autres variables explicatives. En revanche, l'estimation Within permet, en éliminant cette hétérogénéité, d'augmenter l'effet de la taille et de réduire l'effet des autres variables.

D'un autre côté, bien que les coefficients estimés varient relativement en passant d'une estimation à l'autre, toutes les estimations que nous venons de réaliser montrent que la taille de la firme, la capacité d'absorption et la mobilité de la main d'œuvre qualifiée ont un effet positif et significatif sur la capacité innovatrice des firmes. Elles confirment ainsi les propos du théorique avancés dans la section précédente. Dans ce qui suit, nous allons réaliser des tests sur l'existence de l'hétérogénéité individuelle et sur sa dépendance par rapport aux variables explicatives.

4) Les tests statistiques

Les tests de Fisher et de Breusch-Pagan permettent respectivement, en confrontant le modèle sans facteurs aux modèles à effet individuel et à effet aléatoire, de vérifier l'existence de l'hétérogénéité individuelle. Le test de Hausman permet quant à lui, en confrontant le modèle à effet aléatoire au modèle à effet individuel, de tester son indépendance par rapport aux variables explicatives. Les définitions détaillées ainsi que les statistiques de ces tests sont exposées dans la section précédente.

a) Le test de Fisher

Ce test confronte le modèle sans facteur (H_0) au modèle à effet individuel fixe. Les résultats de ce test sont les suivants :

F (4,82) = 3071,03 avec un niveau de significativité = 0.00000000

Ce résultat permet de rejeter largement l'hypothèse nulle de l'absence de l'hétérogénéité individuelle.

b) Le test de Breush - Pagan

Ce test confronte le modèle sans facteur (H_0) au modèle à effet aléatoire. Les résultats de ce test sont les suivants :

Chi-Squared (1) = 45.742878, avec un niveau de significativité = 0.00000000

Les résultats de ce test permettent de rejeter l'hypothèse nulle de l'absence d'une hétérogénéité individuelle entre les pays.

Les deux tests permettent de rejeter l'hypothèse (H_0) correspondant à l'absence de l'hétérogénéité individuelle. Il existe donc une hétérogénéité entre les entreprises composant notre échantillon. Cependant, si cette hétérogénéité est corrélée avec les variables explicatives, les coefficients du modèle à effet aléatoire seront biaisés et non convergents. En revanche, l'estimation Within permet, en éliminant cette hétérogénéité, d'avoir des coefficients non biaisés et convergents. Nous présentons dans le paragraphe suivant le test de Hausman qui permet de tester la non corrélation d'une telle hétérogénéité avec les variables explicatives.

c) Le test de Hausman

Ce dernier permet de tester la spécification du modèle à effet aléatoire (H_0) contre la spécification du modèle à effet individuel fixe. Les résultats de ce test sont les suivants :

Chi-Squared (5) = 93.901002, niveau de significativité = 0.00000000

Ce résultat permet de rejeter la spécification du modèle à effet aléatoire. Les coefficients estimés d'un tel modèle sont donc biaisés et non convergents à cause de l'existence d'une corrélation entre l'hétérogénéité individuelle et les variables explicatives. L'estimation du modèle à effet fixe, en utilisant la transformation Within, élimine cette hétérogénéité et permet d'obtenir des estimateurs non biaisés et convergents.

Cependant, la méthode des moments généralisés "GMM" est une méthode plus efficace qui permet d'estimer un modèle à effet individuel aléatoire en présence de corrélations entre les variables explicatives et l'hétérogénéité individuelle. Il s'agit, dans ce travail, de l'adaptation de la méthode d'Arellano et Bond (1991) au cadre statique. La version plus générale de cette approche dans le cadre dynamique a été exposée dans la section précédente.

5) Utilisation de la méthode "GMM"

L'utilisation de l'estimateur "GMM" consiste à calculer dans une première étape une estimation "2 SLS" en utilisant, après le passage par une différence première (ou une déviation orthogonale), les instruments des variables explicatives. Les résidus estimés de cette étape serviront avec les instruments au calcul d'une matrice de poids. Cette dernière sera utilisée dans une deuxième étape pour calculer un estimateur "GMM" plus efficace[3]. Nous présentons les résultats de cette estimation en différence première et en déviation orthogonale.

a) GMM en différence première

L'équation à estimer dans ce cas devient :

$$TXD_{it} - TXD_{it-1} = \alpha_1[TXC_{it} - TXC_{it-1}] + \alpha_2[TXT_{it} - TXT_{it-1}] + \alpha_3[PRO_{it} - PRO_{it-1}] + \alpha_4[REG_{it} - REG_{it-1}] + \alpha_5[AGE_{it} - AGE_{it-1}] + \alpha_6[COP_{it} - COP_{it-1}] + \alpha_7[TXA_{it} - TXA_{it-1}] + \alpha_8[TXP - TXP_{it-1}] + [\varepsilon_{it} - \varepsilon_{it-1}]$$

L'estimation de cette équation par la méthode "GMM" donne les résultats suivants dans la deuxième étape[4] :

	Coefficient	Ecart type	T-Stat	Significativité
TXC	0.000319680	0.001156	0.277	0.783
TXT	0.635479	0.2116	3.00	0.004
PRO	5.46849e-017	3.161e-017	1.73	0.088
REG	0.000000	-	-	-
COP	0.000000	-	-	-
AGE	0.000000	-	-	-
TXA	1.05041	0.01012	104.	0.000
TXP	0.284033	0.03511	8.09	0.000

Nombre d'observations = 775, test de Sargan: Chi^2(102) = 22.33 [1.000], AR(1) test : N(0,1) = -1.206 [0.0023] **, AR(2) test : N(0,1) = -0.379 [0.705].

Nous remarquons qu'il n'y a aucun changement au niveau de la significativité des coefficients estimés par rapport aux précédentes estimations. Cependant, il y a eu une diminution nette des coefficients attachés à toutes les variables[5], notamment celui de la proximité géographique qui n'a presque plus d'effet sur la variable endogène par rapport aux précédentes estimations.

Par ailleurs, nous remarquons que le test de Sargan accepte l'hypothèse H_0, selon laquelle les instruments utilisés sont valides, alors que le test (AR) rejette l'hypothèse de l'autocorrection des erreurs.

Cependant, l'utilisation de la différence première ne permet pas de contrôler de façon précise l'hétérogénéité individuelle non observée d'où la nécessité de l'utilisation de la déviation orthogonale[6].

b) GMM en déviation orthogonale

L'estimation du modèle dans le cas d'une déviation orthogonale donne les résultats suivants dans la deuxième étape :

[3] Pour plus d'explications, voir Hanchane, S. et Balsan, D. (1999), « Estimations et tests sur données longitudinales - le cas des panels cylindrés et non-cylindrés, » Document de Travail N° 99C05, GREQAM.

[4] Nous nous contentons de présenter dans ce travail uniquement les résultats des estimations de la deuxième étape.

[5] A l'exception du coefficient attaché à la taille qui enregistre une très faible augmentation par rapport à celui obtenu dans l'estimation du modèle à effet individuel aléatoire.

[6] Pour plus d'explications, voir Hanchane, S. et Balsan, D. (1999), « Estimations et tests sur données longitudinales - le cas des panels cylindrés et non-cylindrés, » Document de Travail N° 99C05, GREQAM.

	Coefficient	Ecart type	T-Stat	Significativité
TXC	0.000717213	0.0009439	0.760	0.450
TXT	0.605830	0.2269	2.67	0.009
PRO	2.50772e-016	9.564e-017	2.62	0.011
REG	0.000000	-	-	-
AGE	0.000000	-	-	-
COP	0.000000	-	-	-
TXA	1.05453	0.007537	140.	0.000
TXP	0.287617	0.03911	7.35	0.000

Nombre d'observations = 775, test de Sargan : Chi^2(123) = 77 ,67 [1.000], test AR(1) : N(0,1) = -1,158 [0.147] **, test AR(2) : N(0,1) = -0.432 [0.665].

Nous constatons presque les mêmes résultats qu'avec la différence première, à l'exception d'une légère diminution du coefficient de la taille des firmes (TXT). Ainsi, ce résultat montre que ce coefficient et surtout le coefficient attaché à la proximité géographique ont été surestimés dans les précédentes estimations par la présence de l'hétérogénéité individuelle non observée ou par l'utilisation des méthodes qui ne permettent pas de la contrôler de façon rigoureuse. Plus précisément, l'estimation Within n'a pas permis d'identifier pleinement le rôle joué par l'hétérogénéité individuelle non observée.

En revanche, l'estimation GMM en déviation orthogonale est plus rigoureuse dans la mesure où elle élimine soigneusement l'hétérogénéité individuelle et propose des instruments permettant d'identifier les effets des paramètres structurels nets de tous biais d'endogénéité.

Par ailleurs, le test de Sargan montre que les instruments utilisés sont valides, alors que le test (AR) rejette l'hypothèse de l'autocorrection des erreurs.

II) Analyse dynamique

Les modèles dynamiques se caractérisent par la présence d'une ou plusieurs variables endogènes retardées parmi les variables explicatives. L'estimation d'un modèle dynamique revient à estimer la relation suivante dans le cas d'un retard d'ordre 1 :

$$TXD_{it} = \alpha + \alpha_1 TXD_{it-1} + \alpha_2 TXC_{it} + \alpha_3 TXT_{it} + \alpha_4 PRO_{it} + \alpha_5 REG_{it} + \alpha_6 AGE_{it} + \alpha_7 COP_{it} \quad \alpha_8 TXA_{it} + \alpha_9 TXP_{it} \quad u_i + \varepsilon_{it}$$

Cependant, la variable endogène retardée (TXD_{it-1}) dépend de l'hétérogénéité individuelle u_i. L'utilisation des méthodes d'estimation classiques (OLS, within) donnent des estimateurs biaisés et non convergents. Parmi les méthodes utilisées pour résoudre ce problème, nous faisons appel à celle d'Arellano et Bond (1991).

La méthode d'Arellano et Bond (1991)

La méthode d'Arellano et Bond (1991) permet d'obtenir dans un cadre dynamique un estimateur « GMM » en deux étapes[7]. Dans une première phase, nous obtenons, en passant par une différence première ou une déviation orthogonale et en utilisant les instruments de la variable endogène retardée et des autres variables explicatives, une estimation (2 SLS). Nous combinons les résidus estimés de cette étape avec les instruments pour calculer une matrice de poids qui servira, dans une seconde phase, au calcul d'un estimateur "GMM" plus efficace.

Les résultats de ces estimations en différence première et en déviation orthogonale sont les suivants :

[7] Pour plus d'explications, voir Hanchane, S. et Balsan, D. (1999), « Estimations et tests sur données longitudinales - le cas des panels cylindrés et non-cylindrés, » Document de Travail N° 99C05, GREQAM.

a) GMM en différence première

	Coefficient	Ecart type	T-Stat	Significativité
TXD (-1)	3.74393e-005	9.296e-006	4.03	0.000
TXC	1.30933e-005	0.0005198	0.0252	0.980
TXT	1.30267	0.08248	15.8	0.000
PRO	7.44820e-018	4.422e-019	-16.8	0.000
REG	2.77030e-018	1.645e-019	16.8	0.000
COP	0.000000	-	-	-
AGE	0.000000	-	-	-
TXA	1.06922	0.005609	191.	0.000
TXP	0.218520	0.01315	16.6	0.000

Nombre d'observations = 775, test de Sargan : Chi^2(90) = 22 ,18 [1.000], test AR(1) : N(0,1) = -0,430 [0.067] **, test AR(2) : N(0,1) = -0. 376 [0.707].

La variable endogène retardée (TXD_{it-1}) a un effet positif et significatif sur la capacité innovatrice. Cela confirme la dépendance des dépenses de la R&D d'une année à l'autre des entreprises françaises. Les coefficients des autres variables explicatives sont toujours significatifs et le coefficient concernant la taille des entreprises enregistre une nette augmentation par rapport à l'estimation "GMM" en différence première dans le cadre statique.

Le test de Sargan accepte les instruments utilisés alors que le test (AR) rejette l'hypothèse de l'autocorrélation des erreurs.

Cependant, l'hétérogénéité non observée n'est pas contrôlée de façon précise dans cette estimation, d'où la nécessité de l'estimation GMM en déviation orthogonale.

b) GMM en déviation orthogonale

	Coefficient	Ecart type	T-Stat	Significativité
TXD (-1)	3.81976e-005	1.005e-005	3.80	0.000
TXC	-0.000166937	0.0003452	-0.484	0.631
TXT	1.32369	0.06259	21.1	0.000
PRO	3.00669e-016	1.535e-017	19.6	0.000
REG	0.000000	-	-	-
AGE	0.000000	-	-	-
COP	0.000000	-	-	-
TXA	1.07011	0.005674	189.	0.000
TXP	0.155590	0.09844	1.58	0.120

Nombre d'observations = 775, test de Sargan : Chi^2(98) = 54 ,79 [1.000], test AR(1) : N(0,1) = -1, 057 [0.029] **, test AR(2) : N(0,1) = -0. 482 [0. 629].

La variable endogène retardée est toujours significative, et son cœfficient est toujours positif. Le coefficient attaché à la proximité géographique a connu une nette amélioration par rapport à la différence première alors que celui représentant la mobilité de la main d'œuvre qualifiée a fortement chuté même au niveau de la significativité.

Les coefficients des autres variables représentant l'âge de la firme, l'appartenance à la région parisienne et la coopération sont relativement stables et faibles par rapport à l'estimation « GMM » en déviation orthogonale dans le cadre statique.

Le test de Sargan valide les instruments utilisés alors que le test (AR) rejette l'hypothèse de l'autocorrélation des erreurs.

CONCLUSION

La première implication concerne la taille de la firme. Cette variable a eu un impact très significatif, ce qui nous amène à conclure que la taille des entreprises constitue un facteur favorable qui participe efficacement à augmenter leur capacité innovatrice. Ce résultat rejoint celui de Cohen et Levin (1989), Gooding et Wagner (1985), Galbrarth (1952) et Carrincazeaux (1999).

Concernant la proximité géographique, les résultats suggèrent que cette dernière à un rôle important mais pas suffisant. En effet, en passant aux estimations les plus robustes (GMM), le coefficient de la variable (PRO) diminue nettement mais il reste toujours significatif. Ce résultat confirme les prédictions empiriques de Zucker et al. (1994), Cockbum et Henderson (1998), ces derniers prouvent dans leur étude l'insuffisance du facteur géographique et insistent sur l'importance des interactions entre les entreprises et les universités. Nos résultats suggèrent que la proximité géographique doit être complétée par une forte mobilité de la main d'œuvre qualifiée qui constitue une source très importante d'externalités et une forte capacité d'absorption basée sur un certain niveau de recherche interne. A ce niveau, nos résultats confirment les prédictions empiriques de Verga (1998) dans le cas américain, et de Maurseth et Verspagen (2002) dans le cas européen.

Les résultats obtenus au sujet de la coopération inter firmes ou/et entre celles-ci et les universités ou/et les laboratoires de recherches privés ne sont pas suggestifs. Ils indiquent que la coopération n'est pas indispensable pour augmenter la capacité innovatrice des entreprises françaises. Semblablement, l'appartenance à la région parisienne ne constitue pas un handicap qui empêche les entreprises de développer leur capacité innovatrice.

In fine, les résultats présentés dans cet article confirment l'importance de la proximité géographique dans le processus d'innovation et montrent qu'un tel effet passe par les canaux suivants : une forte mobilité de la main d'œuvre qualifiée, une taille assez importante de l'organisation et une grande capacité d'absorption des entreprises.

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Management of individual expatriation: Case of the academics expatriates in France

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ABSTRACT: The globalization of the labor market has spawned new forms of mobility and expatriation such as individual expatriation. This communication is designed to expose the appropriate practices for better management of individual expatriates, in this case academics. A qualitative approach was undertaken with 10 "academics" expatriates in France from different nationalities.
Their statements show that their host universities have no clear policies for the management of a foreign academic staff. The practices observed (injustice, discrimination, etc.) create counterproductive organizational behaviors and often lead to voluntary departures.

KEYWORDS: Individual Expatriation, Organizational Expatriation, Motivation of expatriation, Career management, Job performance.

1 INTRODUCTION

The globalization of the labor market has spawned new forms of mobility and expatriation. Now, the decision of expatriation is not made only in the context of the Organization; it is the expression of an individual choice, driven by the motivations and the personal expectations of the employee. Thus, a new form of expatriation emerges: the individual expatriation. It's an individual career management which becomes proactive, predictable and unpredictable. It is relational and follows the change and evolution of the context (Collin, 1998).

The University is particularly affected by this trend. Many teachers decide to leave their countries and go to work elsewhere. ''The international mobility of the academics is not imposed by organizations but rather dictated by an individual motivation and a risk taking" (Ackers, 2005, p 103). For the University, the international recruitment of foreign teachers help to enrich its academic network, improve the quality of teaching and research, and allows it to cope with international competition. It is also, a strategy that helps fill the gaps in terms of skills, particularly in specific disciplines.

In this context, several questions arise, such as: What is the difference between traditional organizational expatriation and individual expatriation? What practices of HR we can observe in the field of the management of individual expatriates? More specifically, how do universities manage individually expatriate academics? This research will attempt to answer these questions. Thus, a first theoretical part will be devoted, briefly, to the difference between individual expatriation and organizational expatriation, as well as to their antecedents and their manifestations on Organization and individuals. The second part will outline the results of a first qualitative study undertaken through semi-structured interviews with 10 "academics" expatriates in France.

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2 CONCEPTUAL FRAMEWORK

2.1 THE ORGANIZATIONAL EXPATRIATION: (OE): A CONTEXTUAL REQUIREMENT – A CAREER ACCELERATOR

The evolution of organizational structures and the acceleration of changes in a competitive environment lead companies to seek greater flexibility in the globalized market. Thus, several subsidiaries were created all over the world. Organizations are then required to affect in their subsidiaries abroad a highly qualified staff, typically executives.

Despite its high cost, expatriation is a way to transfer skills and culture of the parent firm in the subsidiaries. Also, it provides activity control and coordination (Ondrack, 1985; Cerdin, 2004). Therefore, the expatriate, often a senior official, has the role to train and develop new skills in the new branch of the firm. The selection and allocation of this senior official is usually done following a complex and rigorous process. Interviews combined with psychometric tests will enable policymakers to be more effective in the selection of a suitable person. The selection is also made on the basis of several criteria, including for example the technical skills, the ability of the individual to adapt to foreign cultures, the marital status of the individual, the particularities of the host country and the mastery of the language (Adams, 2008). Organizations are becoming increasingly aware of the importance of these criteria and their influence on the success or failure of the mission of the expatriate. If it fails, the cost of expatriation will be obviously higher.

For the individual, it is rather a progression in the career that depends primarily on the decision of the organization. Thus, a successful mobility allows the expatriate to develop his skills and to achieve its mission. This will give him the opportunity to access upon returning to positions of responsibility in the parent organization. Indeed, it appears as an opportunity to boost the career and a springboard to climb the ladder. However, several factors may lead to the failure of this expatriation. The perception and expectations of the company are not analyzed in the same way as those of the individual (Cerdin, 2004). The divergence of expectations and motivations of expatriation is certainly costly for the Organization and for the expatriate who decides to put an end to this experience and return before the end of the mission. Thus, according to Yan, Zhu and Hall (2002), traditional expatriation initiated by the Organization must be a process that takes into account the motivations and interests of different parties.

2.2 THE INDIVIDUAL EXPATRIATION (IE) OF UNIVERSITY TEACHERS

Until recently, the managerial expatriation literature focused on traditional expatriation (Brewster and Scullion, 1997; Inkson & al., 1997; Suutari and Brewster, 2000), imposed to a large extent by the requirements of internationalization of the organization. However, with the development of the economy and the globalization of the labor market, new forms of international mobility are emerging, namely individual expatriation (IE). It concerns all socio-professional categories and, in particular, University teachers.

According to some studies (Inkson & al., 1997; Bell & Staw, 1989, Baruch & Hall, 2004; Keep & al., 1996), University teachers are "free agents". The international mobility of academics is not imposed by organizations but driven by individual motivation and risk taking (Ackers, 2005). It is a personal initiative of the academics to improve their professional situations and develop their skills. Also, they have confidence in their ability to manage their careers, taking into account their priorities and personal motivations.

At the beginning, in the middle or at the end of the career, expatriation is an invaluable and beneficial advantage for the academics career in terms of cultural exchange, experience, social networking. Also, it is an opportunity to discover another system of teaching, research and observe other academic practices. Consequently, new trends in research on individual expatriation pay more attention to the individual and his interests.

2.3 OE AND IE: WHAT ARE THE DIFFERENCES?

A comparison between these two types of expatriation allows us to understand and identify the dissimilarities, particularly in regard to the motivations and expectations of expatriates, to better manage human resources.

Thus, the first difference concerns the decision-making of international mobility. Indeed, in the case of an OE, this decision is the prerogative of the organization. Expatriates are like a "Ping-Pong Balls of HRM" with little power (Inkson & al. 1997). Unlike the OE, the IE is controlled and managed by the individual himself, and is considered more flexible and more proactive than traditional career often operated by an employer (Inkson & al, 1997). It is based on improvisation, invention and individual flexibility rather than the 'traditional' method of the Organization (Arthur and Rousseau, 1996).

Another difference raised by Cerdin & Le Pargneux, (2009) notes that the organizational expatriate remains attached to his organization in his country of origin, while the individual expatriate breaks, partially or totally, its links with the organization. In addition, in an OE, organization accompanies its expatriates from the designation until the return. This support does not exist in the case of individual expatriates.

Career anchors also differ between the two types of expatriates. Indeed, a research undertaken by Cerdin and Le Pargneux (2009) about the motivations of expatriation of French expatriates - organizational and individual - shows the similarities and differences between these two types of expatriates in terms of career anchors. They mention that the anchor of quality of life is the most important in both types of expatriates.

In regard to security, the authors anticipate the results of the research and argue that corporate expatriation is safer than individual expatriation. However, the results showed that this type of anchor is more developed in individual expatriates. Another type of anchor (International) seems to be more present among organizational expatriates, who are firmly convinced that the organization makes the international experience easier.

Like the career anchors, motivations are clearly different, in individual or organizational experience. The professional development, the importance of the position and the personal challenge are key factors to consider in the decision-making of expatriation among French corporate expatriates. Among individual expatriates, the personal challenge ranks first, followed by the professional development and the importance of the position. With regard to the changes affecting values, motivations, behaviors and dissimilarities in career management, organizations are certainly facing new challenges in the management of the individual expatriation phenomenon.

3 METHOD AND KEY FINDINGS

The research question is formulated as follows: what GH practices can be revealed in the management of individual expatriates? More specifically, how do universities manage expatriate teachers? To address this issue, we have implemented a qualitative methodology based on semi-structured interviews, using an interview guide.

Our research population consists of teachers expatriate in France individually since at least six months, to ensure a sufficiently rich expatriation experience which provides us with relevant information. More than 50 e-mails were sent to teachers working in several universities and colleges in France (public and private). Only 10 agreed to grant us an interview. The sample of 10 teachers is composed of 3 women and 7 men (Table 1).

We present in the following key results of this research.

Table 1. Distribution of expatriate teachers

Teacher / Nationality	Age	Diploma	In this position for	Host university
A. A. Lebanese	31-40 years	PhD in Management	3 years	ESC Paris
B.K German	41-50 years	PhD in Management	4 years	Catholic University - Lille
B.K Turkish	20-30 years	PhD in HR	2 years	Rouen Business School
H.B Tunisian	31-40 years	PhD in Management	3 years	Business school - Bordeaux
H. M English	41-50 years	PhD in Management	12 years	Catholic University - Lille
R.S.R Brazilian	41-50 years	PhD in Management Control	2 years	Business School -ISG -Paris
S.B Tunisian	31-40 years	PhD in Finance	2 years	School of Management - Champagnes
S.K Tunisian	20-30 years	PhD in Management	2 years	University Paris II
O.J. Cameroonian	41-50 years	PhD in Management	5 years	EDHEC
M.H.C Tunisian	31-40 years	PhD in Management	8 years	EDHEC

How the idea of expatriation has emerged? The answer to this question is very important because it highlights the role of the individual - the University teacher - in the decision of expatriation.

For all of the interviewed academics, expatriation is a personal choice: "it's my own decision", "it's a personal choice''. They describe their expatriation as being thoughtful and a planned action. Also, they mention that they are actively seeking opportunities in foreign universities: "I sent my resume everywhere; Canada, USA and France", "I have always sought an opportunity. I sent my CV to several universities''.

Indeed, they give the image of assertive and ambitious career professionals who leaves nothing to chance. They have academic relations and research projects with other researchers in different countries and with internationally renowned universities. These networks play a key role in the international recruitment: "I had colleagues and friends who worked at the ISG. They asked me to join them. So I sent my CV and I quickly got an offer because they have supported my candidacy. "

Sabri, Octave, and Rosana confirmed that links with colleagues abroad are often the starting point of an expatriation experience: 'The dean knew me and knew that I was looking for a job abroad'', ''I met a teacher in a conference, he told me about a vacancy in his University''. They may, in some cases, recommend them and support their candidatures: ''A friend convinced me to apply for a vacant position. So I sent my CV'', ''I was introduced by my teachers. One of my teachers in Lille has helped me to join the EDHEC Faculty".

However, a few teachers interviewed mentioned the chance and coincidences. They say that expatriation was unexpected: "I did not plan this expatriation; it was a coincidence," "this position is the result of chance, I have not planned my expatriation," "everything is unexpected''.

Interviewed teachers confirm that they are able to manage their careers. Highly motivated, they conduct planned and individual researches for the "best offer" in the international academic market. This shows clearly and unequivocally that individual action is often crucial in expatriation, unlike the managerial literature that presents the expatriates as "HRM ping-pong balls" (Inkson et al. 1997).

However, several motives encourage the individual to work elsewhere. According to interviews conducted with 10 expatriates in France, we identified four main reasons, namely; career, academic research, financial interest and change of lifestyle.

The career is the main reason for expatriation for the majority of the interviewed teachers. They argue that international experience has a positive impact on their academic career: "work abroad brings added value to my cv and my academic career". The majority of those interviewed believe that this international experience is an opportunity to learn how to work in a different academic context: "this experience gives me a know-how to manage different situations that I encounter in my work".

As for academic research, the majority of respondents mention that the French government spends an estimable budget in research and development. Thus, they declare that French universities are well-equipped and offer good conditions of work and scientific research.

The financial interest is another reason for expatriation for university teachers. They evoke pay attraction in France compared to the countries of origin. This allows them to achieve financial ambitions as the purchase of material goods in their country of origin, saving and improvement of the standard of living: "I wanted to improve my standard of living and that of my family", "salary allows me to pursue my dreams and give my family a better standard of living".

For some academics, the expatriation in France allows them to achieve their wish to live a new experience, and change their lifestyle: "I wanted to try a new life with new friends and a new culture".

The decision to expatriation cannot be taken without mentioning the recruitment procedure. Indeed, the majority of the interviewed teachers say they were selected and contacted shortly after sending their CV: "shortly after sending my CV, I received the offer", "I got an offer a month after I sent my CV''. A telephone interview with the head of Department or the Dean was needed as a second phase that seems to be decisive: «I sent a resume and I had an interview via phone», «I was selected through phone interview. They report that the recruitment procedures were fairly simple and fast: "Procedures were fast enough. Forty-five days after sending my CV, I received the job offer".

However, some believe that this period was particularly long: "The recruitment process was long, interviews, file review...". ». Brigitte, German teacher working in Finland says that she passed a competition to get the vacant position of Lecturer: "There was a vacant position in France and I passed a competition. As I was a European citizen, I was treated as the French and Finnish''.

With regard to the selection of candidates, most of expatriates interviewed agree on: "The choice of candidates is made according to their skills. The criteria for selection of candidates are cv, diplomas, experience and skills".

Intercultural training seems to be important in the success of expatriation. It strengthens the adaptation and reduces the effect of culture shock. However, most of those interviewed say they have not received cultural training before travelling in France. They simply consulted information on the internet concerning the climate, currency, lifestyle, etc.: "I did not have training or cultural preparation... I just did a search on the web". They argue that universities do help for common tasks only; housing, bank account, residence etc. Some acknowledge that they followed French language courses before their journey: "I followed French language courses. I was at an American University, so I just refreshed my memory, because I forgot the language'', ''I just took French lessons before leaving for Lille''.

However, they mention that this linguistic training was insufficient: "The French that I studied in school is not enough to communicate with others". Some, in particular Europeans and Tunisians say they don't need a cultural training and their adaptation is easily done: "as I am German, working in France or England is without significance; It is as if I was in Germany. I have no problem coping with culture", "I have no problem with French culture, because I believe that, even in Tunisia, we live almost in a French style''.

Thus, the cultural preparation considered by the literature of international mobility as a means of preparation of expatriates is non-existent in individual expatriation. Most of those interviewed expatriates say that "the host university is aware of the intellectual capacity and skills of teachers. It is not difficult for them to be in harmony with the new environment".

However, the majority of respondents draw attention to inequality and discrimination in the management of human resources in French schools and universities.

Some expatriate teachers say that their universities do not take into account their evolution of rank. This creates a situation of injustice that influences their attitudes and organizational behavior at the University. Sonia, expatriate at the University of Paris II, says: "Our career development is not occurring naturally as for the French. We must work much more (...) The expatriate cannot achieve its objectives without struggle. It is almost impossible for expatriates, particularly for us Arabs, to have the rank of associate professor because that rank gives them the opportunity to access to public service. Our career is blocked because of our origin". Brigitte (German) confirms the words of Sonia: "In France, the direction of academic

institutions is often headed by French. Generally, the expatriate may not be in a position that allows him to take major decisions. Apparently, my colleagues are nice and friendly, but in reality there is always a gap. We are always foreigners''.

Some respondents argue that participation in decision making is a privilege for the associate professors and professors, especially at well-known universities. "The heads of departments and deans involved in decision-making have generally the rank of associate professor or Professor", ''In France, it's different. We don't take decisions, even for courses to teach''.

These statements are relativized by other colleagues (working in business schools) who explain their participation in decision making by the size of their institutions: ''we are not numerous. We think together and take decisions collectively, not only to the Department but for the whole school.''

Finally, half of the interviewed teachers raise the problem of communication with the staff in the host universities. Indeed, administrative staff uses the French language to communicate with our five respondents who do not speak French since they come from Brazil, England, Turkey and Egypt.

They accuse the University of a lack of professionalism and maturity to successfully manage an international activity. "The relationship with the administration is not always easy, because staff do not speak English. Well, I try to communicate with them with the little French I know. In Brazil, the staff speaks English. Here, although the students are international, and courses are taught in English, they prefer to use the French language. But they must speak English especially with the international staff at the University''. "In an international institution, it is more appropriate to communicate in English. Why should I write formal letters in French to apply for a certificate of work for example, while I do not speak the language? »

4 DISCUSSION

The internationalization of academic labor market and mobility of university teachers have increased competition to attract the best foreign talents. Universities are intended to strengthen their performance and enrich their research teams. However, would the universities be ready to meet the challenge of internationalization of their academic teams and better management of these new skills?

University teachers expatriate in France encounter communication problems and suffer varying degrees of anomalies and injustice. Also, they must resolve the problems that arise from the lack of professionalism and maturity of administrative staff in some French universities.

The administrative staff does not speak English and uses French language with all academics, local and expatriate. It is worth noting that the courses are given in English to local and international students. Indeed, this makes it extremely difficult, if not impossible, with the expatriate academic staff. This situation is inconsistent with the internationalization policies undertaken by the universities.

Expatriate teachers are permanently exposed to misunderstandings with administrative staff which, according to them, discredit the international reputation of the University. As a result, some expatriate teachers prefer to change their workplace.

Thus, it would be appropriate that universities include training workshops in terms of linguistic and communicative skills in their professional development policies.

Thus, staff will be well prepared to increase significantly the performance of the university and the organizational commitment of expatriate teachers.

In addition, interviewed teachers emphasize the feeling of injustice and inequality they endure. Inequalities are related to decision making and access to executive positions. This significantly increases the sense of injustice and leads, over time, a lack of motivation and the disengagement among expatriate teachers; a situation which sometimes leads to voluntary departures.

The policy which would strengthen the competitiveness of the university should eliminate all forms of discrimination and inequality between the expatriate teachers and local teachers. Also, participation in decision-making and access to management positions should be part of a transparent policy based on objective criteria such as skills and seniority.

Career management is particularly important in the development of the commitment to the university. Some universities have no clear and transparent policies for the professional development of their expatriate academic staffs, as access to executive positions. Promotion and career development opportunities would enable the university to achieve a high rate of retention of expatriate teachers. In addition, career management policy should be clear, fair and based on skills.

It should recognize as the true value of the teacher, promote creativity and enhance its action. This will have a great impact on the development of motivation, performance and organizational commitment.

5 CONCLUSION

Self-management of career, in particular individual expatriation, constitutes a new phenomenon that allows teachers to explore new teaching and research experiences, acquire new knowledge and skills and build / expand a professional network. However, this phenomenon as well as new organizational challenges is not sufficiently explored in the management literature.

This qualitative analysis allowed us to explore the different contexts and interactions that have an influence on the success of the experience of individual expatriation of the University teacher. We suggest that the university should pay more attention to its performance management system to generate higher levels of performance at work. These levels of performance may be best achieved through a performance management system which promotes organizational engagement of academic staff. Thus, the University should establish a policy of fair management to avoid counterproductive behavior as a result of dissatisfaction, injustice and the discrimination.

We believe that these results cannot be generalizable given the reduced number of sample. A wider exploration is required. We will extend this exploration to other universities and comparisons between them with greater emphasis on the socio-cultural contexts.

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Analyzing an Inspector-Teacher's Discourse from the Critical Discourse Analysis Perspective

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ABSTRACT: This study aimed at identifying the type of power relations in the inspector-teacher discursive discussion during an inspection visit. The data obtained from the critically analysis of a video-recorded speech of a discursive inspector-teacher discussion. The findings revealed that there were two types of power relations practiced by the inspector over his visited teacher, namely the power of authority and power of knowledge. These powers were usually accepted and rarely resisted by the teacher. Finally, the study recommended a training course for all inspectors of English to re-think of their inspecting job for helping teachers rather than terrifying them.

KEYWORDS: School inspection, inspectors, EFL teachers, CDA.

1 INTRODUCTION

Critical Discourse Analysis (henceforth CDA) is a complex and eclectic method as it sometimes indulges two or more disciplines together for the sake of displaying an unavoidable and interrelated relationship between them. This relationship clarifies the type of power relations of authority knowledge, fame, social status, gender, race, etc. to reveal *on the one hand* the source of power, abuse, dominance, inequality and bias. On the other, it attempts to study how these sources are initiated, reproduced, maintained, resisted, transformed within specific social and political contexts (Van Dijk, 1988). For these merits, CDA embraces different types of sciences to be its interests such as commerce, media, gender, sociology, education, linguistics, psychology, sociology, policy, etc. to critically study, *on the one hand*, how each discipline affects the other and how it finds a base of knowledge to be consulted and resolutions for any problem may arise. On the other, CDA attempts to separate all these sciences as one part and brings another could-be effective part (i.e., language) to study how it affects each discipline a time to be an interdisciplinary approach called the *'Critical Linguistics'*. This approach aims at studying the language behavior critically in natural speech contexts of social relevance (Wodak, 1989).

However, Fairclough (2000) identifies three pivotal tenets of CDA namely, *social structure* (e.g. age, status, education, identity, class, ethnic and gender); *culture* (i.e., traditions, habits, norms, behavior, etc.); and *discourse* (i.e., the words we use whether spoken or written). These merits help scholars mix between CDA and other disciplines to produce hybrid studies such as this one in hand. So, education is one of those disciplines which indulges with CDA to be analyzed critically in order to do its job in the society properly.

2 STATEMENT OF THE PROBLEM

The majority, *if not all*, of inspectors of English think highly of their inspection job when they supervise teachers of English in the classroom in the Yemeni secondary schools. The naturalness of their speech might be declined when they talk with these teachers especially when the latter do not do well in the classroom. When they visit teachers, they try to show their power of knowledge and authority over them and address them in front of their students; they do not care about the

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negative attitude the students may get towards their lovable teachers. They forget that they are educational helpers, supporters, and guides to these teachers and their job, *in essence*, is to help and support teachers in what they actually need. These inspectors, *however*, feel snobbish when they talk to teachers about their own mistakes, *if any*, in language and methodology during presenting lessons. They, *in fact*, want to send an indirect message that they have knowledge in language as well as in language learning/teaching. Similarly, the same actions are repeated when they sit with teachers alone outside the classroom to instruct and address them to the right merits of education. Again, they try to address them in a way that reflects their power of knowledge and authority. They think that they are better than them in all language aspects, methods, etc. They talk to them as if they are *only* students; knowing, *as they mistakenly think*, little about language and its other aspects. Reactively, some teachers accept this kind of behavior and listen to their inspectors while some others do not. They refuse to be criticized and addressed in front of their students as well as alone even if their inspectors are right. They, *in other words*, resist this type of hegemony and power at any cost.

3 QUESTIONS OF THE STUDY

Many questions arise justifying the need to conduct the present study. These questions are the following:

- Is there any type of power relations existed in the way the inspectors talk to the teachers of English? If so, what type is it?
- Why do inspectors of English show this type of power relations?
- Do teachers accept, resist, or comply with this power?
- What are the possible solutions for this problem?

4 AIMS OF THE STUDY

- Identifying the type of power relations in the inspector-teacher's (of English) discourse.
- Finding the main causes behind the inspectors' use of this type of discourse.
- Assessing the state of the visited teachers whether they resist, accept, or comply with their visitor's power.
- Finding possible solutions for this problem.

5 SCOPE OF THE STUDY

This study limits itself within three boundaries: the topic of research, the setting, and time. *First*, the topic of the study will deal with the field of CDA to discuss one factor, i.e., the power relations, *and specifically that of authority and knowledge*, ignoring the other factors such as racism, gender, fame, etc. to be beyond the aim of the study. However, the study will discuss how the powers of authority and knowledge affect the inspector-teacher's discourse ignoring the other factors such as behavior, relationship, experiences, etc. *Second*, the setting of the current study will be at Sana Secondary School for Girls, AL-Mashana District, Ibb City, Yemen, and not in any other educational institutions. *Finally*, the study will limit itself to happen on December, 22nd, of the year 2013-2014, the last visit of inspectors of English to the secondary schools of/in the city.

6 SIGNIFICANCE OF THE STUDY

The importance of this study emanates from the fact that CDA is the only enduring discipline which tries to emerge itself in every corner of life for the sake of changing, improving, and affecting the other areas and *in fact* it does. This discipline becomes, *by definition*, the interest of all types of people: educationalists, practitioners, politics, activists, etc. for utilizing what is enhanced by it to be reflected in each group's discipline. Thus, CDA becomes visible in every discipline.

As being an educationalist myself, CDA affects education immensely in all its constituents such as teachers, students, inspectors, curricula, etc. and makes a change, *whether positively or negatively*, in the way these people talk and deal consciously or subconsciously with *either* their equals *or* the outsiders in the society.

In order to shed light on the merits of CDA in education, it is demanding to discuss one factor of the educational process, i.e., inspection and more specifically the inspectors' discourse with their visited teachers in order to identify the type of the discourse occurs between the two parties. Whether or not there are some powers of authority and knowledge shown by inspectors and *if so* to find the reasons behind these practices. Moreover, the study will try to find appropriate solutions to these practices and recommend the relevant parties with the appropriate ways of getting rid of this problem.

7 LITERATURE REVIEW

7.1 TERMS IN FOCUS

It sounds demanding to pinpoint some significant terminologies the study will go around to disambiguate vagueness, if any, through the whole study. As stated earlier, the study will discuss an issue of education, i.e., inspector's talk to his visited teacher from the CDA perspective. So, the following lines will explore the meaning of the concepts of both areas to be identified throughout this study.

First, understanding the concept of CDA can easily be done if the involved terms are clearly known. According to Rogers (2004), the term *'critical'* in CDA goes in the opposite line of *'naturalness*', viz, nothing occurs naturally without any hidden or obvious power. It puts *'why'* and *'how'* questions as the main titles when studying phenomena. However, Corson (2000) argues that the word *'critical'* means to describe, interpret, and explain the relationship between *form* (i.e., grammar, phonology, semantics, syntax, and pragmatics) and *function* (i.e., how people use language to achieve a certain purpose) of language.

Regarding the term *'discourse*', it means *'language above the sentence or clause level*' (Stubbs, 1983: 1). That is, it goes beyond the surface structure of sentences or clauses to reach to the purpose beyond saying such sentences and/or clauses. So, it is the use of language by itself which is seen as a type of social practices (Fairclough, 1992a).

Thus, the meaning of CDA terms collectively is an analysis of not only what is said but also what is left out – not only what is present but also what is absent (Rogers, 2004). Moreover, CDA is more concerned with studying and analyzing words or sentences (i.e., text) to reveal the source of power, abuse, dominance, inequality, bias, etc. and how these sources are resisted, maintained, reproduced in the social, economic, and political context(s) (Van Dijk, 1988).

Second, education is a broad term which aims at developing the desired behaviors in learners. It, however, involves informal and formal education. The former refers to the non-systematized learning and/or teaching for all types of learners which does not subject to the supervision and control of government. It can be practiced by individuals at their special institutions such as homes, mosques, etc. This type of education will NOT be considered at all in the current study. By contrast, formal education is the one which is systemized and subjected to the supervision and control of government whether in schools or universities. The current study will deal with the type of education in schools only due to the presence of inspection in such institutions ignoring the other ones because they are to be beyond the scope of this study.

Owing to the significance of the term *'inspection'* in this study as the inspectors' speech will be analyzed critically, it is crucially important to unfold the exact meaning of such a term which the current study will deal with. Strictly speaking, there is misconception found between the terms *'inspection'*, *'observation'* and *'supervision'*. This ambiguity baffles a lot of scholars as well as researchers, *including me*, to use the three terms interchangeably in their scholarships. To explore such confusion, Ogunsaju (1983) points out that *'inspection'* is the process of monitoring the performance of school staff, noting both merits and demerits they show in the classroom in addition to the use of appropriate techniques to achieve the educational objectives. However, Adepoju (1998) argues that *'inspection'* is a process of improving the instruction in the classroom by working with those who work with pupils, i.e., teachers for helping them achieve excellence in teaching. Supervision, by contrast, is the critical evaluation of schools as a place of learning. Supervisors may pay frequent visits to schools to check both learning and teaching processes in that they go in a good manner and have not any obstacles that could deter the school from delivering its message to the society. Such visits are registered in a special report at the school itself (Ojelabi, 1981).

However, *'observation'* refers to the process of watching pupils in the classroom for the sake of evaluating their teacher's performance. In this sense, *'observation'* can always be associated with *'inspection'* in that the inspector observes both teacher and pupils in the classroom to see to what extent the course objectives are achieved.

To conclude this argument, *'inspection'*, *'supervision*' and *'observation'* are distinct terms; each one means (something) different from the other and this dissimilarity compels the researcher to clarify them all and affirm that the appropriate and accurate term for his study is *'inspection'* as inspectors - and not supervisors - deal with teachers (i.e., language teachers) themselves inside and outside the classroom, which is the objective of the current study.

8 SCHOOL INSPECTION

Inspection is aimed at determining whether plans and practices of both learning and teaching processes are actualized or not. It attempts to correct the possible deficiencies during such processes and identify strategies for ensuring the continuous

development of schools and their staff (Kantos, 2012). In addition, by the inspection process, educators are given suggestions about whether the practices are matched with the goals, the resources, the principals, and the objectives that are framed by the education policy. Furthermore, by the help of inspection, educators can determine whether the practices are accurate, regular, efficient, economic, valid, and reliable. That is, a school teacher is visited by an inspection team to guide, motivate, encourage, and stimulate him for developing the educational process. Similarly, a language teacher, *EFL teacher is an example*, can be visited by his/her inspector for the same purposes. However, Adewole and Olaniyi (1992) argue that inspection is important because it: **a)** improves teaching and learning; **b)** helps students understand themselves and monitors their own behavior; **c)** help teachers develop themselves educationally and academically; **d)** creates confidence in competent teachers; and **e)** examines the application of the subject instructional goals.

However, inspection is of **three** types, namely: **a) routine visits:** they are short visits in which inspectors check the teachers' punctuality and what is happening in the classroom; **b) follow-up visits**: they are done when inspectors want to see whether their recommendations, corrections, suggestions they make during the previous visit have been carried out; and **c) rare visits**: they are done when there is a problem happening to the teacher either a personal problem with his colleagues or an academic one when there is a vague in the goals or the like.

Due to the complex job of inspection, as it is incorporated in developing both learning and teaching processes, it can be associated with some problems. The first problem lies in the possible clashes between the curricula plans and what the inspectors believe (Fidler et al., 1998). Sometimes, curricula have a certain type of a syllabus which is not accepted by inspectors irrespective of who is right or wrong. This clash affects the inspection process in that they (inspectors) visit their relevant teachers with opposing ideas to the syllabi of the curricula themselves and some of them, if not all, want to impose their ideas upon teachers to be followed. This may lead to another clash between inspectors and their visited teachers, as a result. The second problem is brought when some (good) teachers get nervous from their inspectors as the latter come to evaluate and pinpoint the former's errors to show their deficiencies in teaching. This negative feeling affects the inspection process as it gets resisted by teachers (Macnab, 2001). In the same vein, Standaert (2000) provides another problem represented in the scarcity of inspectors saying: *'The number of inspectors in the field of second languages …is rather scarce'* which means that there is a deficiency in the field of inspection as the majority of teachers are not guided, encouraged, and assessed.

9 QUALITIES OF INSPECTORS

9.1 GENERAL QUALITIES OF INSPECTORS

Emanating from the fact that inspectors are watching foreign language teachers in the classroom, it is claimed that such inspectors should *generally* enjoy with three types of qualities, namely *academic*, *educational* and *interpersonal*. Regarding the academic qualities, a foreign language inspector is seen as proficient in the foreign language (e.g. English), knowledgeable in a variety of English Language Teaching (ELT) methods, approaches, old and new, and able to evaluate methodologies to provide the novice teachers with what is new about them. They, *however*, model effective teaching using good lesson formats, activities, and appropriate techniques to help teachers develop English competencies. On the other hand, inspectors are seen as helpers to their visited teachers so as to provide them with relevant websites that enable them to search for knowledge. If teachers are in need to certain knowledge about any single point of language, inspectors should help them know this knowledge.

Regarding the educational qualities, inspectors have to pre-observe teachers in a manner that makes them expect what areas will be observed in the classroom. After observation, they should provide teachers with effective, clear, and meaningful notes that help address their professional and developmental objectives and needs. No matter if teachers get informed about their strengths and pitfalls of their performance in the classroom. Ogunsaju (1983) views that both strengths and pitfalls should be told (i.e, feedback) to them to reinforce the former and minimize the latter. When they comment, they should introduce their comment in an informative way, i.e., to provide them with information they already know, rather than a corrective way which makes them feel less knowledgeable and experienced than their inspectors. It is also preferable if inspectors introduce their comments in the form of asking questions in that they want to know more about them from the teachers themselves rather than imposing their recommended feedback in an aggressive way to make the other part feel less knowledgeable and less powerful. These merits may guide teachers primarily to use a facilitative style to 'self-assess' themselves in the back of inspectors. In addition, inspectors can generate, *in partnership with teacher*s, a realistic plan for a strategic professional development for improvement and on-going learning. Finally, they can prepare a final inspection *report* which is by its nature *formative* rather than *summative* which *in essence* could help teachers utilize in the long run.

Finally, the interpersonal or social qualities of inspectors are the ones which differentiate between inspectors. To put it simply, how do inspectors introduce comments to teachers? In what manner do inspectors introduce their comments? Should they be aggressive or collaborative? These questions may evoke the interpersonal qualities the inspectors should enjoy. According to Fidler et al. (1998), an inspector should make his visited teacher feel comfortable and confident when he sits with him. He should *not* make him feel that he comes to evaluate his performance in the classroom whether it is good or bad. Standaert (2000) adds that the inspector should not make the teacher feel that he comes for identifying his errors. To ensure that inspection is productive and beneficial, it is important that inspectors establish and maintain an appropriate working relationship based on courtesy and professional behavior with teachers as well as the school management. It is well-recommended if inspectors greet teachers warmly and express their feeling that they love them and come only to visit them (ibid.). These etiquettes affect the teachers positively and make them feel that they are proficient and being visited for the sake of being in touch rather than of being evaluated.

9.2 QUALITIES OF INSPECTORS DURING THE INSPECTION VISITS

Inspection is a process where it goes through **three** stages: pre-inspection, during-inspection, and post-inspection. At the *pre-inspection* stage, the inspector is required to inform his head teacher in advance about the time of his visit and the criteria of his evaluation in order to be ready psychologically and mentally (Adepoju, 1998). However, many inspectors, by contrast, try to make their visit abrupt for terrifying teachers which in turn affects them negatively (Ogunsaju, 1983).

At the *during-inspection* stage, i.e., observation, the inspector is required to sit among students in a way that puts him in need to information the teacher provides – not as the one who is very alert to the possible errors coming from him(Standaert, 2000). If he, for instance, finds any problem, he should not stop the teacher and correct that mistake, rather, he should write notes. In case of the error being suggestive, he has the right to correct it at once but in a way that reflects courtesy and modesty. Fidler et al. (1998) mention in this respect that the inspector is required to show his wonder and enthusiasm to the teacher's behavior, language, ideas, etc. he presents.

At the post-inspection stage, which is done after watching the teacher in the classroom, the inspector attempts to comment on the teacher's behavior practiced in the classroom. He should reinforce him positively upon the good things he does in the classroom but he should not rebuke him upon the unsuitable behavior he does while teaching. Ogunsaju (1983) argues that the inspector should introduce his comments politely and kindly to the teacher and not to be aggressive or snobbish. Moreover, he is required to allow the teacher to express himself in front of him, introduce ideas, defend himself, justify, explain anything he wants whether it is right or wrong. In other words, he should not be a dictator as he has power over this teacher (ibid.).

10 QUALITIES OF LANGAUGE TEACHERS

10.1 WHO IS A LANGUAGE TEACHER?

A Language teacher is the person who teaches a language, whether L_1, L_2 or a foreign language. In our Yemeni schools context, there are two types of language teachers, namely the 1st language teachers, i.e., Arabic teachers and the foreign language, i.e., English.

Therefore, who is a teacher of English? Or who should teach English in the Yemeni schools? There are two types of English teachers in the Yemeni schools, namely B.A. and Diploma holders. The 1st type refers to those who study English language for four years in the departments of English at the faculties of Education and are rewarded a B.A. in English. These teachers teach only the secondary school students. However, the 2nd type refers to those who study English at higher institutes, English major, for two years and get diploma in English and sent to schools to teach at the preparatory levels.

10.2 GENERAL QUALITIES OF A FOREIGN LANGUAGE TEACHER

Like inspectors, an English teacher has three main qualities, i.e., *academic*, *educational* and *interpersonal*. The *academic* qualities of the English teacher refer to the ability to use English efficiently inside and outside the classroom. This comes when the teacher manages the main skills of English in addition to some knowledge of pragmatics to know when and how to use the language utterances (Ojelabi, 1981). However, the *educational* qualities refer to the teacher's behavior in the classroom beginning with the type of methodology, approaches, techniques, etc. and ending with the manner he/she deals with students in the classroom represented in accepting their opinions, allowing them to express themselves, etc. In other words, he should be modest, simple, collaborative, helpful, and a facilitator. In case of the *interpersonal* qualities of the

teacher, he should be social in that he makes relationship with his students outside the classroom. In other words, the teacher should not make his students feel hesitated when he talks to them. Moreover, it is preferable if the teacher enlarges his relationship to reach his students' parents.

10.3 QUALITIES OF A FOREIGN LANGUAGE TEACHER DURING INSPECTION

In the beginning, a language teacher is required to be aware of the exact schedules of his inspector's visit. In so doing, he will be aware of the time of the visit to get ready. This idea may enable him to introduce his views before inspection about inspection and what should be focused and what should not be (Adepoju, 1998). If puzzled things discussed before inspection, he can do well when he is observed by his lead inspector. In this case, the teacher allows the inspector, while inspection, to do his work honestly in that he could follow up the procedures of inspection either outside or inside the classroom. However, the teacher is required to deal with the lead inspector smoothly and kindly and *rather* (he) should bear in mind that he is not only an evaluator; rather, he is a helpful guest (Fidler et al., 1998). When they are engaged in discussions, mostly dialogues, he should make the dialogue or discussion more purposeful not merely a meaningless talk (Ogunsaju, 1983). When the lead inspector comments and presents his ideas, the teacher should listen well to him until he finishes and then comments or adds information but politely. Standaert (2000) argues in this regard that the teacher is required to conceal his knowledge in front of the inspector especially when the latter talks about it in some detail. In so doing, the inspector feels that he provides new information to the teacher that could help him. Moreover, he should not interrupt the inspector when he knows such information; this manner will have a negative image on the part of the inspector.

All in all, a good language teacher is the one who makes his inspector feel that he is more knowledgeable than him, *even the converse is true*, and he is in need to his valuable advices and recommendations.

11 CRITICAL DISCOURSE ANLYSIS (CDA)

According to Van Djik (1998), CDA aims at exploring the mutual relationship between discursive practices, events, texts and the political, cultural and social settings to determine the power relations, dominance, inequality, racism, hegemony, bias, etc. *on the one hand* and how these discursive issues are maintained, reproduced, or resisted, *on the other*. However, Fairclough (1995) on his part argues that CDA intends to investigate how such discursive practices affect discourse, whether spoken or written, in the cultural, social, and historical contexts. CDA can be best defined by O'Halloran (2003:11) as *'a type of discourse analytical research that primarily studies the way social power abuse, dominance and inequality are enacted, reproduced and resisted by text and talk in the social and political context'.*

CDA is derived from Critical Linguistics in the late 1970s which (the latter) was developed to achieve three main functions: ideational, interpersonal, and textual (Fairclough, 1995). The ideational function refers to the speakers' experience about the world represented in knowing what is going on around them which could help them in anticipating phenomena. However, the interpersonal function is the effect of one's attitudes and perceptions on judging the in-question phenomena. Finally, the textual function refers to the ability of producing a text as it is understood by the listener (ibid.). The last function is the one which is determined by practitioners, researchers, etc. of CDA as it deals with discursive texts through the utilization of the other two functions. In other words, analyzing a discursive text requires adopting the three functions collaboratively and integratively.

According to Fairclough (ibid.), CDA excels the aforementioned virtues and penetrates into the other disciplines such as human sciences, literature, industry, management, education, etc. and tries to analyze the discourse *critically* in such disciplines to become a *cross-disciplinary* field, however. As an interdisciplinary field, CDA attempts to put its thumps on every field to interpret and analyze massive discursive phenomena that seem very pervasive among people.

12 CDA IN EDUCATION

As we all know, education is an umbrella for many sciences such as psychology linguistics, social sciences, humanities, etc. which can be gained in schools as well as in universities. When these sciences are subjected to learning, they can be studied in the form of texts, manuals, textbooks, instructions, classroom dialogue, etc. Intuitively speaking, such texts are the main focus of CDA as an interdisciplinary field which aims at explicating abuses of power promoted by those texts, through analyzing linguistic/semiotic details in light of the larger social and political contexts in which those texts circulate. When it emerges into education for interpreting and analyzing them *systematically* to show the power relations these texts could associate. For these merits, many education researchers around the globe turned to study the educational problems from the CDA perspective as the latter is considered as the way to interpret, explain, and describe such problems. They attempt

massively to study such educational phenomena with the help of finding the main causes of creating such problems through analyzing language texts (spoken, written, digital), dialogues, spontaneous speech, and social problems, however.

13 METHODOLOGY

13.1 THE INSTRUMENT

The instrument of this study is the inspector-teacher discourse/discussion. It underwent a four-stage process. *First*, the researcher surveyed related literature. *Second*, a visit paid to the General Education Office of Ibb City to see the time of the team inspectors' visit to schools in general and to Sana Secondary School for Girls in particular. *Third*, the researcher went with the inspectors team to tape the discursive talk of the inspector of English and his visited teacher. *Fourth*, the researcher used his LT_9 *mobile* to tape the inspector-teacher discourse in the administration room of the school after the inspector had watched the teacher in the classroom.

13.2 THE PARTICIPANTS

The participants of the study were non-natives speakers of English represented in an inspector and a teacher[1] of English. Both were males and having long experiences in inspection and teaching English as a foreign language, respectively.

13.3 CDA TECHNIQUE

The researcher will analyze an extract of the transcript from the inspector-teacher's discourse which was spontaneous because it was done after watching the teacher in the classroom. The moves of both participants were authentic as they were engaged in their responsibility work to comment, *on the part of the inspector*, and to response, *on the part of the teacher*. In fact, the focus of analysis was primarily on both participants' moves about the way the lesson was presented by the teacher. The researcher undertook the analysis following Fairclough's model represented in the three-stage approach of *description*, *interpretation* and *explanation* (Kettle, 2005).

Regarding the *description* stage, the researcher-analyst will identify and label both linguistic (e.g. vocabulary and grammar) and paralinguistic (e.g. rising volume and intonation) features of the moves as social issues used by people in social settings. However, at the *interpretation* stage, the participants' moves will be interpreted in terms of linguistic choices that really show their meanings and understandings of beliefs and attitudes towards the natural, social worlds and values. *Finally*, the researcher-analyst will *explain* the participants' linguistic and paralinguistic choices which are determined by social, cultural and institutional structures that either resist, challenge or or induce power relations (Fairclough 2001 cited in Kettle, 2005).

14 DATA ANALYSIS

14.1 THE DIALOGUE TRANSCRIPT

Inspector: Mr. Naji, first of all, I thank you so much indeed from the bottom of my heart for the a a a what you have done. Can can I mention some points that I have taken during, I mean your teaching. See, you have also …….. right?
Teacher: [Nodding his head]
Inspector: You have used a picture, that is wonderful …..
Teacher: I collected some pictures on the other part …..
Inspector: Yeah, yeah, that is wonderful. I think this picture that you have used, right? ……
Teacher: Yeah, students they have to guess: where are these people? What are their jobs? What are they saying …
Inspector:[looking at his notes]
Teacher: … a lot of patience and then how they talk about the pictures.

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1. The inspector's name is Ameen Al-Kamil who has been an inspector of English for 10 years.
The teacher's name is Naji Al-Qaderi who has been teaching in Sana School for Girls for 11 years.

Inspector: Well, you were wonderful, but I want to tell you something that you have neglected. I see that you didn't use of the board, well, you use random writing. I found you write randomly like … how long …
Teacher: the the the the the jobs and places only I found the places they don't know …
Inspector: In the board?
Teacher: Yes, I write some words which they don't know.
Inspector: But what what what you tell is not well-organized. That's why …..
Teacher: yeah, yeah ….
Inspector: That's why you attracted my attention …
Teacher: Yeah, but I cleaned the board before enter to the class, not not …
Inspector: the date?
Teacher: not important because ...
Inspector: of course. The date …
Teacher: Aha aha aha I always write the date because I don't know that you come to the class [hhhhhhhh]. In my teaching, I write a lot on the board …
Inspector: ok but I am talking about the organization …
Teacher: yeah, yeah, yes, I get it, I get it.
Inspector: That's wonders me! An an and ok I think mmmm a a I think you accept some answers from all students mmmm those not .. you know … you don't …
Teacher: I tell students to speak English as well as much as they can. I can't say to my students 'you are wrong and ….
Inspector: Why, ok ok … there should be a question when you ask students why do you do like this why or hadn't you know that there is a word like this? What are the signs …
Teacher: you you need to use the present simple and past simple…
I**nspector**: No, no, don't tell me about tenses. I am just asking you students they read the picture and you tell them that they learn well. Why don't you ask the students I mean at that time why don't you ask students to tell you about it like that. This is what I want to tell you. I noticed you didn't do that. You didn't, I mean, take your lesson plan.
Teacher: you just ask me where is your lesson plan. It is in my bag.
Inspector: you did not show me.
Teacher: you did not ask me.
Inspector: Are you sure?!!
Teacher: in my bag
Inspector: ok . you don't give students reinforcement ok? Reinforcement like 'good', 'excellent' to motivate them.
Teacher: teacher Ameen, there is something called Teacher Taking Time. I allow students to talk. I follow the Student Taking Time …
Inspector: Ok, ok, you haven't understood me. What I want to tell you is that to encourage them. Tell them 'very good', 'excellent'.
Teacher: I give them more.
Inspector: I notice .. let me also tell you something I noticed that you stay in one place and the preferable to you to move a little a bit from a place to a place, students we hope to focus.
Teacher: if they are boys, I will do, but they are girls … you know [smiling]
Inspector: you have place to walk. You should do like this [standing and walking] to attract their attention.

14.2 DATA ANALYSIS AND DISCUSSION

According to the discursive speech of both the inspector and teacher, the dialogue was initiated by the inspector starting thanking and mentioning his visited teacher's name for what he had done in the classroom. This gratitude indicated that the inspector adopted the right educational and inspecting way of welcoming a visited teacher using a very suggestive expression *'from the bottom of my heart*' which was used to make the teacher so happy as it came from someone who had an authority on the other. After finishing the 1st gratitude statements, he constructed another statement in the form of an enquiry for allowing him to mention some points he had already noted them during watching the teacher in the classroom. His enquiry started with the modal verb *'can'* which indicated that the inspector seemed polite and simple. When he finished requesting, he reminded him of the lesson he had presented in that it was a reading lesson. When we look critically at the way he constructed the introduction, he used *three* different grammatical statements: affirmative, interrogative, and a question-tag. His use of various statements had a purpose. He started calling him by his name and title 'Mr.' and thanked him for what he had done and forgot that he was his inspector who had a higher position than him. This feeling made him constructing a question immediately for mapping out his first gratitude statement as it should not be said to the teacher and reminding both of being an evaluator, *on the part of the inspector*, and erroneous, *on the part of the teacher*. Then, he immediately composed a tag-question statement to remind the teacher of the topic of the lesson in order to start commenting *on the one hand* and showing that he was *not* in need to anyone to remind him of the topic, *on the other*; that is, he had a good memory to remember things for a long time. This argument can be supported by his *falling* intonation to the word *'right'* (see the video tape) which means that the inspector did not need the teacher's response as he was sure of his ideas and confident of

his memory; unlike the *raising* ones which indicate the speaker's need to the listener' response to support or refute him (Yule, 2010). This behavior indicated that the inspector showed some power over his poor visited teacher.

Again, he wanted to attract the teacher's attention to the picture he used in the classroom by the same style that showed his confidence of his ideas presented. He did *not* start the question with a question particle (e.g., have, do) to avoid the teacher's response of '*yes'* for the same purpose that he had a good a memory and did not need any one to remind him. He *then* commented on the teacher's use of the picture by saying '*wonderful'*; it was not said for reinforcing the teacher; rather, it was said to show his power of knowledge with regards to teaching methods in that he knew more about the effectiveness of using such realia in the classroom and had (using picture) to be appreciated. He wanted to continue commenting on the use of pictures and may be the other realia but the teacher felt happy with his inspector's appreciation as he did not expect it from him; he directly interrupted him to indicate the source of bringing the picture but he could not continue as he is interrupted by the inspector. This interruption aimed at suppressing the teacher in order not to indicate the source of bringing the picture and show his power of knowledge of the ability to select a suitable and relevant picture. This was clear from the inspector's repetition of the expression *'that is wonderful*'; as if he wanted to say *'you have to listen to me only, I appreciated it earlier and no need to elaborate'*. This unspoken utterance shows the inspector's power of authority over his poor teacher. But frankly, the teacher did not subject to him and be silent; he resisted his inspector's power and elaborated for some while to indicate the purpose of bringing the picture in a reading lesson such as *'guessing the topic involved in the picture*', *'knowing the place and jobs of people'*, *'the idea they carry'*, etc. The teacher wanted to show his power of knowledge he had in order to resist the assaulting power of knowledge of his inspector. Saying this by the teacher while the inspector was looking at his notebook. That is to say, the inspector did not listen to the teacher when he justified the use of the picture because he knew the purpose of the picture in advance and no need for hearing it from the teacher. This behavior showed his power of knowledge in knowing purposes of bringing pictures into the classroom. Again the teacher tried to resist that power by continuing listing the purposes of bringing the picture in his next move. This behavior can be interpreted as the teacher wanted to seize the opportunity to continue listing purposes, i.e., to resist, when the inspector looked at his notebook in order to avoid listening to him.

After a long silence by the inspector looking at his notebook, he appreciated the teacher by saying *'you were wonderful*', which is educationally demanding, to refrain him from showing his power of knowledge and he immediately, *in the same sentence*, informed him that he had another comment about the use of the board. According to the inspector, the teacher did not use the board effectively and when he sometimes used it, he used it randomly. When we look at the verbs he used, we find that he used the verbs *'see'*, *'found'* which express certainty (Lyons, 1995). In other words, he was sure of what he commented and no way for argument. This behavior indicated some power of authority in that his comments could never be rejected or even modified. Not only that, but he started, *at the end of the same statement*, forming a wh-question of *'how long …*', asking the teacher a personal question relevant to this problem but he did not complete it due to the teacher's interruption. The presupposed question could be *'how long have you been using the board in this (bad) way?'* as it was understood from the context. The desire of asking this question and specially using *'how long'* was that he wanted to attract the teacher's attention to his long novice experience in dealing with boards. In other words, he wanted to tell the teacher that he used to practice this experience (of writing on the board) for a long time, which was not really welcomed. This is what the inspector was going to say if he was not interrupted by the teacher's interrupted sentence *'the the the the the jobs and places only I found the places they don't know'.* The structure of this move is so weak as some words were repeated such as *'the'* for five times with no purpose followed by broken and fragmented clauses. This indicates that the teacher was not confident in what he justified to his inspector due to the irrelevant justification to what the inspector commented *on the one hand* and the fear from the inspector's power, *on the other*.

However, the inspector understood what the teacher meant although the justification was irrelevant and asked him another question, i.e., *'In the board?'*, related to his previous comment in order to see how the teacher would answer the question although he (inspector) knew the answer in that he did not write them on the board. This behavior showed that the inspector wanted only to prove that the teacher's way of using the board was wrong while he was *always* right. This interpretation is supported by the facial expressions he made to show his snobbish way of using his inspection authority over the teacher. Here, the teacher responded that he used the board for writing some words. That is, he tried to resist the inspector's false belief represented in the lack of using the board effectively. This resistance evoked the inspector and/to comment that the teacher's use was not *'well-organized'*. This means that the inspector did not say that the teacher neglected the board as he commented earlier but the only problem was that the teacher's writing was not organized. From the CDA point of view, the inspector seemed to use his authority to homogenize the teacher over anything irrespective of whether it was right or wrong. But what about the teacher? Did he accept or resist that massive insistence (of being wrong) of his inspector? The teacher's response of *'yeah, yeah,…'* showed his weakness, i.e., acceptance, in front of a man of a higher position than him. This acceptance sensitized the inspector to say *'That's why you attracted my attention'* to point out that he

was always right in all what he commented. This in turn showed that the inspector used two types of powers: the *power of authority* when he insisted on introducing ideas that could never be changed and the *power of knowledge* when he said that his attention was attracted because of the wrong use of board by the teacher, which was considered as a crime in ELT, as he implied.

The next move showed that the teacher again wanted to resist this false belief to say that he cleaned the tidy work from the board before he came. In other words, the teacher wanted to say that he knew all things that the inspector knew with regards to the way of presenting information to learners on the board or through any other tool. To put it simply, the teacher wanted to say the well-organized work was cleaned before the inspector came. But, the inspector did not accept it from him and wanted to prove him wrong, asking him *'The date?*'. He wanted to say that if the organized work had been cleaned as the teacher proclaimed, what about the absence of date?! Was it cleaned too?! So, the teacher wanted to cast another comment about the date in that it was absent which should appear on the board. This move showed that the inspector used his authority to prove the teacher guilty at any cost. This made the teacher felt frustrated as he responded wrongly in that the date was not important to be written on the board. This wrong comment helped the inspector to show his power of knowledge again to *imply* the necessity of writing the date on the board. This implication made the teacher accepted, *and not resisted*, his inspector's comment, starting laughing and claiming that he *always* wrote it on the board except the day of the inspector's visit. In other words, the teacher felt sorry because he did not know that the inspector would come to watch him; if he knew, he would write the date on the board instead of being guilty in front of him. This implication admitted the inspector's power over his visited teacher in a way or another.

The next move of the inspector *' Ok but I am talking about the organization …*' showed the wobbly comments he used to suppress the teacher relaying blindly on his power. Why did he resume talking about the organization after discussing it extensively with his teacher?! This means that he felt that he had power over him which legitimated any comments he used to say. And this was clarified by the response of the teacher *' yeah, yeah, yes, I get it, I get it'* which means that no need for repeating it again and again. Critically speaking, this response was not easy/simple to be said from those of lower ranks to those of higher ranks. That's why the inspector justified his repetition by saying ' *that's wonders me!*' to point out that he never repeated and asserted things unless they were worth noting. This, in turn, showed some power of knowledge in that he knew when to assert points and when not. He had a power of knowledge represented in the ability to differentiate between important points and trivial ones.

However, in the same statement, he composed another question starting commenting on the teacher in accepting some wrong answers from students. When looking at the structure of the inspector's sentence, one will find that it is full of *'an, mmm, ok, you know'* which indicates that the inspector still thinking of what to comment the teacher. There were no ready questions in his mind which he thought they were necessary for his visited teacher. This showed the inspector's insistence of using his power of authority over the teacher. In this regard, the teacher knew what the inspector was going to say and immediately responded that he allowed his students to speak English as much as they could. He continued saying that he never stopped his students and said they were wrong. This move indicated that the teacher tried to show his power of knowledge represented in knowing how the negative reinforcement or feedback affected the students' interaction in the classroom. He said that for two purposes: *first*, he wanted to show his knowledge to his inspector because he was his evaluator; and *second* to resist his inspector's power of knowledge in order not to excel him, *rather*, to be *at least* somehow equal.

In the next move, the inspector tried to find another comment to the teacher with regards to the signs of tenses to show his power of knowledge of, i.e., of grammar. Immediately, he tried to avoid his comment by admitting that the students needed present and past tenses to know. This move indicated that the teacher wanted to show his power of knowledge represented in showing the inspector that he knew his students' needs in their current level. This move sensitized the inspector and made him resisted this power, *as being from lower to higher*, by saying ' *No, no, don't tell me about tenses. I am just asking you…*,' which showed the greater power of authority the inspector practiced it over the teacher. The rest of his move showed that the teacher misunderstood him of what he intended to say; that is, the inspector intended talking about the picture whereas the teacher thought of the use of tenses. This showed that the inspector showed his power of authority over the teacher represented in stopping him even impolitely and showed the power of knowledge represented in refusing the idea of tenses at all as being irrelevant to the goal of the lesson. But in the end of the move, he tried to change the theme of the question into asking him about his lesson plan in that it was not available with him. Putting this idea at the end of his comment, after murmuring some interrupted sentences, pointed out the extensive searching for more comments to downgrade the teacher for the sake of satisfying his authority of power as an inspector-evaluator.

In response to this comment, the teacher admitted that it was found in his bag and it was the inspector's problem when he did not ask for it in the classroom. This move did not make the inspector feel well as being mistaken by the teacher whom

he thought that he was lower. Immediately, he said ' *you did not show me!'* to be far away from being wrong. He always blamed the teacher for anything while he, *as an inspector*, could never be blamed by anyone. He tried to point out that he was always right and perfect. With regards to this point, Adepoju, (1998) argues that a lesson plan should always be associative with the teacher and presented to the inspector while teaching; if not, the inspector himself should ask for it to follow up the teacher in the classroom. In our context, it was clear that the teacher forgot to present it to the inspector, so no matter if the inspector asked for it to see how the teacher applied the plan he did. But, what happened was that the inspector did not admit at all that asking lesson plans was part of his duty. In this regard, the teacher tried to resist his power and insist on making his inspector the wrong-doer. His insistence made the inspector uttered this question *'Are you sure?!!* with raising intonation which echoed the sense of dissatisfaction with all what had been argued. Here, the teacher responded saying *'in my bag.'* in which the inspector's question did not, in essence, need an answer because he did not ask for answer, but to stop argument. These moves enahnced the availability of some power (i.e., of authority) on the part of the inspector and some resistance to this power on the part of the teacher.

As stated earlier, the inspector wanted to stop such argument and, *in his next move*, he started commenting by using *'ok'* to end this argument and cast another missile towards the teacher represented in the lack of reinforcements in the classroom. He said that the teacher did not use any kind of reinforcement such as *'good'* or *'excellent'* for motivating his students. This move indicated that the inspector *again* tried to show his power of knowledge represented in two implications. The *first* implication is that he wanted to tell the teacher about the words that indicated reinforcement while the *second one*, to tell the teacher how reinforcements were very motivative and encouraging to students.

As a response to this comment, the teacher said: ' *Teacher Ameen, there is something called Teacher Taking Time. I allow students to talk. I follow the Student Taking Time …'.* In this move, the teacher used a technique to sympathize the inspector through using *'Teacher Ameen'*[2]at the beginning for two purposes, namely stopping him from any coming comments and making a soft ground for showing some power of knowledge (i.e., talking about the classroom right time of both teacher and student). Both techniques, i.e., *calling him by his title and showing power*, are considered as a kind of resistance to the great powers the inspector practiced them over him along the dialogue. To put it more clearer, the teacher intended to mitigate the inspector's power of authority by saying *'teacher'* and (mitigate) the power of knowledge by talking about the TTT and STT.

With regards to the inspector, he did not react to these techniques positively; rather, he *instead* accused the teacher of misunderstanding. Then, he tried to clarify his point, meaning the teacher should encourage his students by saying *'good'* and/or *'excellent'*, nothing more. Again, he did not want in fact to correct the teacher to help him but he wanted to re-show his powers of authority and knowledge simultaneously through using the imperative verb *'tell'* in ' *Tell them 'very good', 'excellent'* and the repetition of the words *'good*' and '*excellent*', respectively. For that, the teacher did not dare to raise his voice to say *'I give them more'* which indicated that he accepted his inspector's power.

Finally, the inspector found another comment leveled against the teacher in that he stayed in one place in the classroom which was wrong as he implied. He rather advised him to move from one place to another to make his students pay more attention to what he would say. In this move, the teacher showed his power of knowledge represented in knowing about the importance of moving around in the classroom. The teacher, in turn, tried to justify this problem by saying that his situation was special as his students were girls, saying: *'if they are boys, I will do, … '; but they are girls … you know [smiling]*'. When we look at this move from both coherently and cohesively point of views, we find that the teacher used *'substitution*' when he used the auxiliary verb *'do'* in the place of the verb *'move'*. His use could be interpreted in two different critically ways. The *first* interpretation is that he accepted his inspector's power represented in ordering him to move around and felt sorry to express it in the sentence for his dissatisfaction. The *second* interpretation is that he wanted to show his power of knowledge through using *'substitution*' as his use of language would be more eloquent than with the original word itself.

In the second part of his move '' *…. but they are girls…',* the teacher tried to *implicitly* attract the inspector's attention to the purpose behind his sitting in one place in the classroom; which is, the Islamic and Yemeni habits and traditions in dealing with girls. In this move, the teacher used ellipsis which could be presupposed as ' *…. but they are girls…[I cannot do it]*. He used such a cohesive tie to hide what he supposed to say as being of a lower rank from the listener. The teacher knew well if he used the clause explicitly, the inspector might feel angry and (might) use his power over him and hurt him in his job. So, it is considered as a technique for accepting the power of authority of his inspector, *on the one hand*, and as a type of *linguistic*

It is more appropriate if the teacher uses 'Mr. Ameen' than 'teacher Ameen'. [2]

resistance to the power of the inspector. The inspector concluded his comments by showing the teacher how to walk and move among students in the classroom. It did not mean that the teacher could not move in the classroom to be taught so by his inspector; rather, he mocked at him in being disable to do his duty, *albeit the classroom movement*, and should be shown this movement practically. Form the CDA point of view, he was conceited by his power and forgot that he was dealing with an experienced teacher like him - if not better than him.

15 CONCLUSIONS AND RECOMMENDATIONS

In this study, the researcher has explored the type of power relations induced from the inspector-teacher talk during an inspecting visit. The qualitative/content analysis of the current study, *and for answering the study questions*, showed that there were two types of power relations in the inspector-teacher discourse, i.e., power of authority and power of knowledge practiced by the inspector. As a result, such powers were mostly accepted and rarely resisted by the teacher.

Based on these findings, the researcher suggested training courses for inspectors of English to be done by the Education Office of Ibb City – Inspection Section to train them about the inspection responsibility. In such courses, highly proficient experts in education should be invited to train such inspectors in order to re-think of their job as being facilitators, helpers, cooperators, consolers to the teachers they visit in schools in order to help them achieve the set objectives of the course rather than being horror-causers and authority and power dominants.

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Synthesis of exfoliated polystyrene/SWY-Na nanocomposite by emulsion polymerization using a chloride of cétylpyridinium and dielectric proprieties

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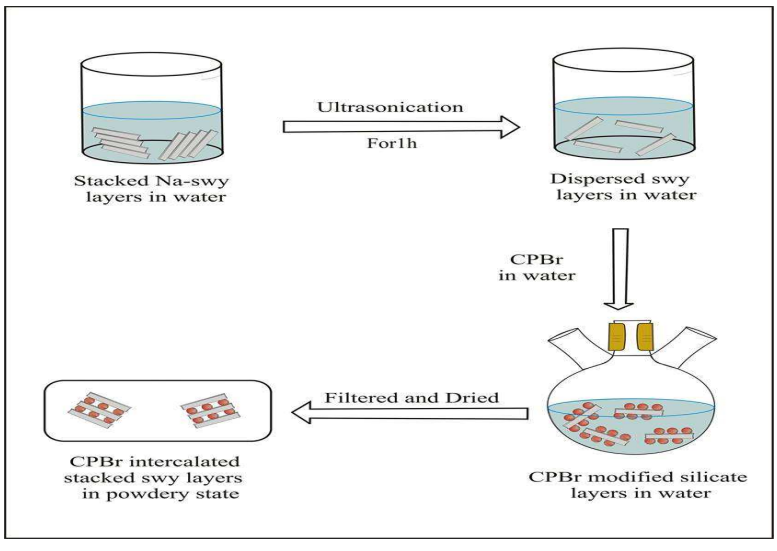
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ABSTRACT: Polymer nanocomposites of polystyrene matrix containing 5 wt % of organoswy were prepared using the solution method with sonication 23 hours. CPBr is used to modify the SWY clay after suturing with surface with Na^+. Polystyrene was synthesized through solution polymerization in the presence of potassium persulfate (KPS) as an initiator. The synthesized PS/oswy were characterized by XRD, FTIR, SEM methods. Frequency dependent complex dielectric function, loss tangent spectra of PS and PS/swy nanocomposites up to 5 wt %.The nanocomposite materials with low dielectric constant and loss tang compared to the pure polystyrene were obtained. The dielectric constant increase with the increase of temperatures.

KEYWORDS: clay, swy, oswy, CEC, RX, SEM, IR, Dielectric.

1 INTRODUCTION

Polymer-layred silicate nanocomposites have become effective alternatives to conventional composites in many applications. Nanocomposites, such as polymer–layred silicate nanocomposites, have a least one characteristic dimension in the order of the nanometer. In general, two types of clay nanocomposites can be obtained intercalates and exfoliates [3,4, 5]. Intercalated are obtained when single polymer chain is located between clay layer spacing while attractive forces between the layres keep these in a regulary spaced stacks.



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Polystyrene (PS) is a commercialized and mass productive polymer. Hence, continuing research efforts have been devoted to the development of polystyrene/montmorillonite (PS/MMT) nanocomposites. Various methods based on simple mechanical mixing, bulk polymerization, solution polymerization and emulsion polymerization have been employed.

So far the majority of PS/MMT nanocomposites prepared via emulsion polymerization showed an intercalated morphology. In this paper, we use a novel zwitterion amino acid to modify the clay, and PS/MMT composite is synthesized via emulsion polymerization in the presence of the modified clay. This approach is proved to be effective for the preparation of water-borne exfoliated polymer/clay nanocomposites. For comparison, emulsion polymerization in the presence of cetyltrimethylammonium bromide-modified MMT or pristine sodium montmorillonite are also studied.

Polymer-clay nanocomposite materials, in which nanometer-thick layers of clay dispersed in polymers, are generally stiffer, stronger, and tougher than normal polymeric materials and can be potentially useful in a variety of applications. These polymer-clay nanocomposites can be prepared in several ways, namely by intercalation where polymer chains are sandwiched in between silicate layers and by exfoliation where separated, individual silicate layers are more or less uniformly dispersed in the polymer matrix. However, exfoliation and orientation of the clay platelets in the polymer matrix is not optimized for the approaches currently used to prepare polymer-clay nanocomposites. The objective of this work is to prepare anisotropic polymer-clay nanocomposite particles with exfoliated clay platelets encapsulated inside latex particles in order to improve the exfoliation and orientation of the clay platelets in the final polymeric film. In our present study, we report for the first time a simple in situ preparation and characterization of an exfoliated polystyrene clay nanocomposites site with low dielectric constant, the microstructure of nanocomposites were determined by X-ray Diffraction (XRD) and Scanning Electron Microscope (TEM) and their dielectric proprieties were also investigated.

2 EXPERIMENTAL

2.1 MATERIALS

Styrene monomers sodium dodcylsulfate (SDS, Aldrich, 99%) and the initiator, potassium persulfate (Kps, Aldrich, 98%), Raw Wyoming was collected from Bir El Hfei (Gafsa), the chemical composition was determined using X-ray florescence (XRF).

2.2 MEASUREMENTS

BET surface area and pore volumes of adsorbent were measured using the physical adsorption of nitrogen by quantachrome Autosorb-1 instruments.

The cationic exchange capacity of CEC was determined using the cooper ethylene diamine $(EDA)_2$ Cu Cl_2) complex.

The X-ray diffraction patterns of the polystyrene PS were measured using the $Cuk_{\alpha 1}$ (1,5406Å) radiation in the range of 2θ=10-70º, with a step size of 0.02º.

The infrared spectroscopic absorption data were obtained with a Fourier TransformInfrared spectrometer with an attenuated total reflectance accessory (FTIR-ATR).

Finally the electrical measurements of dielectric constant, dielectric loss and impedance parameters Z'' and Z' were made over a wide range of temperatures (40°C-200°C) with cooling rate of 10°C and a stabilization time of 10 min between consecutive measurements and a frequency of (10 Hz --13 MHz), by means of a Hewlett Packard HP 4192A impedance analyzer.

2.3 PREPARATION METHODS

2.3.1 SYNTHESIES OF POLYSTYRENE

Polystyrene were prepared in batch emulsion polymerization at 80°C from styrene (Aldrich, 99%), in 200 ml of H_2O the surfactant, sodium dodcyl sulfate (SDS, Aldrich, 99%) and the initiator, potassium persulfate (Kps, Aldrich, 98%). Removing SDS and conterions from the suspension from the experiments,

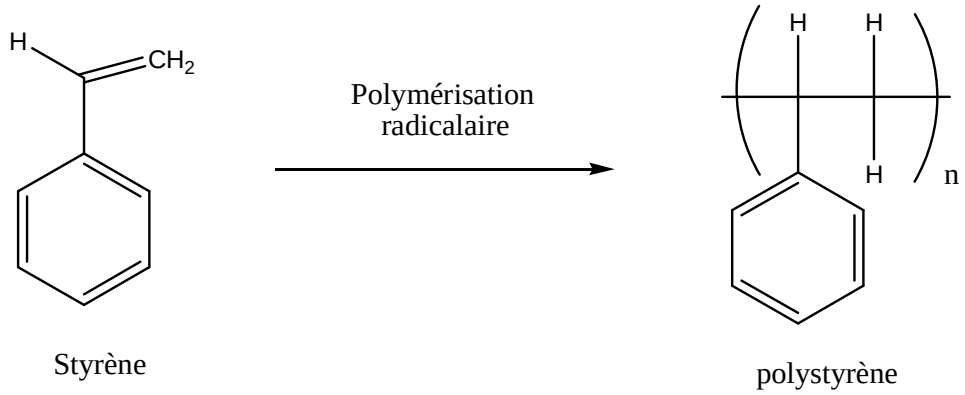


Fig. I. 1. Method of Synthesies of polystyrene.

2.3.2 WASHING AND SATURATION OF SWY

To prepare the suspension, 31 ml of distilled water was added to 150 g of SWY and shaken for 24h. The suspension was allowed to sit for 30 min. Distilled water was added to the separated swy suspension. After, the swy suspension was separated and saturated by shaking with 0.5 mol/L of NaCl solution for 24 h. This step was repeated five times. The sediments was washed with distilled water to remove excess salt. This was confirmed by a negative chloride ion test using $AgNO_3$. The organoswy were prepared by drop wise addition of 0,1 M aqueous solutions of CPBr to a 0.5 % aqueous suspension of the Na – SWY, it was stirred for 24 h. The complexes was centrifuged and washed several times with distilled water until the absence of chloride in the filtrate. The organoswy was dried in hot air dried.

2.3.3 PS/OSWY

Ten percent of the weight of organoswy was added to 20 ml of toluene. The suspension was stirred magnetically for 1h and sonicated for 1h before PS (2g) was added. The resulting mixture was magnetically stirred for 1h and sonicated for 2h.

3 RESULTS AND DISCUSSION

3.1 CHEMICAL COMPOSITION OF SWY

The chemical composition of swy as well as surface area and organoswy are shown in Table 1. BET surface area of swy and organoswy was measured using the physical adsorption of nitrogen by quantachrome Autosorb-1 instruments.

Table.1. the chemical composition of raw swy.

Constituent	Percentage (%)	Cation exchange	Adsorbent	Specific surface area
SiO_2	52,98	92 meq/100g	swy	27
Al_2O_3	16,32		oswy	2.3
Fe_2O_3	7,26			
CaO	2,52			
MgO	3,86			
Na_2O	0,5			
K_2O	0,5			
Loss of ignition	14,20			

3.2 XRD

XRD analysis of swy and organoswy shows information of interlayer spacing of the clay layers (Fig.1). After the cation exchange with CPBr, the d_{001} spacing was expanded. This increase of d spacing provides evidence to support the exchange of the interlayer by $CPBr^+$. The results of basal spacing of each synthesized organo-swy and swy are given in Table1.

Table. 2. XRD Results of swy and organo-swy (1 CEC, 2 CEC and 3 CEC).

samples	swy	1CEC	2 CEC	3 CEC
d_{001}	12.5	40.07 A°	39.09A°	38.41A°
2θ(°)	5	1.8	5.7	1.5

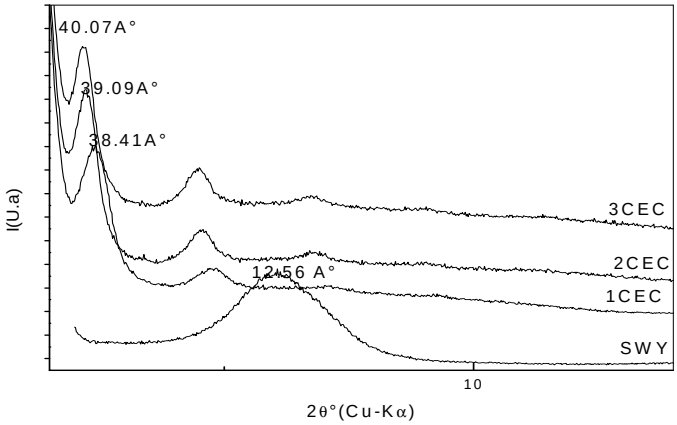


Fig.1. X-ray powder diffraction patterns of swy and oswy equivalent to 1, 2 and 3 times the CEC.

3.3 FTIR

The infrared absorption spectra (FT-IR) of swy and organoswy were recorded in the region from 400-4000cm^{-1}. For the swy spectrum, the absorption band at 3645 cm^{-1} is because of the stretching vibrations of structures OH groups coordinated to AL-AL pairs the complex broad band at approximately, and the bands are related to Al-O-Si, Si-O-Si deformations. Adsorbed molecules of water result in abroad bad at 3403 cm^{-1} which corresponds to the H_2O stretching vibrations was at 1639cm^{-1}[6]. The additional peaks at 1425 and 1467 cm-1 in organoclay, which are absent in swy, indicate the presence of C-N vibrations intertiary amines. This observation clearly indicates that the surface modification of swy is achieved by surfactant.

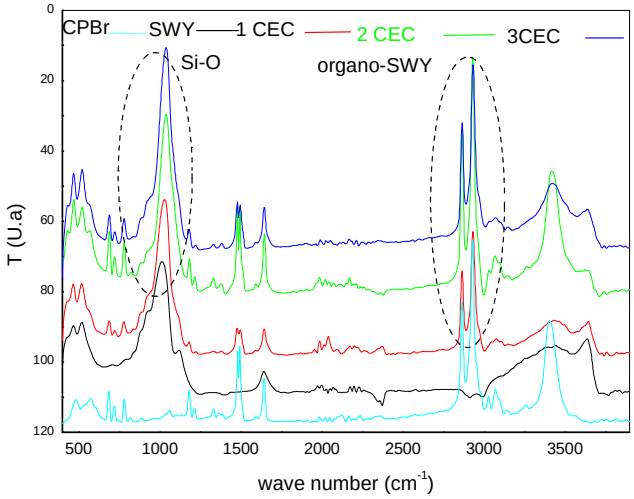


Fig.2. FTIR patterns of swy and oswy equivalent to 1, 2 and 3 times the CEC

3.4 SEM

Scanning electron microscopy (SEM) shows some significant changes on the surface of the organoclay oswy (1 CEC, 2 CEC and 3 CEC) Fig.4. The Na-treated smectites appears, some aggregated and some massive. However the clay treated with organic surfactants (Fig.3.b, c and d) shows slightly non aggregated morphology, and severely curled or crumpled edges. The organoclay particules (oswy) are relatively separated (Fig.4.b, c and d) it seems that the replacement of the inorganic interlayer cations and their hydratation with $CPBr^+$

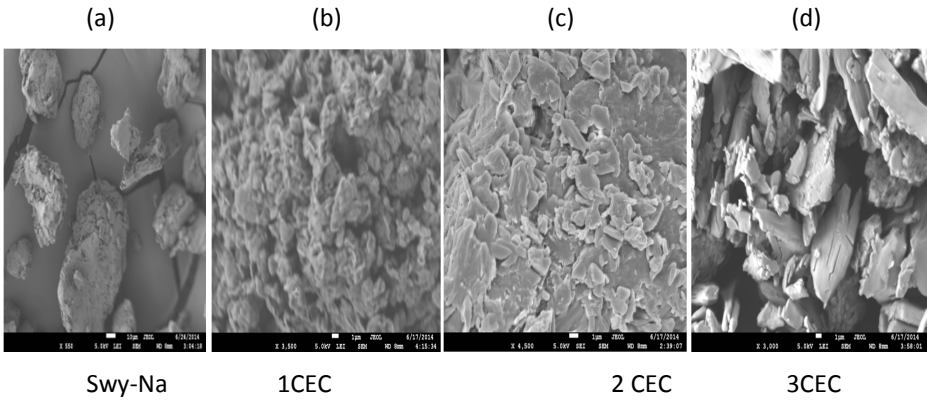


Fig.3. SEM images of OSWY

Spherulite-looking crystals with beautiful impinged boundaries were observed in PS/organo-MMT after 1 h of sonication time compared to PS. Good dispersion of this percentage of MMT throughout the PS matrix under sonication could be led to a nucleation effect and increase the percentage of crystallinity. It is result strongly agrees with the XRD results.

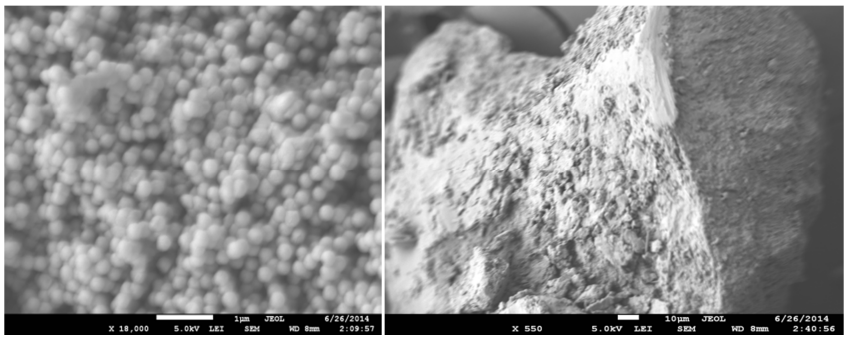


Fig.4. SEM images of PS/OSWY

3.5 XRD

XRD technique is widely used to investigate the dispersion degree of swy in matrices. Intercalated and/ or exfoliated polymer/oswy nanocomposites can be classified based on displacing of the peak in terms of the gallery height of swy. The characteristic peak of the organoswy (at 2θ=2°) was disappeared in the nanocomposites. These XRD indicate to the fact that the ordered structure of the clay was destroyed, resulting a well exfoliated morphology in the PS/oswy nanocomposites [8].

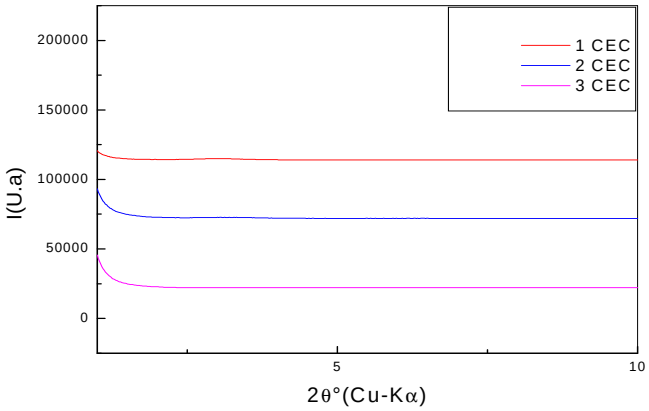


Fig. 5. XRD patterns of organo-swy

3.6 FTIR

The infrared of PS features bands at 3066, 3025, 2922, 2851, 1666-1945, 1491-1599, 1188-1368, 1026,698-756, and 543cm^{-1}[11, 9]. The infrared spectra (FT-IR) of PS /organoswy nanocomposites were recorded in the region from 400cm^{-1} - 400cm^{-1} as shown in figure.7. In these spectra, all PS bands appeared in these spectra with shight shifting. New bands appeared in the regions of 3625, 1027, and 466cm-1 were attributed to OH stretching of structural hydroxyl groups (AL-OH) and bending vibrations of organoswy and were indicating the existence of organoswy and were indicating the existence of organoswy in the PS matrix where the polymer chain was inserted between the layers of the organoswy by secondary valence force (Fig .6).

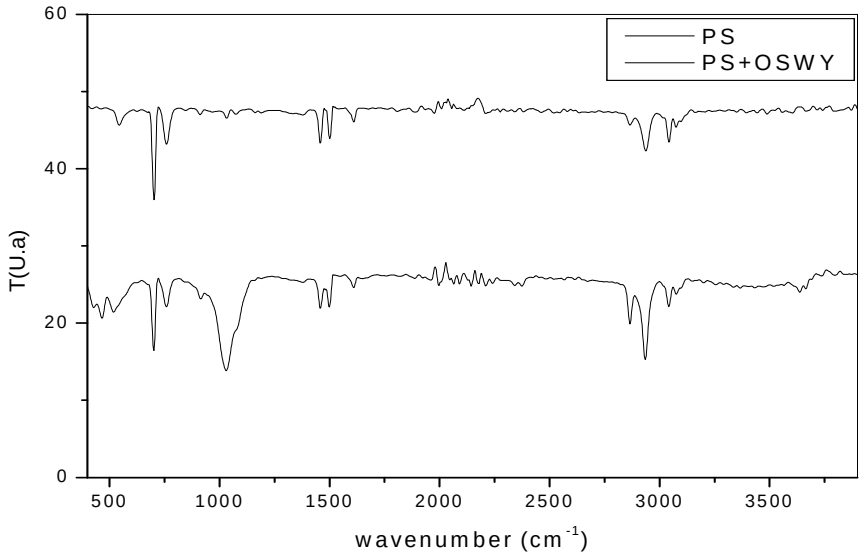


Fig.6. FTIR patterns of PS, PS/oswy

Table. I.1. Positions and assignments of the IR vibration bands of PS.

Wavenumber (cm^{-1})	*Assignement*
3066 et 3026	Stretching vibration of aromatic C-H
2922et2851	Stretching vibration of aliphatic C-H
1666-1945	Overtan and combunation bands (monosubstituted aromatic)
1491	Stretching vibration of aromatic C=C
1188-1368	Stretching vibration of aliphatic C-H
1026	Stretching vibration of aliphatic C-H
698-756, 543	Stretching vibration of aromatic C-H

3.7 DIELECTRIC RELAXATION SPECTROSCOPY.

3.7.1 THE COMPLEX DIELECTRIC FUNCTION SPECTRA

The real part (permittivity) ε' and imaginary part (dielectric loss) ε'' of the complex relative dielectric function can be seen in Fig.8 the dielectric constant of pure PS and PS/organoclay nanocomposites with different temperatures. The reduction in the dielectric constant of the PS can be explained a complicated polarization. It is clear from this figure that ε decrease by increasing organoclay concentrations. At low frequencies and higher while at higher frequencies the rate becomes very slow. An explication for this is that at low frequencies, the dipole movements and charge carriers can freely move within the material while at higher frequencies dipole and charge carriers become to follow variations of the applied electric field resulting in a dependence of tangent loss of nanocomposites [19, 20, 21, 23, 24].

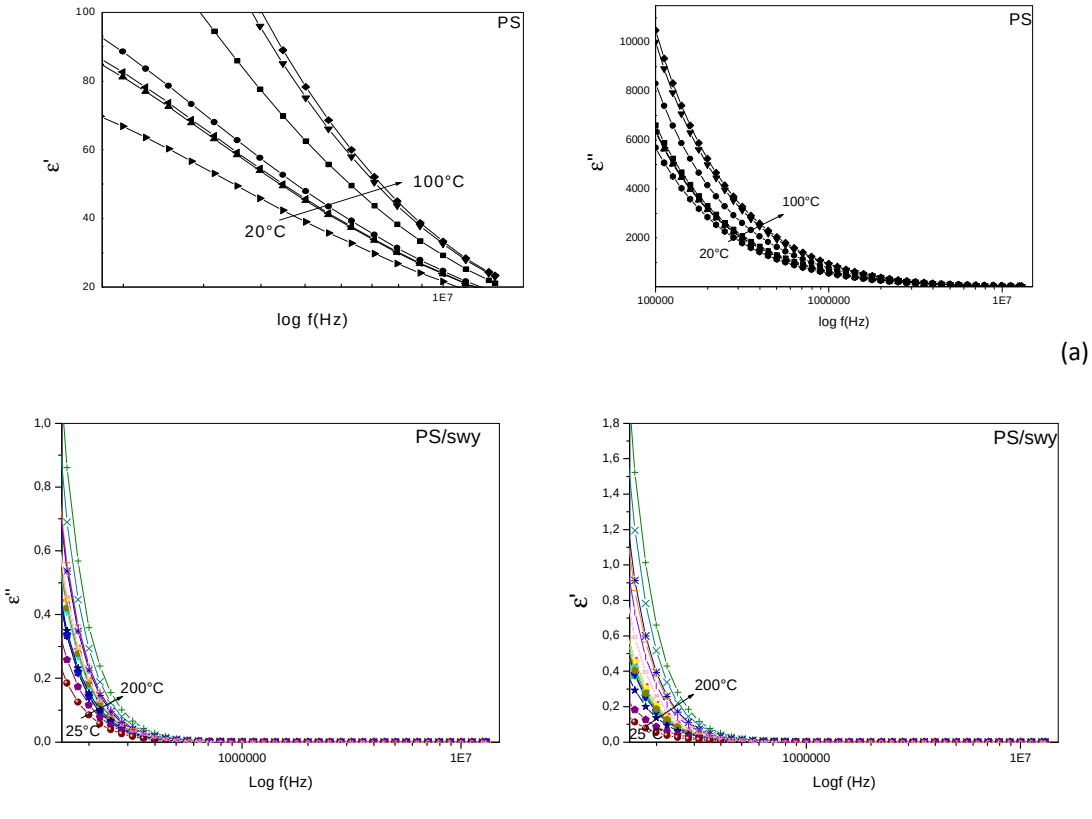


Figure.7. the dielectric constant of polystyrene (a) and nanocomposites (b) at various temperatures and frequencies

3.7.2 DIELECTRIC LOSS TANGENT SPECTRA

The dielectric loss δ of polystyrene and nanocomposites (PS/organoclay) are shown in Fig.9, it indicate that the tang loss of pure polystyrene and nanocomposites increased slightly up to 1000 Hz then rapidly decreased with frequency range suggest the existence of one or more of the following processes: (i) electrode polarization, (ii) interfacial polarization and (iii) conductivity phenomenon . This is the case in polymer matrix-inorganic filler composites due to the accumulation of mobile charges at the interface of the constituents. The Tangent losses for pure polystyrene and nanocomposites (PS/swy) are due to the dipolar relaxations at this frequency for PS/swy are readily explained by interfacial polarization between the interface of clay mineral and polymer matrix. This why interfacial polarization appears at low frequencies in the nanocomposites. This maximum tangent loss of the samples was observed at low frequencies than at high frequencies [16, 17, 18, 23], the decrease in dielectric losses is due to the intercalation and exfoliation of the clay layers.

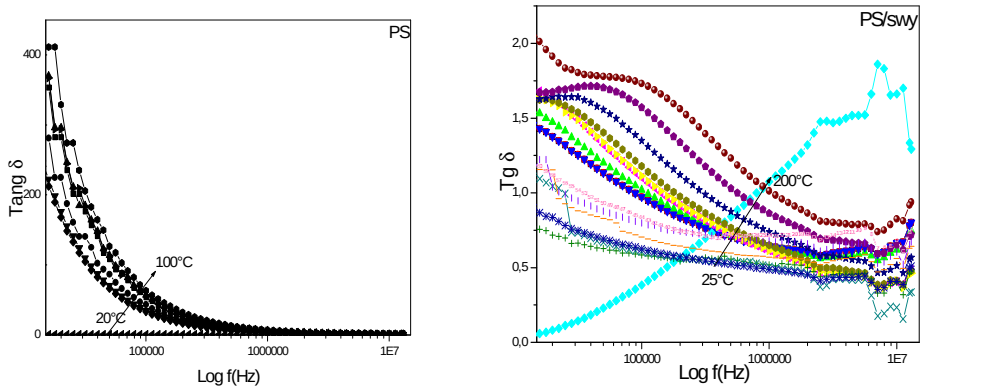


Figure.7. the dielectric loss of polystyrene (a) and nanocomposites (b) at various temperatures and frequencies

4 CONCLUSION

In conclusion the synthesized PS/oswy was characterized by XRD, FTIR, SEM methods. The results showed that the PS/swy nanocomposites have better dielectric proprieties in our experimental conditions. DRX, SEM, FTIR confirms the dispersion of nanometer silicate layers in the PS. The dielectric constants decreased with the increase of the clay content. The materials with lower dielectric constant than pure PS which can be used in particularly electric-electronic industry were obtained.

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Conodontes du Carbonifère inférieur de la région de l'Oued Cherrat (Meseta nord-occidentale, Maroc)

[Lower Carboniferous Conodonts of the Oued Cherrat area (north-western Meseta, Morocco)]

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ABSTRACT: The study of two Lower Carboniferous sections from the Oued Cherrat area (north-western Meseta, Morocco) revealed the existence of the conodonts in this area. Ten species and one subspecies from four genera (Lochriea, Gnathodus, Mestognathus and Pseudognathodus) have been determined, some of them reported from Morocco for the first time. Two conodont zonation have been recognized (*Lochriea nodosa* and *Lochriea cruciformis*) indicating for the first time the transition between the Upper Visean and the Lower Serpukhovian in this area.

KEYWORDS: Oued Cherrat, Morocco, Conodont zonation, Visean, Serpukhovian.

RESUME: L'étude de deux coupes du Carbonifère inférieur d'Oued Cherrat (Meseta nord-occidentale, Maroc) a révélé l'existence de conodontes dans cette région. Dix espèces et une sous-espèce appartenant à quatre genres (Lochriea, Gnathodus, Mestognathus et Pseudognathodus) ont été déterminées, certaines d'entre elles n'avaient encore jamais été mentionnées au Maroc. Deux zones à conodontes ont été reconnues (*Lochriea nodosa* et *Lochriea cruciformis*) indiquant le passage entre le Viséen supérieur et le Serpukhovien inférieur reconnu pour la première fois dans la région.

MOTS-CLEFS: Oued Cherrat, Maroc, Zones à conodontes, Viséen, Serpukhovien.

1 INTRODUCTION

Les conodontes se sont révélés d'un grand intérêt stratigraphique et ont permis d'établir des zonations biostratigraphiques très précises à différents étages. Ils sont devenus les microfossiles les plus utilisés pour résoudre les problèmes stratigraphiques du Paléozoïque et du Trais.

Au Maroc, les premières études biostratigraphiques (Silurien et Dévonien) à base de conodontes ont vu le jour dans l'Anti Atlas par [1]. Par la suite, plusieurs auteurs ont fait des études similaires dans ce domaine [2, 3]. Dans la Meseta marocaine, ces études ont été réalisées au Maroc central par [4] et [5]. Cependant, dans la Meseta nord-occidentale, les terrains du Silurien et du Dévonien ont été étudiés par [6], [7], [8] et [9]. En ce qui concerne le Carbonifère, aucune étude biostratigraphique à base de conodontes n'a été faite jusqu'à présent.

La biostratigraphie des séries carbonifères du Maroc a été généralement faite sur base de foraminifères [10, 11, 12, 13]. Le faite de trouver pour la première fois des conodontes dans deux coupes du Carbonifère inférieur de la région de l'Oued Cherrat, rend très intéressant de les étudiés.

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2 SITUATION GEOGRAPHIQUE ET CADRE GEOLOGIQUE

La région de l'Oued Cherrat est située à environ 55 Km au SW de Casablanca. Elle est bordée à l'Ouest par la région de Ben Slimane, au Nord par la région de Rabat, au Sud par le massif du Khatouat et à l'Est par la région de Sidi Bettache (1).

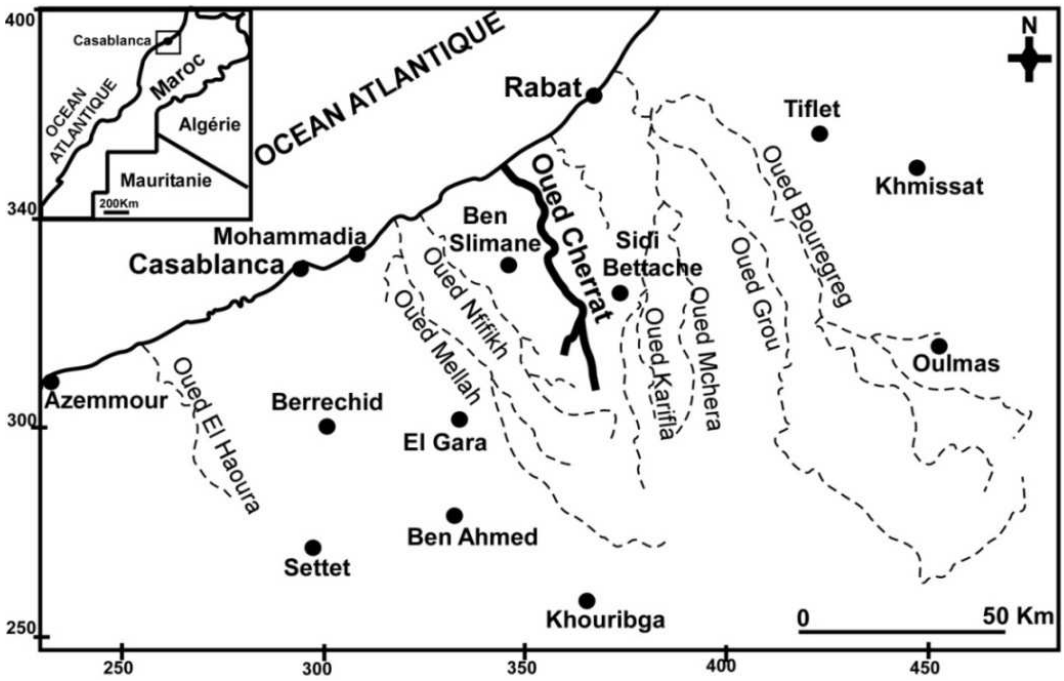


Fig.1. Localisation géographique de la région de l'Oued Cherrat.

La bande de l'Oued Cherrat est à cheval sur le Môle côtier septentrional et la partie ouest du Maroc central (2-A). Elle est caractérisée par des formations paléozoïques (siluriennes, dévoniennes et carbonifères) qui sont plissées, schistosées et fracturées [14, 15]. La séquence lithostratigraphique commence avec des schistes et des calcaires contenant les graptolites [14, 15] et les conodontes [9] d'âges silurien supérieur. Ce dernier est surmonté par des formations dévoniennes qui commencent avec des argilites, donnant lieu graduellement à des formations carbonatées et se terminant avec des conglomérats transgressifs. Ces conglomérats sont coiffés par des formations carbonifères qui constituent essentiellement par des grés, pélites et calcaires (2-B).

3 MATÉRIEL ET MÉTHODES

Généralement, le poids des échantillons de calcaires ou calcaires dolomitiques prélevés est de l'ordre de 1 à 3 kilogramme. Parmi les 63 échantillons traités seuls 16 échantillons, dans les deux coupes, ont livré des éléments conodontes. Ces échantillons ont été traités par des acides faibles (acétique ou formique) à 10% durant 48 heures, puis le résidu obtenu est observé sous la loupe binoculaire. Les déterminations des conodontes ont été faites par Carine RANDON (Université Pierre et Marie Curie à Paris, France).

La photographie des conodontes a été réalisée au microscope électronique à balayage (MEB) au Centre National de Recherche Scientifique et Technique à Rabat (CNRST).

4 ETUDE DES COUPES

Cette étude est basée sur deux coupes affleurent le long de l'Oued Cherrat (2) :

4.1 LA COUPE DE SOUK EL HAD

Elle est située le long de la piste qui descend de Souk El Had vers l'Oued Cherrat (2). Les coordonnées lambert correspondant sont : x = 346,9 et y = 357,25 (feuille de Bouznika au 1/50000^{e}). Cette série correspond au deuxième membre de la formation de Mechraa Kraret [15].

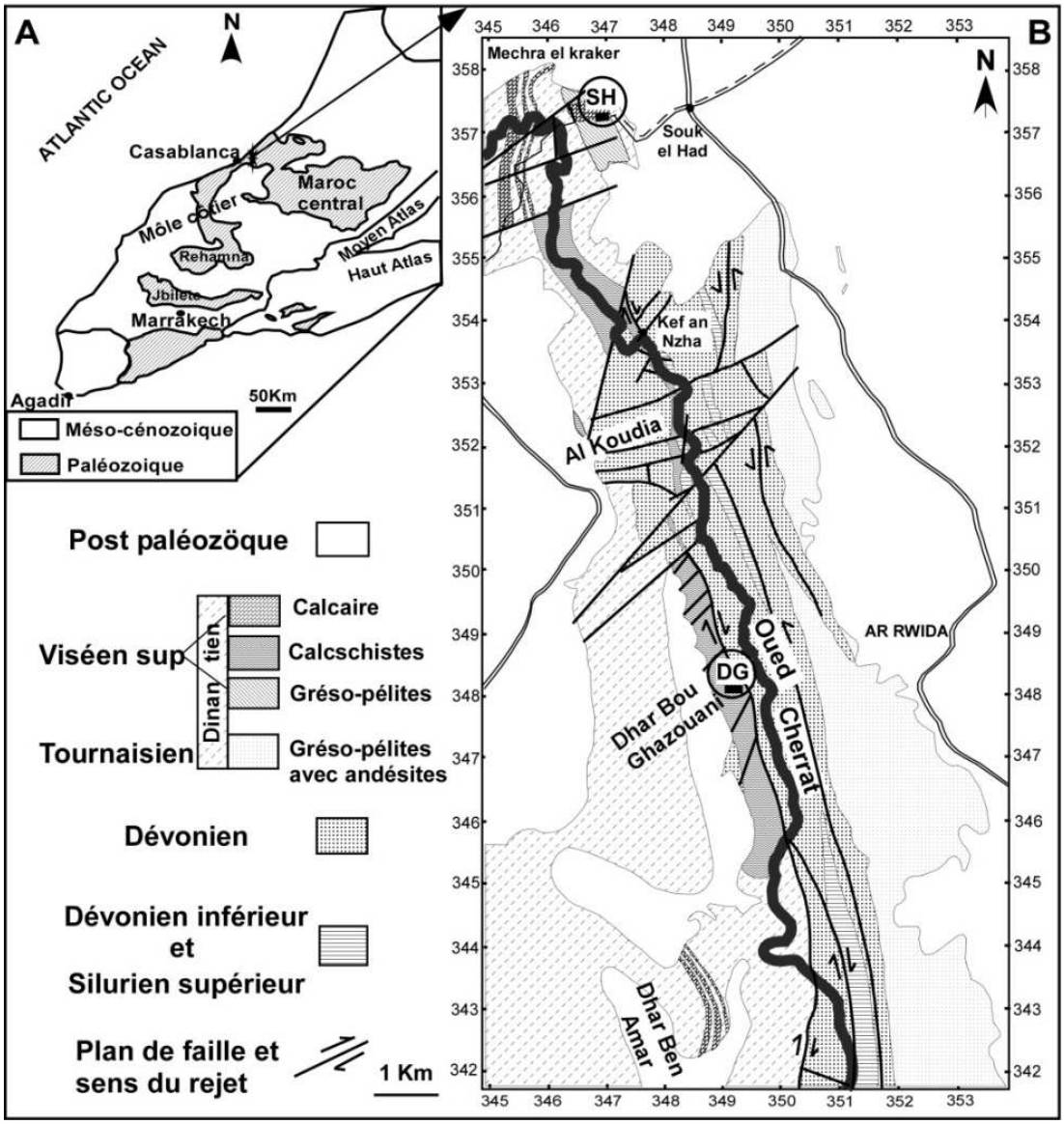


Fig.2. Contexte géologique de la zone d'étude : A-Carte schématique de la Meseta occidentale ; B-Carte géologique de la partie nord de l'Oued Cherrat [14]. SH : coupe de Souk el Had ; DG : coupe de Dhar bou Ghazouani.

Les terrains viséens de l'Oued Cherrat ont été étudiés par Kelling & Mullin (1975), [16, 14, 15]. Ce dernier a développé l'étude sédimentologique de ces terrains en apportant des précisions micropaléontologiques.

Cette coupe se présente, sur environ 13 m d'épaisseur, sous forme de deux unités (3):

-Unité A : 10 m de pélites noirs avec des intercalations de bancs centimétriques à décimétriques de calcaires gris et quelques bancs gréseux. Les bancs calcaires sont micritiques de type wackestone à packstone riche en organisme (tentaculites, foraminifères, crinoïdes, ostracodes, coraux, bivalves, bryozoaires, oolites et quelques débris d'algues). Cette unité a livrée des conodontes: *Lochriea commutata* [17], *Lochriea mononodosa* [18], *Lochriea nodosa* [19], *Lochriea cruciformis* [20], *Lochriea sp, Gnathodus praebilineatus* [21], *Gnathodus girtyi meischneri* [22], *Gnathodus bilineatus* [23] et *Gnathodus sp.*

-Unité B : 3 m d'une alternance de calcaires métriques gris et de pélites noirs. Ces calcaires renfermant de tentaculites, foraminifères et crinoïdes et sont de type wackestone. Ils ont fourni *Mestognathus bipluti* [24].

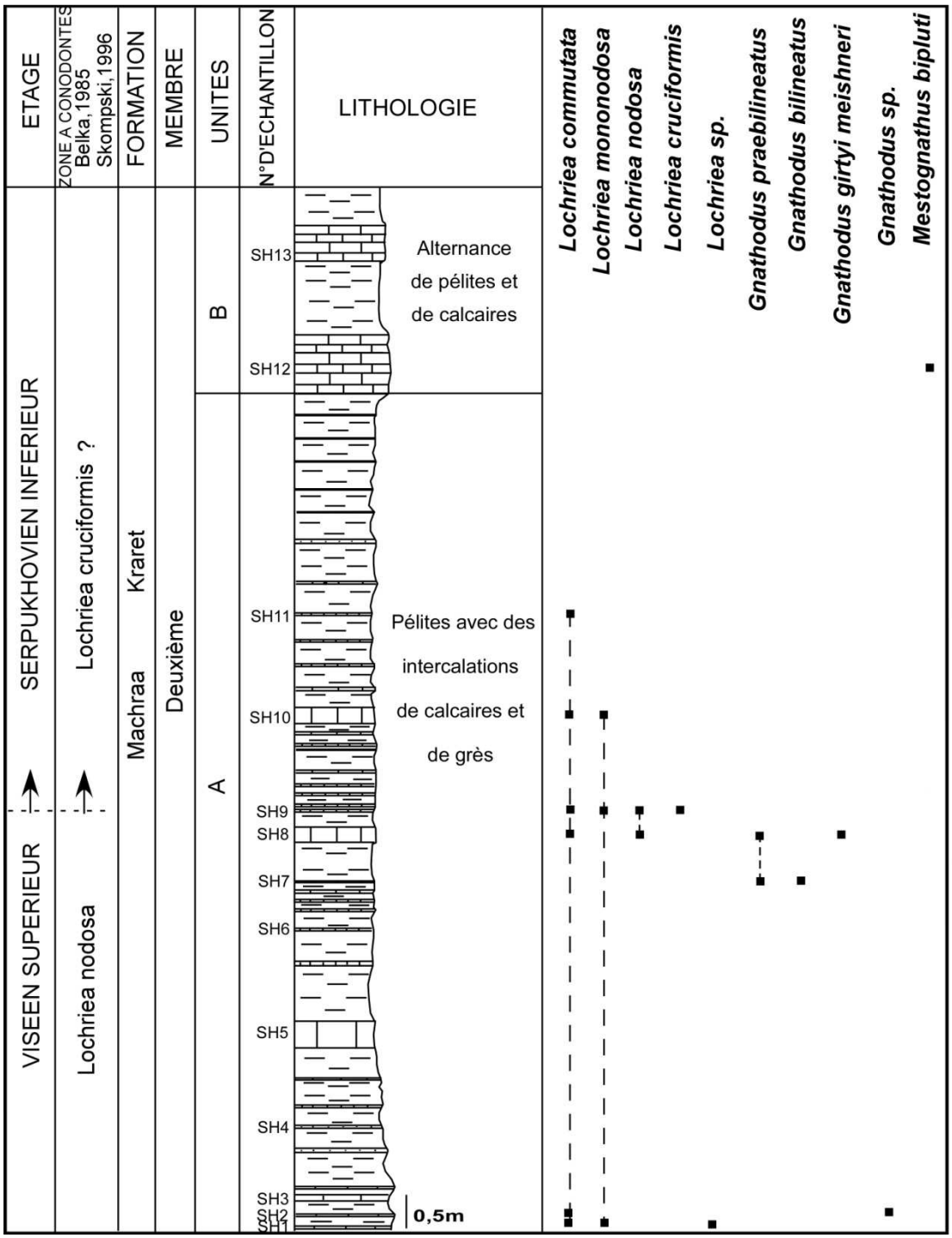


Fig.3. Répartition stratigraphique des conodontes du Viséen supérieur/Serpukhovien inférieur de la coupe de Souk El Had (Région d'Oued Cherrat).

4.2 LA COUPE DE DHAR BOU GHAZOUANI

Cette coupe est située à environ neuf kilomètres au Sud de la coupe précédente, sur la rive gauche de l'Oued Cherrat (2). Les coordonnées lambert sont : x = 349,25 et y = 348 (feuille de Benslimane au 1/50000e). Elle montre sur environ une centaine de mètres, des bancs calcaires alternant avec des niveaux schisteux. Cette série appartient à la formation de Kef an Nzaha [14]. Ce dernier a considéré, d'une manière générale, les calcaires de Dhar bou Ghazouani comme étant du Viséen supérieur, grâce à la présence d'une association de brachiopodes (*spiriferidae, schellwiennella sp, buxtonia sp, athyridae* et *gigantoproductus sp*) et de foraminifères (*planoarchaediscus* et *endothyra*).

Les échantillons examinés (4) sont de calcaires micritiques de type packstone plus ou moins dolomitisés et renfermant une faune riche en tentaculites, foraminifères, crinoïdes, brachiopodes, lamellibranches, bryozoaires, bivalves, oolites et débris d'algues. La microfaune de Conodontes trouvée est représentée par *Lochriea saharae* [25], *Lochriea commutata* [17], *Lochriea nodosa* [19], *Gnathodus girtyi* [26], *Gnathodus girtyi meischneri* [22], *Pseudognathodus homopunctatus* [27], *Gnathodus sp* et *Mestognathus bipluti* [24].

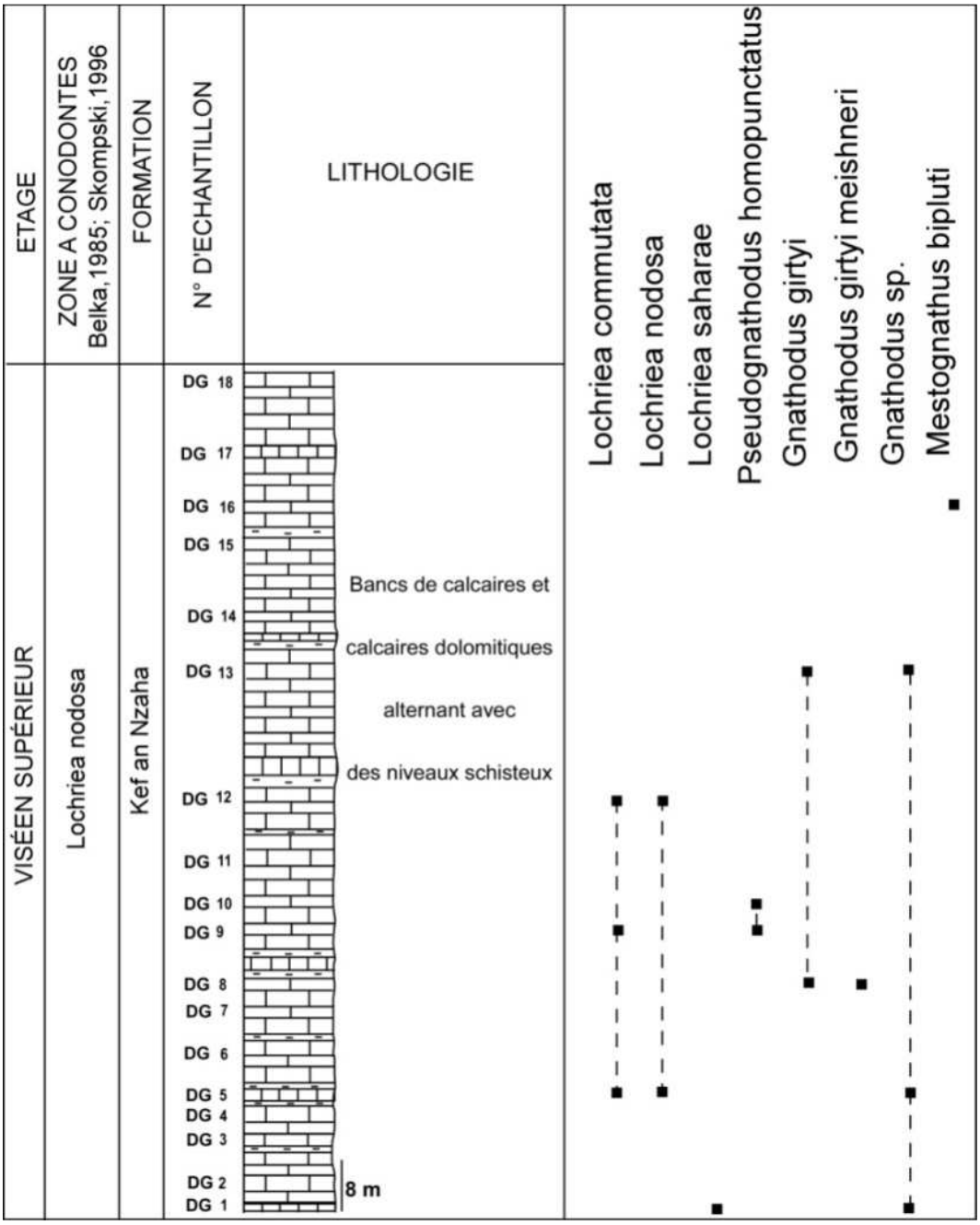


Fig.4. Distribution stratigraphique des conodontes du Viséen supérieur de Dhar Bou Ghazouani (Région d'Oued Cherrat).

5 RÉSULTATS ET DISCUSSION

Seuls les éléments plateformes trouvés ont été attribués à un genre, voire une espèce précise. L'analyse des éléments conodontes obtenus au niveau des deux coupes (5), a permis d'identifier dix espèces et une sous-espèce réparties en quatre genres (Lochriea, Gnathodus, Mestognathus et Pseudognathodus). Les deux premiers genres, qui caractérisent les environnements marins ouverts et relativement profonds, sont plus abondants que les autres.

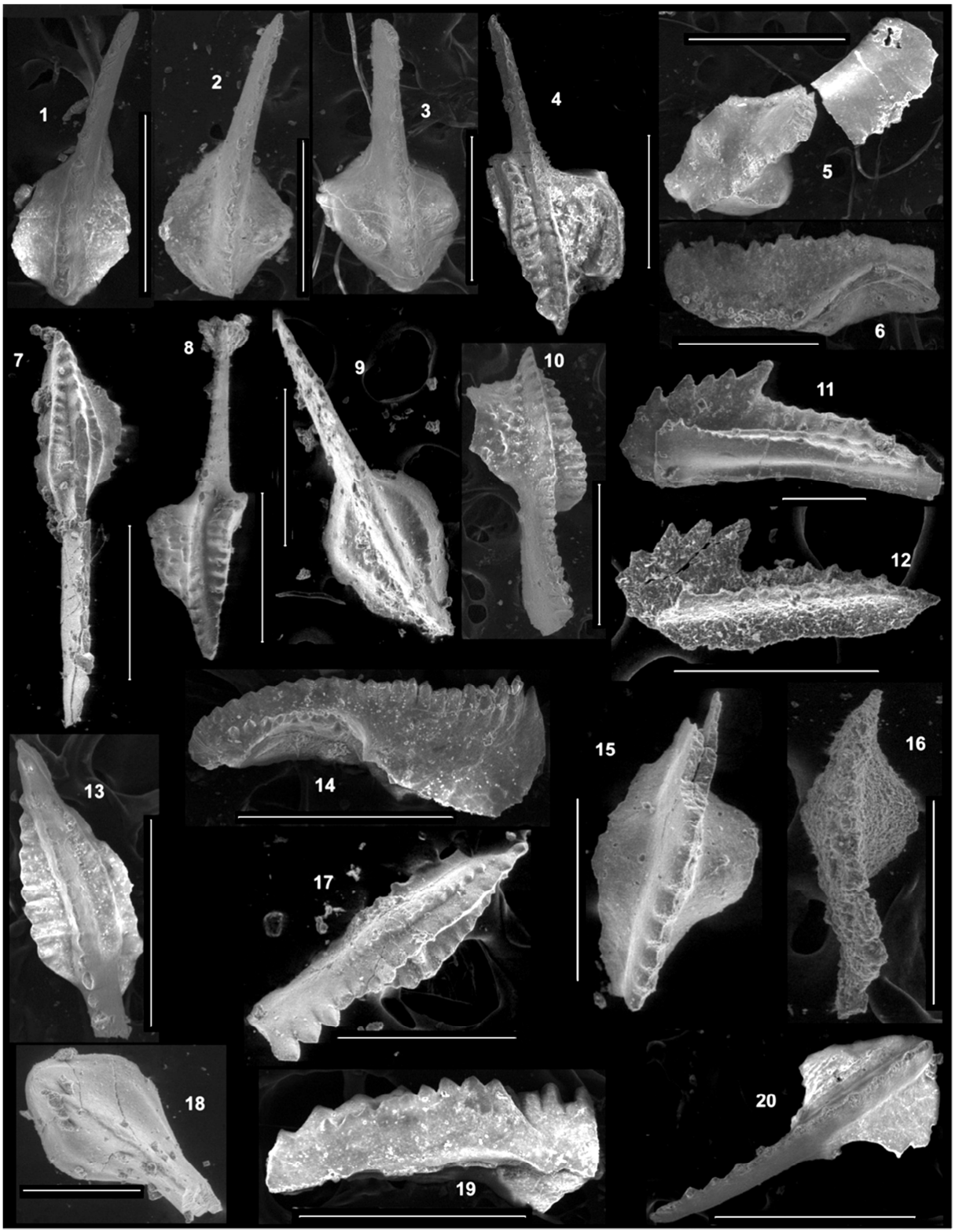


Fig. 5. Les conodontes de l'Oued Cherrat. 1, 15, 18, 20 : Lochriea commutata [17], éléments Pa, vue orale; 1 (éch. SH2. 400µm), 15 (éch. DG9. 300µm), 18 (éch. DG12. 300µm), 20 (éch. SH9. 400µm). 2, 6 : Lochriea mononodosa [18], élément Pa, 500µm; 2 (éch. SH2. vue orale), 6 (éch. SH2. vue latérale). 3 : Lochriea nodosa [19], élément Pa, vue orale, éch. SH8. 500µm. 4 : Gnathodus bilineatus [23], éléments Pa, vue orale, éch. SH7. 500µm. 5 : Lochriea cruciformis [20], élément Pa, vue orale, éch. SH9. 500µm. 7, 13, 19 : Gnathodus girtyi meischneri [22], éléments Pa ; 7 (éch. DG5. vue orale. 500µm), 13 (éch. SH8. vue orale. 400µm), 19 (éch. SH8. vue latérale. 400µm). 8, 10, 14 : Gnathodus praebilineatus [21], élément Pa ; 8 (éch. SH7. vue orale. 500µm), 10 (éch. SH8. vue orale. 400µm), 14 (éch. SH8. vue latérale. 500µm). 9 : Pseudognathodus homopunctatus [27], élément Pa, vue orale, éch. DG10. 400µm. 11, 12 : Mestognathus bipluti [24], élément Pa, vue latérale ; 11 (éch. SH12. 200µm), 12 (éch. DG14. 300µm). 16 : Lochriea saharae [25], élément Pa, vue orale, éch. DG1. 300µm. 17 : Gnathodus girtyi [26], élément Pa, vue orale, éch. DG13. 400µm.

La lignée de Lochriea est mieux représentée puisqu'on y retrouve la plupart des espèces connues durant le Viséen supérieur/Serpukhovien (*Lochriea saharae, Lochriea commutata, Lochriea nodosa, Lochriea mononodosa* et *Lochriea cruciformis*). On constate également que les formes ornées comme *Lochriea mononodosa*, *Lochriea nodosa* et *Lochriea cruciformis* sont dominants par rapport à celles qui sont lisses telles que *Lochriea saharae* et *Lochriea commutata*.

Le genre Gnathodus est représenté par *Gnathodus bilineatus, Gnathodus Praebilineatus, Gnathodus girtyi* et par la sous-espèce *Gnathodus girtyi meishneri*. Le genre Mestognathus est présent dans les derniers niveaux, alors que le genre Pseudognathodus est présent uniquement dans la deuxième coupe.

L'association des espèces de *Lochriea nodosa, Lochriea commutata, Lochriea mononodosa, Lochriea saharae, Gnathodus praebilineatus, Gnathodus Girtyi meishneri, Pseudognathodus homopunctatus* et *Mestognathus bipluti*, dans les deux coupes, indique la zone à *Lochriea nodosa* [21, 28] qui caractérise la fin du Viséen supérieur. Elle a été rencontrée presque avec la même association au NW de l'Espagne [29, 30], à l'Oural en Russie [31] et au Sud de la Chine [32]. Dans la coupe de Souk El Had, la limite supérieure de cette zone coïncide avec l'entrée de *Lochriea cruciformis* qui caractérise la zone à *Lochriea cruciformis* [28]. L'apparition de cette espèce indique la base du Serpukhovien comme cela a été proposé par [33], mais l'espèce marqueur de la base du Serpukhovien inférieur la plus utilisée selon [30] c'est *Lochriea ziegleri* [34]. Cependant, ces deux espèces apparaissent presque ensemble à la limite du Viséen supérieur/Serpukhovien, avec une première apparition de l'une à l'autre. *Lochriea cruciformis* apparaît avant Lochriea ziegleri en Allemagne [35] et après *Lochriea ziegleri* en Angleterre et en Espagne (Montagnes Cantabriques) [30]. *Lochriea ziegleri* est beaucoup plus abondante et se distingue très facilement par rapport à *Lochriea cruciformis*, c'est la raison pour laquelle on considère *Lochriea ziegleri* comme espèce index de la base du Serpukhovien.

6 CONCLUSION

Les séries du Carbonifère inférieur de l'Oued Cherrat (Meseta nord-occidentale, Maroc) ont été attribuées au Viséen supérieur. La présence de *Lochriea cruciformis*, dans la coupe de Souk el Had (région de l'Oued Cherrat), indique pour la première fois l'existence du Serpukhovien inférieur dans cette région. Des affinités des microfaunes à conodontes du Carbonifère inférieur de la Meseta Nord-occidentale avec celles de l'Europe et de l'Asie sont reconnues.

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Effect of heat treatment on optical properties of Cadmium Zinc Telluride thin films grown by cathodic radiofrequency sputtering

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ABSTRACT: Cadmium zinc telluride thin films were prepared by cathodic radio frequency sputtering from cadmium telluride and zinc telluride targets. The films deposited on glass substrates were annealed in vacuum at different temperatures (300 °C – 400 °C). Structural properties of Cadmium zinc telluride were studied using X-ray diffraction; the effects of heat treatment temperature on the optical properties were investigated through optical transmission. It was found that all annealed films were polycrystalline with preferential (111) orientation. The grain size increases as the annealing temperature increases. The optical transmission data showed that annealed films exhibit high transmission. The band gap and the refractive index changed with increase in annealing temperature.

KEYWORDS: $Cd_{1-x}Zn_xTe$ thin films, CdTe, ZnTe, Cathodic rf-sputtering, annealing temperature.

1 INTRODUCTION

The ternary compounds cadmium zinc telluride, with the chemical formula $Cd_{1-x}Zn_xTe$, are II-VI semiconductors which have attracted increasing interest for their wide application in a variety of optoelectronic devices such as photovoltaic cells [1], [2], [3], light emitting diodes [4], radiation detector [5], [6], [7], infrared, X-ray imaging [8], gamma rays detectors [9]. The band gap of $Cd_{1-x}Zn_xTe$ can be tailored in the range of 1.45 to 2.26 eV by controlling its composition, therefore, $Cd_{1-x}Zn_xTe$ has emerged as a leading candidate for tandem solar cells [10].

$Cd_{1-x}Zn_xTe$ thin films have been successfully grown by a variety of techniques such as radio frequency sputtering [11], chemical vapour deposition [12], molecular beam epitaxy [13], vacuum thermal evaporation [14], tow-stage process [15], and electrodeposition [16]. All of these methods of film preparation have their inherent advantages and disadvantages. In the last decade, there has been an increased interest in the study of physical properties of Cd1-xZnxTe thin films for the above mentioned applications [17], [18], [19], [20].

In this paper we focus on the preparation and characterization of $Cd_{1-x}Zn_xTe$ thin films for optoelectronic device. Attention was paid to the influence of heat treatment temperature on optical properties of $Cd_{1-x}Zn_xTe$ thin films grown by sequential radio frequency sputtering.

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2 EXPERIMENT

The Cd1-xZnxTe thin films were prepared by cathodic radio frequency sputtering from a cadmium telluride (CdTe) and zinc telluride (ZnTe) commercial targets of high purity (99.99 %) in a vacuum chamber and onto corning glass substrates degreased and ultrasonically cleaned.

The glass substrates were maintained at ambient temperature during the growth. The vacuum chamber was evacuated to a final pressure of 10^{-6} Torr. During sputtering, the argon pressure was 2 x 10^{-2} Torr and the incident radio frequency power was maintained at 100 W (CdTe) and 300 W (ZnTe). Under these conditions, the deposition rate was 300 Å/min and 630 Å/min for CdTe and ZnTe respectively. The targets were pre-sputtered for 10 min. The films were subsequently annealed in vacuum at 300, 350 and 400 °C for 2 hours.

The structural properties of Cd1-xZnxTe thin films were investigated by X-ray diffraction technique (XRD) by means of an Xpert MPD Difractometer system with CuKα radiation. Optical transmittance measurements were performed using a Shimadzu UV-PC spectrophotometer in the 200 – 3200 nm wavelength range.

3 RESULTS AND DISCUSSION

X-ray diffraction carried out on as-deposited films show two phases assigned to the binary CdTe and ZnTe (Fig. 1.a).When the samples undergo an annealing at 300, 350 and 400 °C in vacuum during 2 hours, we note on the spectra the absence of the CdTe and ZnTe phases and the appearance of diffraction peaks associated with (111), (220) and (311) reflections of Cd1-xZnxTe of orientation (Fig. 1.b-d). All annealed films have a preferential growth in the (111) direction with cubic structure.

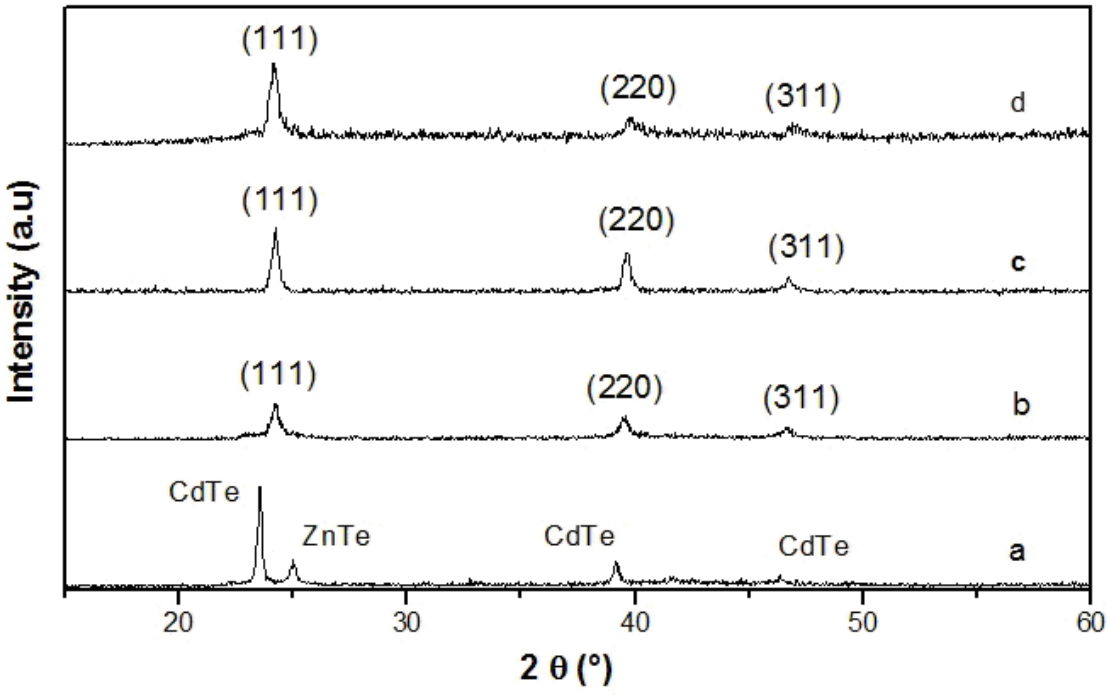


Fig.1. XRD patterns of: (a) as-deposited films; (b-d) annealed at 300; 350 and 400 °C respectively for 2 hours.

Table 1 shows the full width at half maximum (FWHM) of the (111) peaks, and crystallite size calculated from Sherrer's relationship for the cubic system [21]. The composition of Zn in the film is determined from Vegard's law [12].We note on this table that the crystallite size increases as the annealing temperature increases.

Table 1. full width at half maximum (FWHM), crystallite size and alloy composition of $Cd_{1-x}Zn_xTe$ annealed at different temperatures

Annealing temperature	Composition (x)	FWHM (111) (°)	Crystallite size (Å)
300 ° C	0.3	0.3764	27.77
350 ° C	0,26	0.3640	28.74
400 ° C	0,18	0 .3149	34.64

Figure 2 shows the normalised transmittance spectra of $Cd_{1-x}Zn_xTe$ films annealed at different temperatures. The measurements show that the $Cd_{1-x}Zn_xTe$ films exhibit a high transmission with a sharp drop at the end of the strip which indicates a good crystallinity of these layers. From these spectra the absorption coefficient α and refractive index were obtained as a function of the photon energy hυ and the wavelength λ.

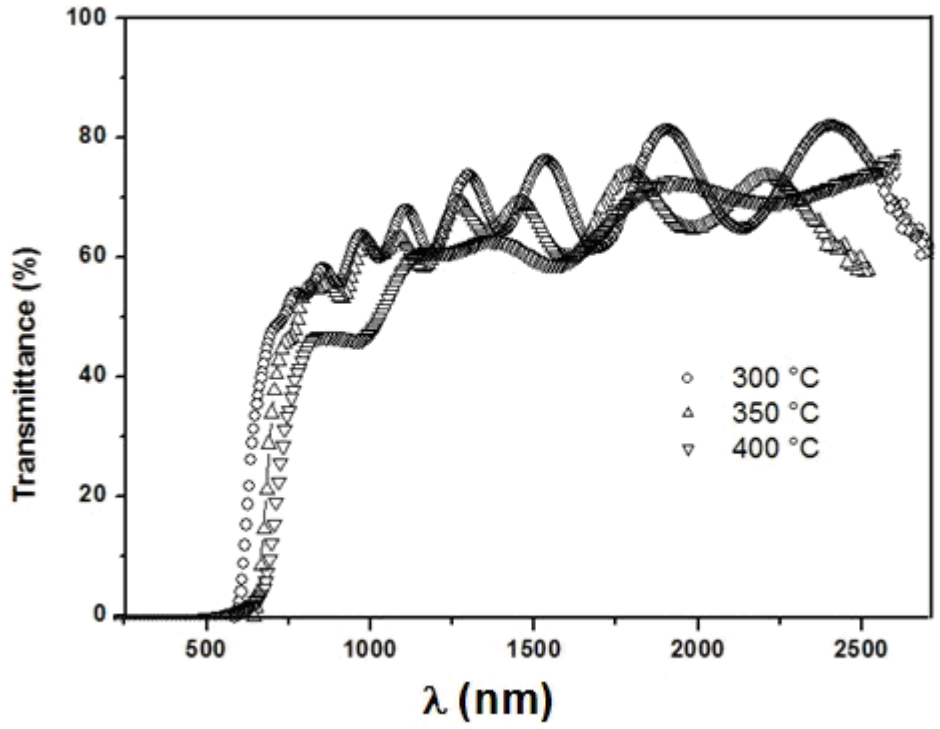


Fig.2. Normalized transmittance spectra of Cd1-xZnxTe films annealed at different temperatures

Figure 3 represents the variation of $(\alpha h\upsilon)^2$ as a function of the energy hυ. The value of the energy band gap is obtained from the extrapolation of the curve to the energy axis. The obtained band gap energies are 1.64, 1.61 and 1.53 eV, respectively for the films annealed at 300, 350 and 400 °C. We note from this figure that the value of the band gap energy decreases as the annealing temperature increases. This variation of the band gap energy can be explained by the increase in particle size due to the quantum effect of the size, a similar observation was made on thin films of CdTe and ZnTe [22].

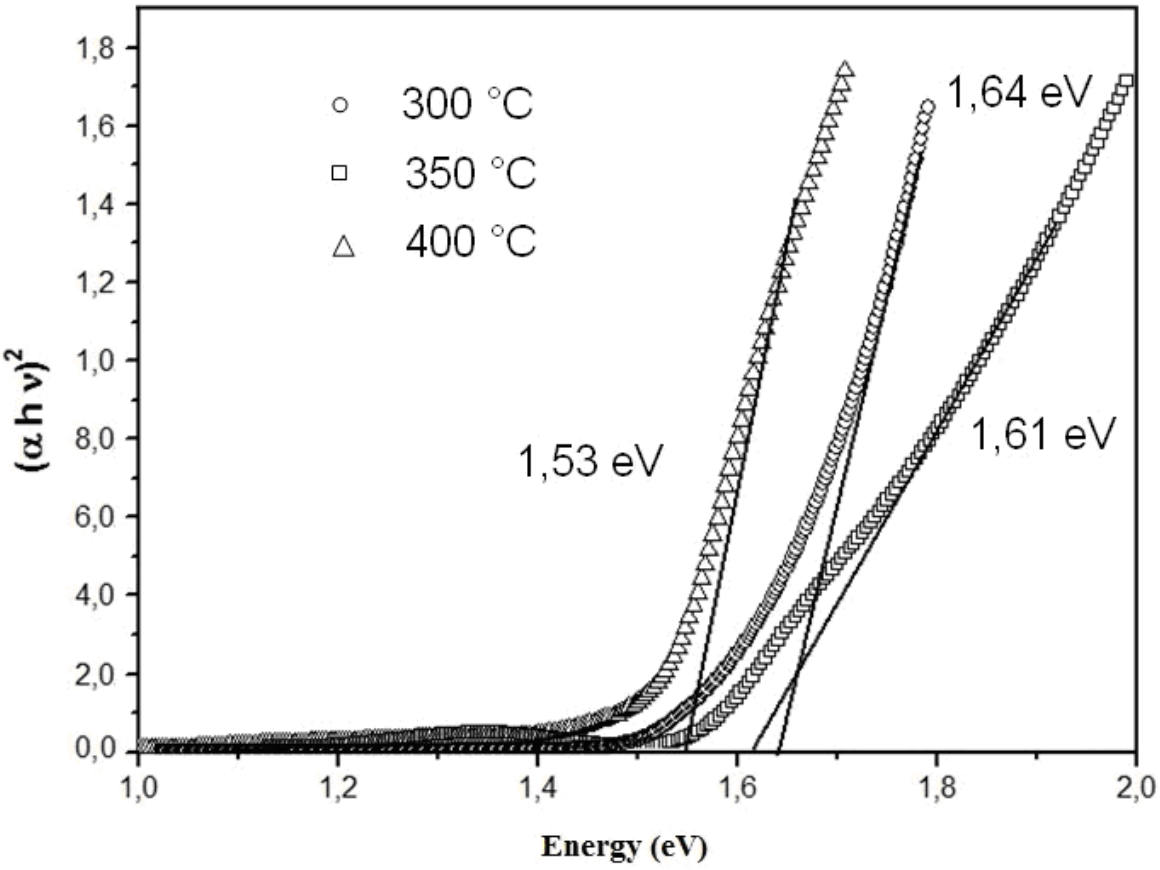


Fig.3. Variation of $(\alpha h\nu)^2$ as a function of photon energy (hν) for $Cd_{1-x}Zn_xTe$ thin films annealed at different temperatures

Figure 4 shows that the variation of the refractive index with the wavelength λ of $Cd_{1-x}Zn_xTe$ films annealed at different temperatures follows Sellmeier's law [23], and varies as the annealing temperature varies. This variation correlates well with observed changes in the crystallite size and the band gap energies of these films.

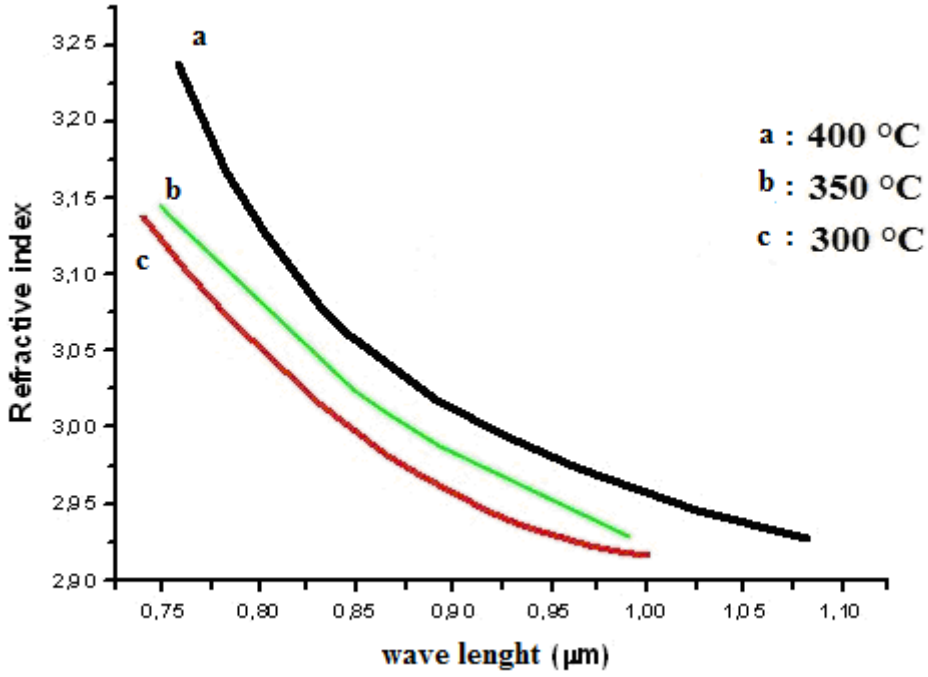


Fig.4. Variation of refractive index versus wavelength for Cd1-xZnxTe films annealed at different temperatures

4 CONCLUSION

In this work, we have investigated the effect of heat treatment on optical properties of Cadmium Zinc Telluride thin films grown on glass substrates by cathodic radio frequency sputtering from Cadmium telluride and Zinc telluride targets and then annealed in vacuum at 300, 350 and 400 °C for 2 hours. XRD characterization and optical transmission data show that crystallite size increases with annealing temperature increase, also direct band and refractive index varied with annealing temperature increase which can be explained by the increase in particle size due to the quantum effect of the size. However, all films remain strongly oriented along (111) direction with cubic structure.

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Improvement of Fetal Electrocardiogram Extraction by Application of Fuzzy Adaptive Resonance Theory to Adaptive Neural Fuzzy System

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ABSTRACT: non-invasive fetal electrocardiogram (FECG) signal extraction from signals recorded at abdominal area of mother is a challenging problem for the biomedical and signal processing communities. In this paper, we improve the FECG extraction approaches which consist to find the relation-ships between the cardiac potentials generated at the heart level of mother and the potentials recorded on the abdominal area. We used an efficient signal processing method combining a hybrid learning algorithm based on the fuzzy adaptive resonance theory and the hybrid soft computing technique called Adaptive Neuro Fuzzy Inference System (ANFIS) trained with modified Particle Swarm Optimization (PSO) endowed with an initialization strategy to adjust the antecedent parameters of fuzzy rules. We implemented our algorithm and other algorithm on simulated signals, and we found that the proposed ANFIS with hybrid learning algorithm achieves superior performance in learning accuracy and allowed yielding best processing results to extract the FECG signal.

KEYWORDS: Fetal ECG, ANFIS, ART, PSO, AECG, MECG.

1 INTRODUCTION

Estimation of the fetal electrocardiogram signal is a classical problem in medical engineering. The signal FECG reflects the electrical activity of the fetal heart and contains information on the health status of the fetus. Consequently, its extraction can help children's heart disease specialist to evaluate the health and condition of the fetus during delivery or after birth.

Many active research projects explored FECG signal processing, and one of the early processing works is that of M. Cremer [1] who used galvanometric apparatus to observe fetal electrocardiogram signal, but with the developments in computer science and signal processing techniques, automatic signal processing and adaptive filtering techniques were used such as matched filtering [2], adaptive filtering [3], IIR adaptive filtering combined with genetic algorithms [4], and least square error fittings [5] have also been used for this purpose. Note that the existing adaptive filtering methods for maternal ECG artifact removal require a reference maternal ECG channel that is morphologically similar to the contaminating waveform, or require several linearly independent channels to roughly reconstruct any morphologic shape from the three references [6]. Also, the linear decomposition methods proposed wildly such as blind source separation [7], singular value decomposition [8], and wavelet transforms [9]. However, linear decomposition methods are limited for nonlinear or degenerate mixtures of signal and noise. In fact, fetal signals and other interferences and noises are not always linearly separable, Accordingly, an important aspect of non linear FECG signal processing exist such as fuzzy logic [10], dynamic neural network [11], polynomial network [12], adaptive neuro fuzzy logic technique [13].

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In this paper, we suggest a method combining a hybrid learning algorithm based on the fuzzy adaptive resonance theory and the neuro fuzzy inference system trained with modified particle swarm optimization endowed with an initialization strategy to improve the performance of the traditional PSO.

The rest of the paper is organized as follows. Section 2, it details the FECG signal extraction model; Section 3 explains the methodology of the research including some subsections. Section 4 discusses the results of the performance of the proposed algorithm on simulated signals. Finally, section 5 summarizes the main conclusions and results of this work.

2 FECG SIGNAL EXTRACTION MODEL

In this work, the objective is to improve the approaches which consist to find relation-ships between maternal electrocardiograms (MECG) generated at the mother thorax and the maternal ECG measured at the abdominal area (AECG), because these relation-ships are the key to extract FECG signal from AECG signal by weakening the power of MECG signal components as far as possible. The MECG components travel from their source, i.e. mother's heart, to the abdomen, and this causes its distortion which it can be taken as unknown transformation applied on MECG signal components. By finding this transformation, we can extract a good approximation of FECG signal.

Fig. 1 can be summarized in the equations 1 and 2:

$$AECG = \overline{MECG} + FECG + Noise \quad (1)$$

$$\overline{MECG} = T(MECG) \quad (2)$$

Where the T models a path through which MECG signal passes from thoracic area to the abdominal area, where the signal is recorded.

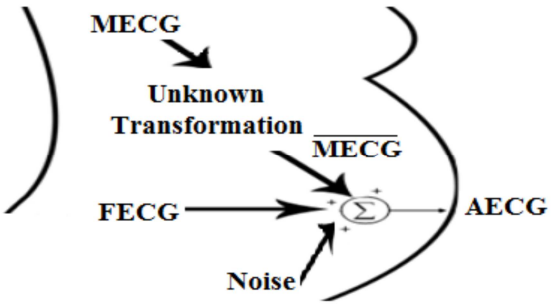


Fig. 1. Recording and formation of thoracic and abdominal signals

3 THE ADAPTIVE NEURAL FUZZY SYSTEM

The modeling systems based on general mathematical tools (like differential equations) is not an appropriate tool to model human knowledge. On the contrary, a fuzzy inference system, using if-then rules, is able to model qualitative aspects of human knowledge and rational process without using precise quantitative analyses. This fuzzy modeling or fuzzy diagnosis has been investigated by Takagi et al. in 1985, but implementing some of the basic aspects of this type of approaches needed a more complete understanding. Accordingly, Jang et al. in 1997 proposed a new architecture called ANFIS to implement a set of rules with appropriate membership functions for producing specific input and output pairs. In this section, the fundamental of ANFIS model is presented with some modification.

3.1 THE STRUCTURE OF ANFIS

There are many advantages in using ANFIS for training patterns and detection as compared to linear systems or neural networks. These advantages results from the combination of the capabilities of neural network and fuzzy systems in learning non-linear models. Moreover, the requirements and the primary assumptions of ANFIS structure are less and it is simpler than neural networks.

ANFIS based architecture is illustrated in fig. 2. It should be noted that, in this figure, the circle represents a stable node (the parameters do not change during training) and the square represents adaptive node (the parameters change during training).

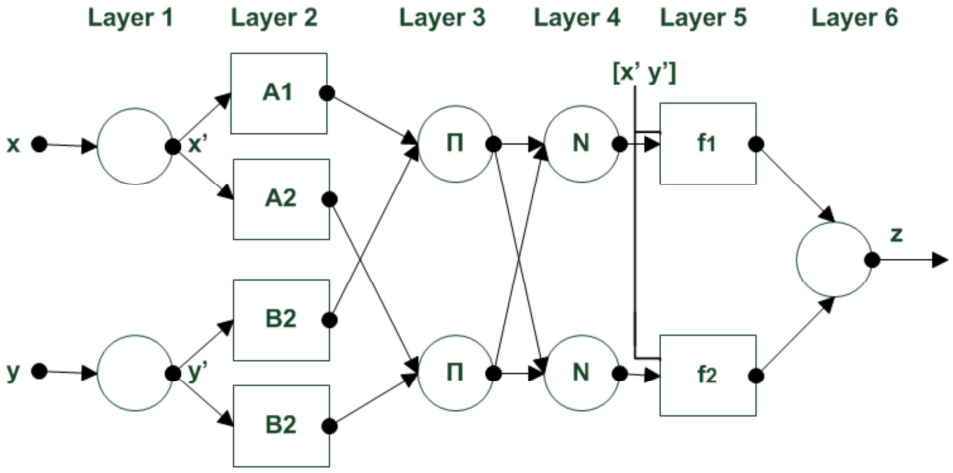


Fig. 2. ANFIS Architecture

Layer 1: This layer consists to use of the technique of complement coding to normalize the input training data and helps avoiding the problem of category proliferation for data clustering. The complement coding is a normalization process that rescales an N-dimensional vector in $\Re^n$, x = (x_1, x_2, …,x_n) , to its 2N-dimensional complement coding form in $[0, 1]^{2n}$, x', such that

$$x' = [\overline{x}_1, 1-\overline{x}_1, \overline{x}_2, 1-\overline{x}_2, \ldots, \overline{x}_n, 1-\overline{x}_n] \text{ , with } [\overline{x}_1, \overline{x}_2, \ldots, \overline{x}_n] = \overline{x} = x/\|x\| \quad (3)$$

The output function of the first layer is noted as $O_{1,i}$ for i = 1, 2.

Layer 2: This layer (membership layer) receives the complement coded input values from the first layer and calculates the fuzzy sets of the respective input variables. Here we use trapezoidal membership function with parameters u and v. More details on how this membership function works on the real N-dimensional space combining the n inputs can be found in [14]. The output function of this layer is noted as $O_{2,i}$.

Layer 3: Each node in this layer performs a fuzzy-AND operations using the T-norm operator of the algebraic product. The result to each node's output being the product of all of its inputs and represents the level of each rule or the firing strength of the corresponding fuzzy rule. The output of the product layer is noted as

$$o_{3,i} = w_i \quad (4)$$

Layer 4: This layer normalizes the activation values of all fuzzy rules, the normalized output is computed for the ith node as the ratio of the ith rule's firing strength to the sum of all rule's firing strengths as follows

$$o_{4,i} = \frac{w_i}{w_1 + w_2} \quad (5)$$

Layer 4: This layer provides the output values resulting from the inference of rules; this represents another set of parameters for the neuro fuzzy network. The output of this layer is computed according to the formula

$$o_{5,i} = o_{4,i}.(f_i = p_i x + q_i y + r_i) \quad (6)$$

Where p_i, q_i and r_i are the linear or consequent parameters of the corresponding node i.

Layer 6: This layer is called as the output layer which sums up all the inputs coming from the layer 5 and returns the overall output using the following fixed function

$$o_{6,i} = \frac{\sum w_i f_i}{w_1 + w_2} \quad (7)$$

3.2 THE STRUCTURE LEARNING

Initial fuzzy rules are obtained in the phase of structure identification using fuzzy adaptive resonance theory. We have used the codes [15] and [16] to find the input membership function parameters u and v, and also to find proper input-space fuzzy clustering; the degree of association is strong for data within a fuzzy cluster and weak for data in different fuzzy clusters. Then, a fuzzy IF–THEN rule describing the distribution of the data in each fuzzy cluster is obtained.

Initially, for each complement coded input vector, the values of choice functions T_j are computed by

$$T_j(x') = \frac{\left|x' \wedge w_j\right|}{\alpha + \left|w_j\right|} \quad , j = 1,..., N \quad (8)$$

Where " $\wedge$ " is the minimum operator performed for the pair wise elements of two vectors, $\alpha \geq 0$ is a constant, N is the current number of rule nodes, and w_j is the complement weight vector.

The choice function value indicates the similarity between the input vector x' and the complement weight vector w_j. We then need to find the complement weight vector closest to x'. This is equivalent to finding a category to which x' could belong. The chosen category is indexed by j where

$$T_j = \max \left\langle T_j : j = 1,..., N \right\rangle. \quad (9)$$

Resonance occurs when the match value of the chosen category meets the vigilance criterion

$$\frac{\left|x' \wedge w_j\right|}{x'} \geq \rho \quad (10)$$

Where $\rho \in [0,1]$ is a vigilance parameter. If the vigilance criterion is not met we say mismatch reset occurs. In this case, the choice function value is set to zero for the duration of the input presentation to prevent persistent selection of the same category during search. A new index is then chosen using (9). The search process continues until the chosen satisfies (10). If no such is found, then a new input cluster is created by adding a set of new input-term nodes. More details on how this works can be found in [17].

3.3 PROPOSED TRAINING STRATEGY

The problem of parameter learning can be stated as: given the training input data [x, y] and the desired output value z, and we want to adjust the parameters of the membership functions optimally. Let the total set of parameters be S and let S1 denote the premise parameters which are known as nonlinear parameters and S2 denote the consequent parameters which are known as linear parameters. The proposed ANFIS uses a two learning algorithm: the Recursive Least Squares (RLS) algorithm which computation the consequent parameters, and the particle swarm optimization PSO which computed the premise parameters.

Particle swarm optimization is a method used to explore the search space of a given problem to find the settings or parameters required to optimize a particular objective. Consider an optimization problem of N variables, and let denote in the N-dimensional search area, the position x(t) and velocity v(t) of ith particle at time t are respectively shown with the following vectors:

$$x_i(t) = (x_{i1}(t), x_{i2}(t) \ldots x_{in}(t)) \quad (11)$$

$$v_i(t) = (v_{i1}(t), v_{i2}(t) \ldots v_{in}(t)) \quad (12)$$

At each time, particles are corresponded with an objective value and the best positions of the particles from the beginning to this moment have been stored by the algorithm. The best position for a particle, at time t, is a position which based on that the particle has the best objective value. The best position for the ith particle up to the time t is represented as:

(13)

$$P_{best,i}(t)=(P_{best,i1}(t), P_{best,i2}(t) \dots P_{best,in}(t))$$

The PSO also stores the best position that is obtained by all of particles up to the time t, which it can be shown as below:

$$g_{best}(t)=(g_{best,1}(t), g_{best,2}(t) \dots g_{best,n}(t)) \quad (14)$$

Where x_{ij} and v_{ij} are jth element of the velocity vector V and position vector X for the ith particle, respectively. Each particle position and velocity pair at time (t+1) is obtained as follows:

$$v_{ij}(t+1) = w.v_{ij}(t) + c_1 . rand1_{ij} . (P_{best,ij}(t) - x_{ij}(t)) + c2 . rand2_{ij} . (g_{best,j}(t) - x_{ij}(t)) \quad (15)$$

$$x_{ij}(t+1) = x_{ij}(t) + v_{ij}(t+1) \quad (16)$$

where i=1, 2,… n is particle index, x_{ij} is the jth dimension of the ith particle position, v_{ij} is the jth dimension of the ith particle velocity, $P_{best,ij}$ is the jth dimension of the best position of the ith particle at time t, $g_{best,j}$ is the jth dimension of the best position that so far achieved by all of the particles, W is the inertia weight. The $rand1_{ij}$, $rand2_{ij}$ ~ U(0, 1) are two random numbers; c_1 and c_2 are training factors, where $C_1 + C_2 < 4$ [18].

The performance of this algorithm heavily relies on initialization of the algorithm parameters which is so important, because if they are not correctly selected, the PSO algorithm may never converge to the extremum point.

In Fig. 3 a method is proposed to obtain a better initial swarm. A fitness value is assigned to each particle in the swarm, where small values mean good fit. The objective function used in this work is defined as

$$\text{Objective function} = \frac{1}{s}\sum_{t=1}^{s}(y(t) - y'(t)) \quad (17)$$

Where y(t) is the output, y'(t) is the predicted output from fuzzy model, and s is the number of training data pairs.

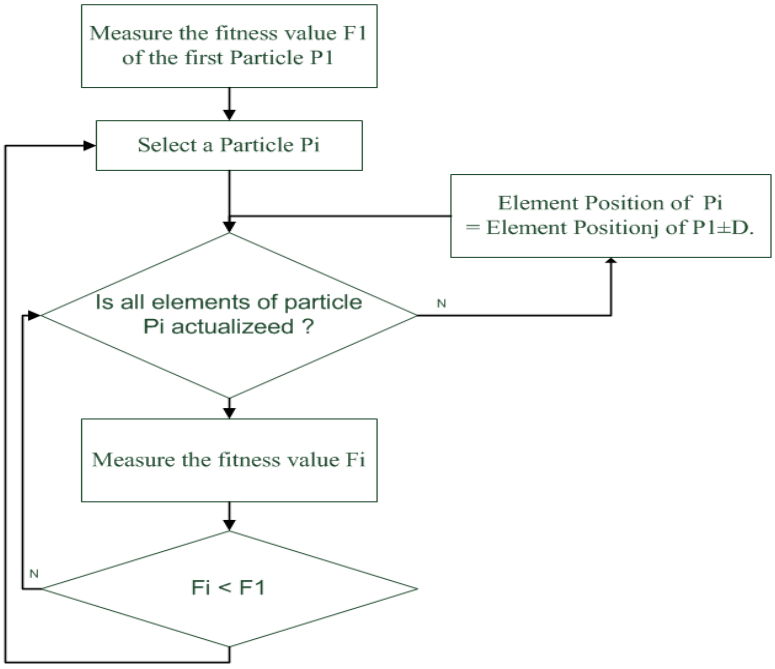


Fig. 3. Typical flowchart illustrates the initialization steps

In general, the PSO algorithm is used in accordance with the following steps:

1- Selecting the algorithm parameters and initializing particles [$x_i(t)$, $v_i(t)$].
2- Initializing the P_{best} vectors for all of the particles using the initial values obtained in step 1 for the position vectors.
3- Calculate the fitness value for each particle and determining the g_{best}.
4- Updating the particles velocity vectors and position vectors according to (15) and (16),

5- Updating the parameters of the fuzzy system membership functions by the position vector of each particle and calculating the objective value for each particle,
6- Updating the P_{best} , for each particle, if the fitness value of the new particle is good than those of local best, then the local best will be replaced with the new particle.
7- Updating the g_{best} , If the fitness value of the new particle is good than those of global best, then the global best will be also replaced with the new particle.
8- If the stopping condition is met, algorithm is stopped and the optimal parameter values are achieved.

4 RESULTS AND ANALYSIS

In this part, we will compare the proposed method executed in LabVIEW software relatively to the most used technique to model the transformation of MECG signal which is ANFIS of Matlab fuzzy toolbox. In contrary to all the studies presented in literature which use more than an iteration to obtain a good linearization. We will show only the results of small iterations in both methods to understand the improvement presented in this work. We will use two recorded signals: one M(n) and one A(n). The two recorded signals are segmented so that they are prepared for ANFIS training. They are segmented in a way that each one is partitioned into N-sample segments. The i-th segment of the signal M(n) is the x input and the (i-1)-th segment of the second M(n) signal is the y input. Also, the i-th segment of the signal A(n) is the z output

4.1 RESULTS ON SIMULATED ECG SIGNAL

For generating the synthetic ECG signals we use the dynamical model developed by McSharry et al. [19]. Both fetal and maternal ECG signals are synthesized using this model using different parameters to account for different shapes and beat rates of the two signals. A model for generating the abdominal signal is proposed as shown in Fig. 4. The MECG signal is processed through a system to simulate the delays and the nonlinear effects it undergoes as it travels from the heart to the abdomen. The attenuation effects are reflected on the FECG signal before it is added to the nonlinearly transformed MECG. Additive noise effects can be modeled by adding white Gaussian noise; in this paper we will ignore the effect of noise. This is so because, as we mentioned earlier, we are interested in extraction which can be cleaned later via postfiltering if needed. The nonlinearity and multipath effects that undergoes the MECG until it reaches the abdomen are modeled as

$$M_e(n) = M(n) + a_1.M(n-1) \tag{18}$$

$$\overline{M}(n) = \alpha.\mathrm{sgn}(M_e(n))\left|\tan^{-1}(M_e(n))\right| \tag{19}$$

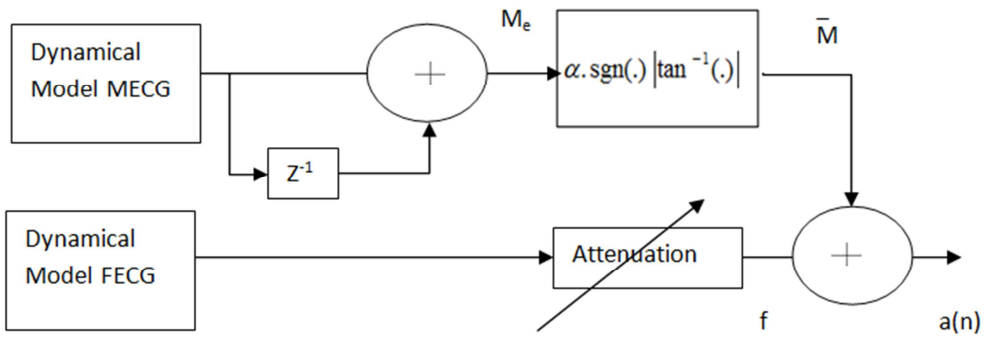


Fig. 4. Block diagram for simulating the abdominal ECG signal

In algorithm comparisons, we have used not only visual (quality) criterion but also a quantity criterion, the signal-to-noise ratio (SNR) of the abdominal signal is adjusted with the different power levels of the FECG component. Where the inputSNR, outputSNR and the correlation coefficients R are defined as:

$$inputSNR = 10\log_{10}\left[\frac{\sum_n (f(n)^2)}{\sum_n ((a(n)-f(n))^2)}\right] \tag{20}$$

$$outputSNR = 10\log_{10}\left[\frac{\sum_n (f(n)^2)}{\sum_n ((f(n)-F(n))^2)}\right] \quad (21)$$

$$R = \frac{\sum_n (f(n)-\overline{F(n)})(F(n)-\overline{F(n)})}{\sqrt{\sum_n (f(n)-\overline{F(n)})^2 \sum_n (f(n)-\overline{F(n)})^2}} \quad (22)$$

Fig. 5d shows the FECG extracted from the synthetic abdominal signal using our proposed method with the inputSNR=−20 dB.

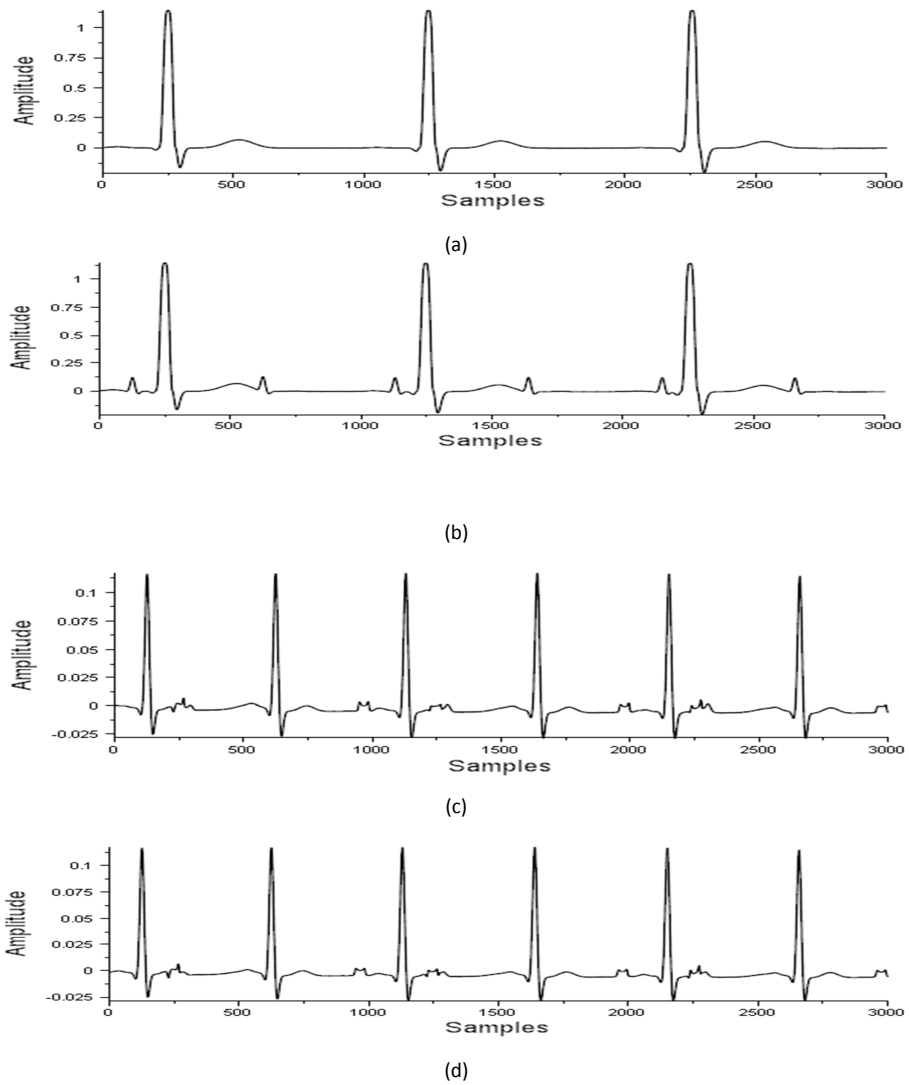


Fig. 5. Synthetic ECG signal, (a) thorasic ECG, (b) abdominal ECG, (c) ANFIS extraction ECG, (d) proposed ANFIS extraction ECG

The SNR and the correlation coefficients results are shown in table 1 and table 2, which illustrate the robustness of the proposed ANFIS-based technique as compared to the other techniques.

Table 1. Effect of the fetal to maternal signal to noise ratio on the quality of FECG extraction using three different FECG extraction techniques

inputSNR	-10DB	-15DB	-20DB	-25DB	-30DB	-35DB
Proposed_ANFIS	19,0862	19,0858	19,0852	19,0839	19,0816	19,0764
ANFIS	18,7527	18,7523	18,7518	18,7508	18,749	18,7452

Table 2. The correlation coefficients between the extracted and the actual FECG frames using three different FECG extraction techniques.

SNR	-10DB	-15DB	-20DB	-25DB	-30DB	-35DB
Proposed_ANFIS	0,9976169	0,9976160	0,9976145	0,9976116	0,9976062	0,9975939
ANFIS	0,9968066	0,9968058	0,9968045	0,9968020	0,9967975	0,9967879

5 CONCLUSION

This paper describes an algorithm to improve the linearization of MECG with AECG to separate the FECG using a combination of fuzzy adaptive resonance theory, particle swarm optimization and a neuro-fuzzy inference system. It should be noted that the implementation of this algorithm is independent of the period length of the maternal heart beat. In order to completely validate this FECG recovery technique and methodology, the results of the algorithm for different fetal to maternal ECG ratios are proposed and the correlation coefficients result demonstrates that the proposed algorithm works well.

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Notice of Retraction

The authors of the following article have requested that it be retracted from publication in the *International Journal of Innovation and Applied Studies*:

Soufiane Haddout and Mohamed Aghfir, “Absolute calibration of a thermocouple « Seebeck effect » : Experimental Study,” *International Journal of Innovation and Applied Studies*, vol. 9, no. 1, pp. 104–109, November 2014.

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Optimization of firing cycle for different porcelain bodies of sanitaryware: the influence of feldspar

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ABSTRACT: Four formulas of sanitaryware porcelain were studied. The influence of soda feldspar on the reduction of firing cycle is particularly highlighted. The samples were prepared and treated thermally at various temperatures and holding times and then characterized in terms of water absorption, total shrinkage and flexural strength. The results affirm that it is possible to reduce the firing temperature thirty degree Celsius (30°C) less than the usual temperature which is 1220°C, with a ratio of sodium oxide compared to potassium oxide equal to 5,744.

KEYWORDS: Soda feldspar, water absorption, firing, porcelain, shrinkage, flexural strength.

1 INTRODUCTION

In ceramic sanitaryware sector, tunnel and intermittent kilns are the biggest consumers of thermal energy. The estimated percentage of this energy in the production costs is about 30% [1], [2], [3].

That is why manufacturers try to reduce the cost of this energy by optimizing the cycle of firing.

In this context, we have thought about studying suitable bodies formulas in order to lower the temperature of firing or reduce the holding time.

Accordingly, three new compositions of porcelain bodies were developed starting from standard formula of an industrial use which is fired at 1220°C and at 30min of holding time. The latter were developed, by mixing usual raw materials then firing them at various temperatures and various holding time.

The choice of the formulas is based on the increase of the proportion of fusible phase brought by sodium oxide which exists in soda feldspar to the detriment of potassium oxide which exists in mixed feldspar potash-soda. This said, after the thermal treatment the physical and mechanical characteristics must satisfy the standards.

2 EXPERIMENTAL

The raw materials used in this work were two kaolins (K1 and K2), two clays (A1 and A2), two feldspars (Fel1 and Fel2) and quartz (Q1). The chemical analysis was performed by means of x-ray fluorescence spectroscopy (Axios de Panalytical) and the results are given in table 1.

Four compositions were prepared according to the formulas shown in table 2. From the chemical analysis of the raw materials (Table 1) and the formulas (Table 2), we applied the relation of "Seger" [4] (Table 3) which gives us major information: Evolution of the rate of sodium oxide compared to potassium oxide Na_2O/K_2O by keeping the ratio of silicate oxide compared to alumina SiO_2/Al_2O_3 almost fixed. This relation will be used later to interpret the results.

Twenty-kilogram batch of each were weighed out. Formula n°1 refers to the base compound of this work being similar to the composition of porcelain of sanitaryware used in the factory. In the subsequent formulas (Formula 2 to formula 4), mixed feldspar progressively is eliminated and substituted by soda feldspar. The non-plastic proportion of each batch was wet-ground in a boll mill with 50% of water, for a duration of 4–4,5 h to achieve a fineness of ~99% passing through a 75 µm sieve. Subsequently the plastic raw materials were added to the crushed products in a separate container with small quantities of deflocculent agents which are 2 ‰ of sodium silicate (Na_2SiO_3) and 0,1 ‰ of sodium carbonate(Na_2CO_3). As a result the slip produced was ready for casting in plaster molds to obtain rectangular samples of dimension 200mm×20mm×10mm. These samples were dried in stove at 100°C +/-10 and then thermally heated in an electric laboratory kiln at the rate of 20 ◦C/min at different peak temperatures 1220°C, 1190°C, 1160°C and 1130°C changing for each one the holding time to 10, 30 and 60 min.

After firing, all specimens were subject to the test of water absorption, and those fired at the holding time equal to 30 min were subject to the tests of linear total shrinkage, flexural strength as well.

Table 1. Chemical analysis of raw materials

	Clays :		kaolins :		Feldspars :		Quartz Q1
Chemical elements	**A1**	**A2**	**K1**	**K2**	**Fel1**	**Fel2**	
SiO_2	58,60	54,10	48,11	46,93	77,02	73,09	99,21
Al_2O_3	26,26	30,50	36,14	37,52	12,86	15,99	0,37
Fe_2O_3	1,00	1,33	1,22	0,96	0,60	0,37	0,08
TiO_2	1,26	1,04	0,05	0,30	0,04	0,14	0,01
CaO	0,12	0,08	0,00	0,00	0,21	0,23	0,01
MgO	0,33	0,28	0,27	0,19	0,06	0,32	0,00
K_2O	2,04	1,71	1,90	0,96	4,68	0,09	0,20
Na_2O	0,34	0,21	0,09	0,04	3,82	9,04	0,03
Loss on the ignition	9,92	10,61	12,12	13,04	0,67	0,64	0,11

Table 2. Formulations of the prepared batches

Formulas n° :	A1	A2	K1	K2	Total plastics	Fel1	Fel2	Q1	Total non-plastics	Total
1 (mass%)	18	7	13	13	51	29	9	11	49	100
2 (mass%)	18	7	13	13	51	20	18	11	49	100
3 (mass%)	18	7	13	13	51	11	27	11	49	100
4 (mass%)	18	7	13	13	51	0	38	11	49	100

Table 3. Formulas « SEGER »

Formulas n° :	SiO_2	Al_2O_3	Fe_2O_3	TiO_2	CaO	MgO	K_2O	Na_2O	SiO_2/Al_2O_3	Na_2O/K_2O
1	5,062	0,978	0,022	0,021	0,009	0,021	0,110	0,146	5,177	1,332
2	4,968	0,979	0,021	0,021	0,009	0,024	0,087	0,181	5,077	2,082
3	4,878	0,980	0,020	0,022	0,009	0,026	0,065	0,215	4,979	3,318
4	4,789	0,980	0,020	0,022	0,009	0,028	0,043	0,248	4,884	5,744

2.1 PROTOCOL OF MEASURMENT OF WATER ABSORPTION

This procedure is based on the standard UNE 67001:2008 (AENOR), which consists of drying the samples at 110°C for 180+/-5 minutes in drying stove cooling them down at room temperature, weighing each sample with an accuracy balance of 0,05g recording its weight (m_0) and then entering the samples in the bath containing demineralized water to prevent the samples from touching the bottom or sides of the bath. We heat water to boiling temperature (100°C) maintaining that temperature for 120+/- 5minutes,then, we stop the heating process and keep the samples immersed for 20 +/- 1h. Afterwards, we remove the samples from the bath and dry them immediately with an absorbant paper. Finally, we weight the samples immediately and record its weight (m_1). The value of water absorption is calculated according to the following equation:

$$WA = 100 * m_1\text{-}m_0/m_0 \quad (1)$$

Where :

WA: is the water absorption coefficient, expressed

in % to tow decimal places.

m_0: is the mass of the dry sample, expressed in g.

m_1: is the mass of the sample after testing.

The final result is the calculation of the average of the three tested samples.

In the case of ceramic porcelain of sanitaryware items, the absorption of water must be less than 0,5% [5], [6], [7], [8].

2.2 Protocol Of Measurment Of Total Linear Shrinkage

After firing, we measure the length of samples with a caliper with accuracy of 0,1 mm (L_2).

The percentage of total linear shrinkage is expressed in % to one decimal places and given by the expression:

$$(L_0\text{-}L_2)/2 \quad (2)$$

Where :

L_0 : The initial length of the sample which is 200 mm.

L_2 : The length of the sample after firing.

2.3 Protocol Of Measurment Of Three-Point Flexural Strength (Module Of Rupture)

Mechanical resistance is calculated as module of rupture (MOR). This measures the maximum force that a rectangular material with withstand before it breaks when it is under a load in a three-points bending setup.

To determinate the “module of rupture” of the studied bodies we used the NETZSCH equipment reference 401. This parameter is expressed in MPa as stated by the following formula:

$$MOR= 0.015*P*L/a^2*b \text{ (MPa)} \quad (3)$$

Being:

a: Hight (cm) of specimen in the break area.

b: Width (cm) of specimen in the break area.

P: Load of rupture for the tested specimen, directly read on the arm of the machine (Newton “N”)

L: Distance between supports of the specimen (cm).

3 Results And Discussion

The temperature usually used in production of ceramic sanitaryware is 1220°C with holding time of 30 min. We will also have the results of the study for three other temperatures: 1190°C, 1160°C and 1130°C. The values in the tables below represent the average of measurements from four samples.

3.1 WATER ABSORPTION

3.1.1 FORMULA N°1

Table 4. The water absorption (%) of the formula n°1 according to the holding time at various temperatures of firing.

	Temperatures (°C)			
Holding time (min)	**1130°C**	**1160°C**	**1190°C**	**1220°C**
60	7,26	2,01	0,98	0,07
30	8,60	3,31	3,11	0,25
10	9,85	5,25	3,55	0,74

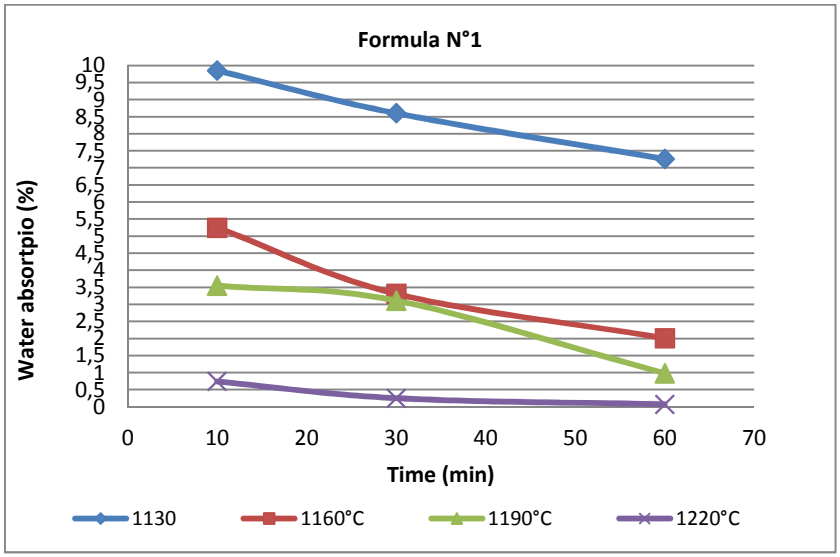


Fig. 1. Evolution of the water absorption of the formula n°1 according to the holding time at various temperatures of firing

With the formula n°1 in which the ratio Na_2O/K_2O is equal to 1,332, the porcelain reaches a porosity lower than 0,5%, only when the thermal treatment is performed at 1220°C at holding times of 30 and 60 min. Therefore it is excluded to work at lower temperatures or soaking times because the material is not vitrified enough.

3.1.2 FORMULA N°2

In the formula n°2, the ratio Na_2O/K_2O increase to 2,082 and we made the same study as that done with the formula n°1.

Table 5. The water absorption (%) of the formula n°2 according to the holding time at various temperatures of firing

	Temperatures (°C)			
Holding time (min)	**1130 °C**	**1160°C**	**1190°C**	**1220°C**
60	7,15	1,84	0,35	0,07
30	8,44	3,00	2,43	0,12
10	9,22	4,08	2,15	0,42

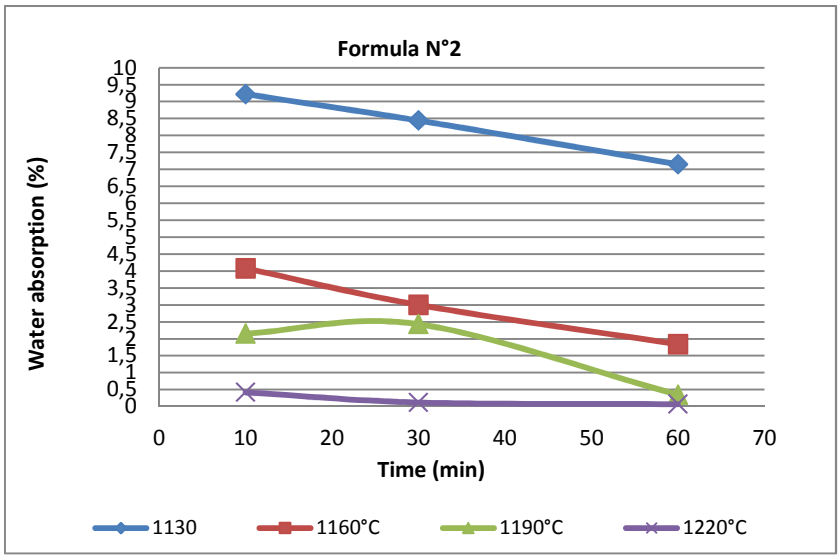


Fig. 2. Evolution of the water absorption of the formula n°2 according to the holding time at various temperatures of firing

Fig. 2 shows that the increase of liquid phase allows the material to be treated thermally at 1190°C but with relatively slow holding time (60min) compared to the usual one which is generally about 30 min.

3.1.3 FORMULA N°3

To achieve better results, we propose to continue our study in order to establish the same abacuses for formula n°3 in which we increase soda feldspar on mixed one to reach a ratio Na_2O/K_2O equal to 3,318. The results are as follows:

Table 6. The water absorption (%) of the formula n°3 according to the holding time at various temperatures of firing

	Temperatures (°C)			
Holding time (min)	**1130 °C**	**1160°C**	**1190°C**	**1220°C**
60	6,32	1,60	0,28	0,06
30	8,12	2,07	0,93	0,08
10	8,59	4,03	1,57	0,22

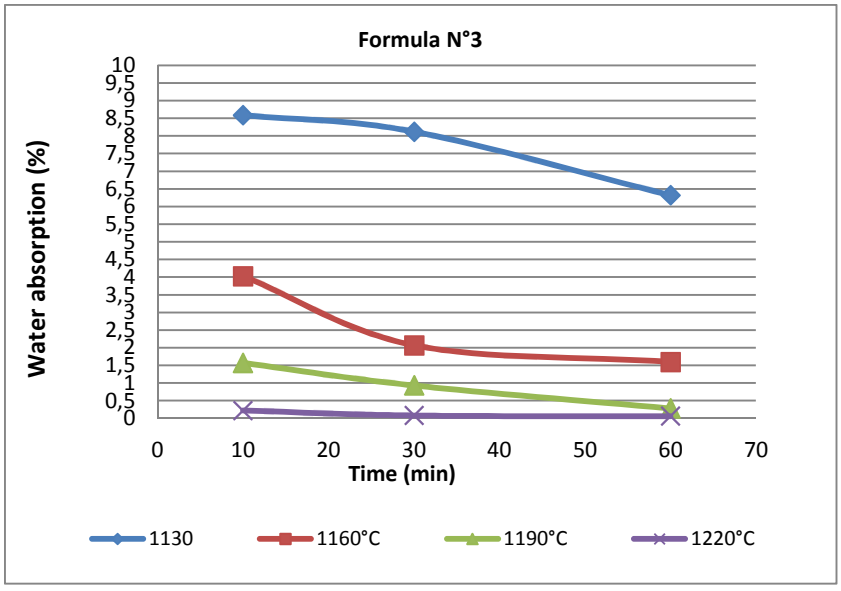


Fig. 3. Evolution of the water absorption of the formula n°3 according to the holding time at various temperatures of firing

Concerning this figure, the porosity drops according to the increase of temperature, but it still impossible to work at temperatures lower than 1190°C.

However, as in the formula n°2, with 1190°C it is possible to reach a satisfactory result after 60 min of holding time. For the same reasons mentioned above, we try to work with the last formula to be able to treat the specimen faster and at low temperature.

3.1.4 FORMULA N°4

Table 7. The water absorption (%) of the formula n°4 according to the holding time at various temperatures of firing

	Temperatures (°C)			
Holding time (min)	**1130°C**	**1160°C**	**1190°C**	**1220°C**
60	6,02	0,39	0,10	0,06
30	8,10	1,68	0,44	0,04
10	8,34	3,61	0,92	0,11

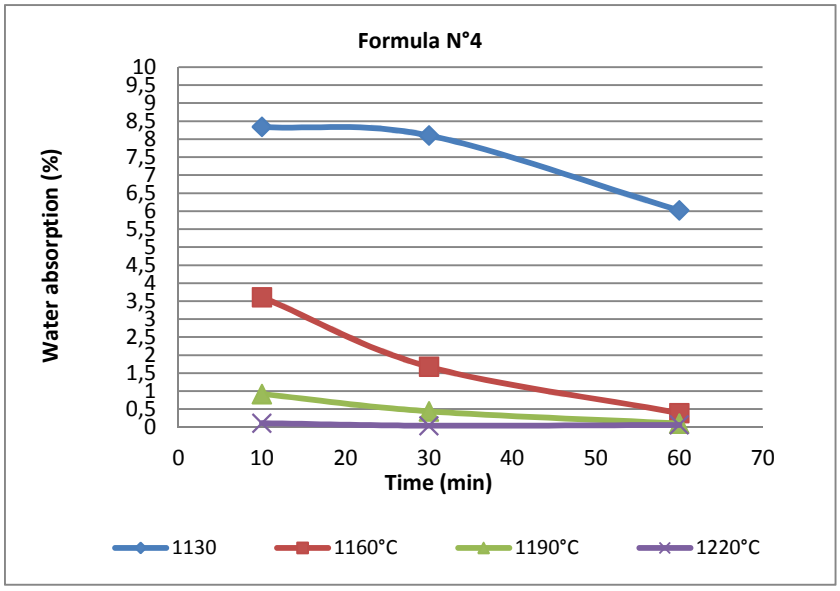


Fig. 4. Evolution of the water absorption of the formula n°4 according to the holding time at various temperatures of firing

With this formula we reached a threshold in which the rate of Na_2O/K_2O is equal to 5,744 (five times more than the usual one). The latter allows to have a vitrified material with a rate of water absorption equal to 0,44% and this at 1190° during a 30 min of holding time.

3.2 ABSORPTION OF WATER AT HOLDING TIME EQUAL TO 30 MIN

To summarize the results, we put in the same table the evolution of the water absorption of the four formulas according to all temperatures but only in 30 min of holding time. The results are as follows:

Table 8. The water absorption (%) of the four formulas according to the temperature with the holding time of 30 min

	Temperatures			
Formulas	**1130°C**	**1160°C**	**1190°C**	**1220°C**
F1	8,60	3,31	3,11	0,25
F2	8,44	3,00	2,43	0,12
F3	8,12	2,07	0,93	0,08
F4	8,10	1,68	0,44	0,04

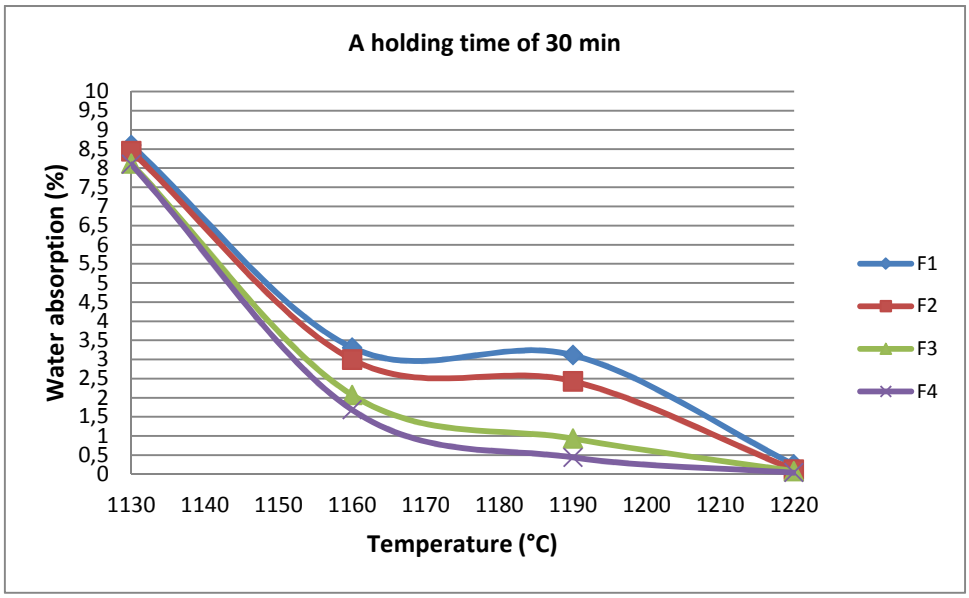


Fig. 5. Water absorption (%) of the four formulas according to the temperature at holding time equal to 30 min

This curve shows that at holding time equal to 30 min, all the bodies resulting from the four developed formulas are vitrified at 1220°C; and that the porosity is lower than 0.5%.

With the formula n° 4, it is clear that we can have water absorption less than 0,5%, yet at temperature of 1190°C.

Generally, porosity decreases with the rise of temperature or the rise of the fusible phase due to the contribution of fluxing agents allowing the formation of eutectics at low temperature. The diameter of the pores starts by increasing with disappearance of the small ones, then while approaching the temperature of sintering, the diameters and the number of open pores fall with formation of one-eyed pores, then of closed pores of small diameter.

In parallel to the study of the influence of soda feldspar on the evolution of water absorption, we have also measured the total shrinkage of four materials treated at various firing temperatures.

3.3 THE TOTAL LINEAR SHRINKAGE AT HOLDING TIME EQUAL TO 30 MIN

Table 9. Total shrinkage (%) of the four formulas according to the temperature at holding time equal to 30 min

	Formulas			
Temperature (°C)	**F1**	**F2**	**F3**	**F4**
1130	8,6	8,7	8,7	8,9
1160	9,8	10,2	10,7	12,0
1190	10,1	10,5	11,0	12,3
1220	11,7	11,5	11,5	12,5

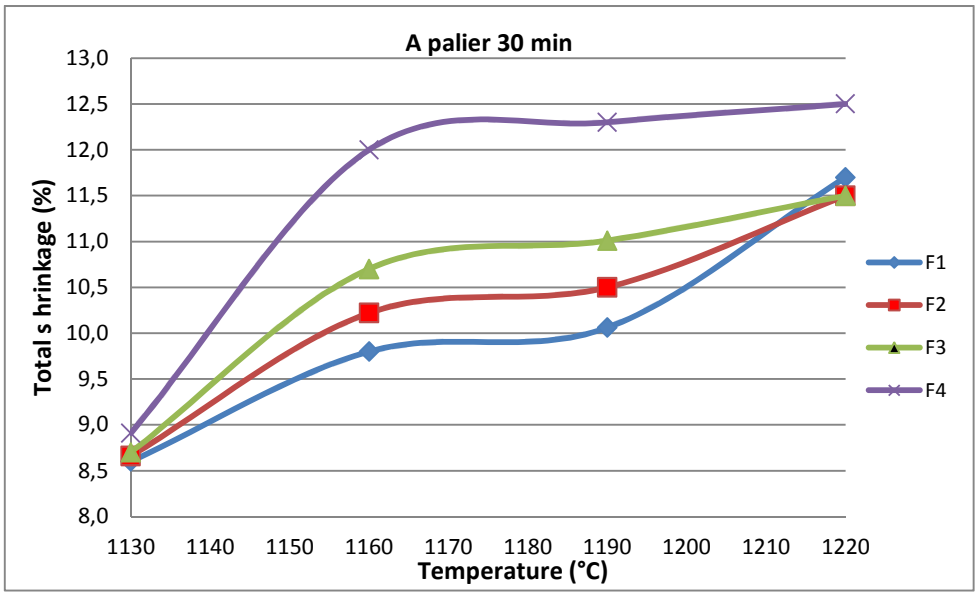


Fig. 6. The evolution of total shrinkage (%) of the four formulas according to the temperature at holding time equal to 30 min

During sintering, the reduction in the volume of the materials is generally due to the progressive disappearance of porosity.

The fig. 6 illustrates the variation of the total shrinkage of the four formulas at various temperatures with holding time equal to 30 min.

It is noticed that the rate of the shrinkage varies in a coherent way. However it is always higher for the formula n°4 compared to the rest of formulas. We can say that the liquid phase appears at lower temperature for this formula and becomes more abundant at high temperatures (1220°C).

3.4 The Flexural Strength At Holding Time Equal To 30 Min

In order to obtain materials not only sintered but also mechanically resistant, we measured the flexural strength for each developed ceramic body at the same holding time (30min).

The mechanical properties of ceramic depend on the surface defects. Among the most important factors influencing these properties there is:

- The porosity;

- The temperature of sintering;

- The volume of the fusible phase in material;

With regards to fired porcelain, the flexural strength reaches its maximum when apparent porosity tends towards zero [5], [9]. Commercial sanitaryware under our experimental conditions yields modulus of rupture values of about 48,26 MPa (mega-Pascal) [10] and this may be compared with experimental body values shown in table 10.

Table 10. The flexural strength (MPa) of the four formulas according to the temperature at holding time equal to 30 min

	Formulas :			
Temperature (°C)	**F1**	**F2**	**F3**	**F4**
1130	28,10	32,40	33,36	38,72
1160	38,80	44,56	48,80	51,98
1190	48,30	52,82	54,11	55,17
1220	61,92	62,33	62,21	65,53

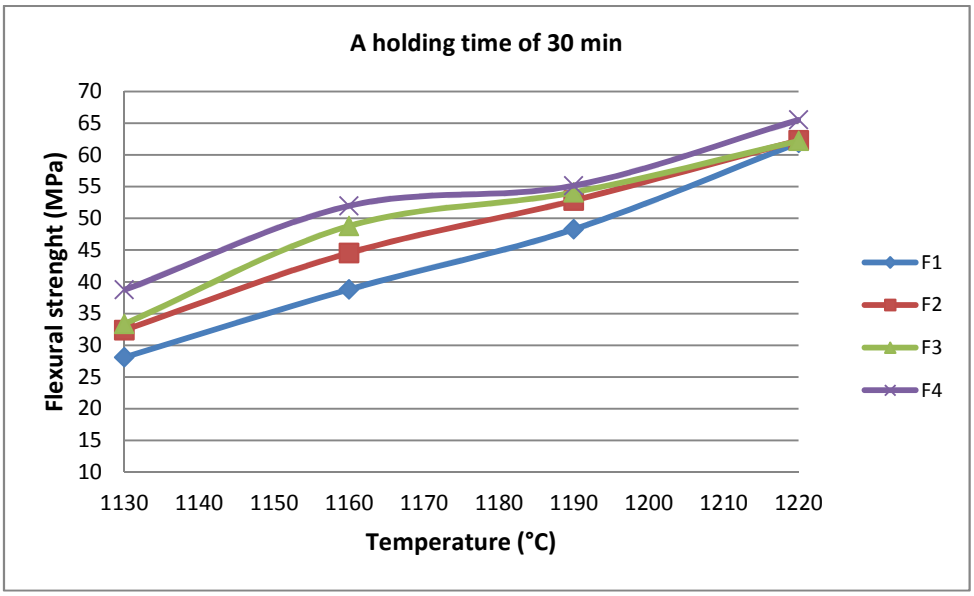


Fig. 7. The evolution of flexural strength of the four formulas according to the temperature at holding time equal to 30 min

The fig. 7 illustrates the variation of the flexural strength of the four compositions at the temperatures: 1130°C, 1160°C 1190°C and 1220°C at holding time of 30 min.

At 1220 °C, the mechanical resistance reaches its maximum between 62 and 65, 53 MPa at all formulas.

With lower temperatures, only the formulas having a high volume of vitreous phase have a relatively important mechanical resistance, especially the formulas n°3 and n°4 which reach the limit of the mechanical resistance at 1160°C. Below this temperature, the materials for the entire compositions become fragile and present a flexural strength lower than the standard.

4 CONCLUSION

During sintering, the growth of the quantity of liquid phase is strongly influenced by the rate of existing sodium oxide in the composition. This oxide decreases the viscosity of glass during the firing of the body and consequently supports the formation of eutectics at low temperature. Taking into account its proportion raised in the formula n°4 to about 0,248 according to the stoechiometric composition “Seger” and which is 1,7 times higher than that in the standard formula, we have successfully reached an optimal firing at a maximum temperature of 1190°C with a holding time of 30 min.

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Alimentation hydrique de *Lippia multiflora* en pépinières issues de graines

[Water supply *Lippia multiflora* nursery from seeds]

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ABSTRACT: This study was conducted to estimate the water requirement of the plant *Lippia multiflora* MOLDENKE. (Verbenaceae), also known as the bush tea or Gambia tea. Seeds initially germinated, are transplanted into pots of 14.5 cm high and 8.5 cm in diameter, completed soil indoors. The treatment consists of 5 parts water, I_1, I_2, I_3, I_4 and I_5, respectively, for 15, 30, 50, 70 and 100 per cent of the usable reservation made by spraying the plants, for 3 months. Weighing pots with plants were made before and after watering, to calculate actual evapotranspiration (ETa).
The results show that actual evapotranspiration of *Lippia multiflora*, nursery ranges from 0.5 $mm.d^{-1}$ to 2 $mm.d^{-1}$. Plants with the irrigation dose, received I_1, have a low ETR for the 3 months, followed by I_2. Irrigation doses I_3, I_4 and I_5 indicate ETR ranging from 1 mm to 2 mm per day. The crop coefficient in nursery phase is 0.32 for the month of May and 0.23 in July.
Regarding the vegetative growth, the results obtained show that, it is the I_3 or I_4 irrigation doses which allow a homogeneous development of the plants. These doses are thus, considered the maximum evapotranspiration of *Lippia multiflora*. And Culture of *Lippia multiflora*, it is necessary to go through the nursery phase by providing 50 or 70 per cent usable reserves of soil for optimal growth.

KEYWORDS: *Lippia multiflora*, evapotranspiration, nursery plant, seeds, irrigation.

RESUME: Cette étude est effectuée pour estimer le besoin en eau de la plante *Lippia multiflora* MOLDENKE. (Verbenaceae), encore appelée le thé de savane ou le thé de Gambie. Des graines, initialement prégermées sont repiquées dans des pots de 14,5 cm de hauteur et de 8,5 cm de diamètre, dûment remplis de sol sous abri. Le traitement est constitué de 5 doses d'eau, I_1, I_2, I_3, I_4 et I_5 respectivement 15, 30, 50, 70 et 100 p.c. de la réserve utilisable, apportées par aspersion aux plantes, pendant 3 mois. Des pesées des pots avec les plantes sont faites avant et après arrosage, pour le calcul de l'évapotranspiration réelle (ETR).
Les résultats montrent que l'évapotranspiration réelle de *Lippia multiflora*, en pépinière varie de 0,5 $mm.j^{-1}$ à 2 $mm.j^{-1}$. Les plantes ayant reçues la dose d'irrigation I_1, présente une ETR faible durant les 3 mois, suivis de I_2. Les doses d'irrigation I_3, I_4 et I_5 indiquent des ETR qui varient de 1 mm à 2 mm par jour. Le coefficient cultural en phase de pépinière est de 0,32 pour le mois de mai et 0,23 en juillet.
Concernant la croissance végétative, Les résultats obtenus montrent que, ce sont les doses d'irrigation I_3 et I_4 qui permettent un développement homogène des plantes. Ces doses sont donc, considérées comme l'évapotranspiration maximale (ETM) de *Lippia multiflora*. Ainsi pour une culture de *Lippia multiflora*, il est nécessaire de passer par la phase de pépinière en apportant 50 ou 70 p.c.de la réserve utilisable du sol pour une croissance optimale.

MOTS-CLEFS: *Lippia multiflora*, évapotranspiration, pépinière, graines, irrigation.

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1 INTRODUCTION

Lippia multiflora est une plante qui se retrouve spontanément dans les zones tropicales de l'Afrique et de l'Amérique [1]. Ses feuilles sont utilisées pour le traitement de plusieurs cas de maladies [2], [3], [4], [5], [6] dans ces zones. Cette plantes possède des propriétés pharmacologiques, médicinales, pesticides, insecticides, alimentaires et cosmétiques [2], [3], [4], [5], [6], [7] et est génératrice de revenus [8], [9]. Cependant, l'obtention de ces feuilles par la cueillette des plantes sauvages peut favoriser l'extinction de l'espèce et entraîner un déséquilibre de la biodiversité [11]. Ainsi, vu son intérêt, des techniques culturales sont entamées pour sa domestication en culture industrielle [12].

L'eau constitue un facteur limitant la production végétale. En effet, les plantes ont besoin de l'eau se trouvant dans le sol pour leur alimentation ou leur survie. Cette demande d'eau est variable selon l'espèce et les stades phénologiques de la plante [13], [14].. La répartition de l'eau dans le sol, voire l'eau disponible du sol pour les plantes, est variable selon les types de sol. Dans le but d'avoir une production satisfaisante, il faut que la culture soit dans des conditions hydriques optimales (Anonyme 2012a). Cette étude est initiée dans le but de déterminer le besoin en eau de la plante, en pépinière, pour sa croissance optimale.

2 MATÉRIEL ET MÉTHODES

2.1 MATÉRIEL

2.1.1 MATÉRIEL VÉGÉTAL ET DE TRAITEMENT

Le matériel végétal est constitué de graines de *Lippia multiflora* récoltées sur des plantes sauvages.

Les Réserves Utilisables, (RU) ont été prises pour les traitements hydriques, apportées aux plants. Des godets gradués sont utilisés pour les arrosages des plantes par aspersion. Nous avons cinq (5) traitements. 15, 30, 50, 70 et 100 p.c., de la réserve utilisable, appliquées aux plantes par aspersion dans les pots.

2.1.2 SITE

Les données climatologiques du site sont données par le tableau I.

Tableau I : Evolution du climat à Abidjan de mai à juillet

	Mai	Juin	Juillet
Pluie (mm)	222,2	287	111,7
Température (°c)	27,7	16,4	24,9
Insolation (h)	188,8	153,3	116,2
Humidité relative (p.c.)	82,6	84,2	86
ETP (mm)	127,2	107,5	105,9

Le type de sol est un ferralsol à pseudogley à faciès d'hydromorphie en profondeur. C'est un sol sablo-limoneux

2.2 METHODES

2.2.1 DISPOSITIF EXPÉRIMENTAL

Le dispositif expérimental est présenté par les figures 1 et 2.

$I_1.13$	$I_1.23$	$I_1.33$		$I_2.13$	$I_2.23$	$I_2.33$		$I_3.13$	$I_3.23$	$I_3.33$		$I_4.13$	$I_4.23$	$I_4.33$		$I_5.13$	$I_5.23$	$I_5.33$
$I_1.12$	$I_1.22$	$I_1.32$		$I_2.12$	$I_2.22$	$I_2.32$		$I_3.12$	$I_3.22$	$I_3.32$		$I_4.12$	$I_4.22$	$I_4.32$		$I_5.12$	$I_5.22$	$I_5.32$
$I_1.11$	$I_1.21$	$I_1.31$		$I_2.11$	$I_2.21$	$I_2.31$		$I_3.11$	$I_3.21$	$I_3.31$		$I_4.11$	$I_4.21$	$I_4.31$		$I_5.11$	$I_5.21$	$I_5.31$
	$T_1.0$				$T_2.0$				$T_3.0$				$T_4.0$				$T_5.0$	
I_1				I_2				I_3				I_4				I_5		

Figure 1: Dispositif expérimental des essais sur graines à Abidjan

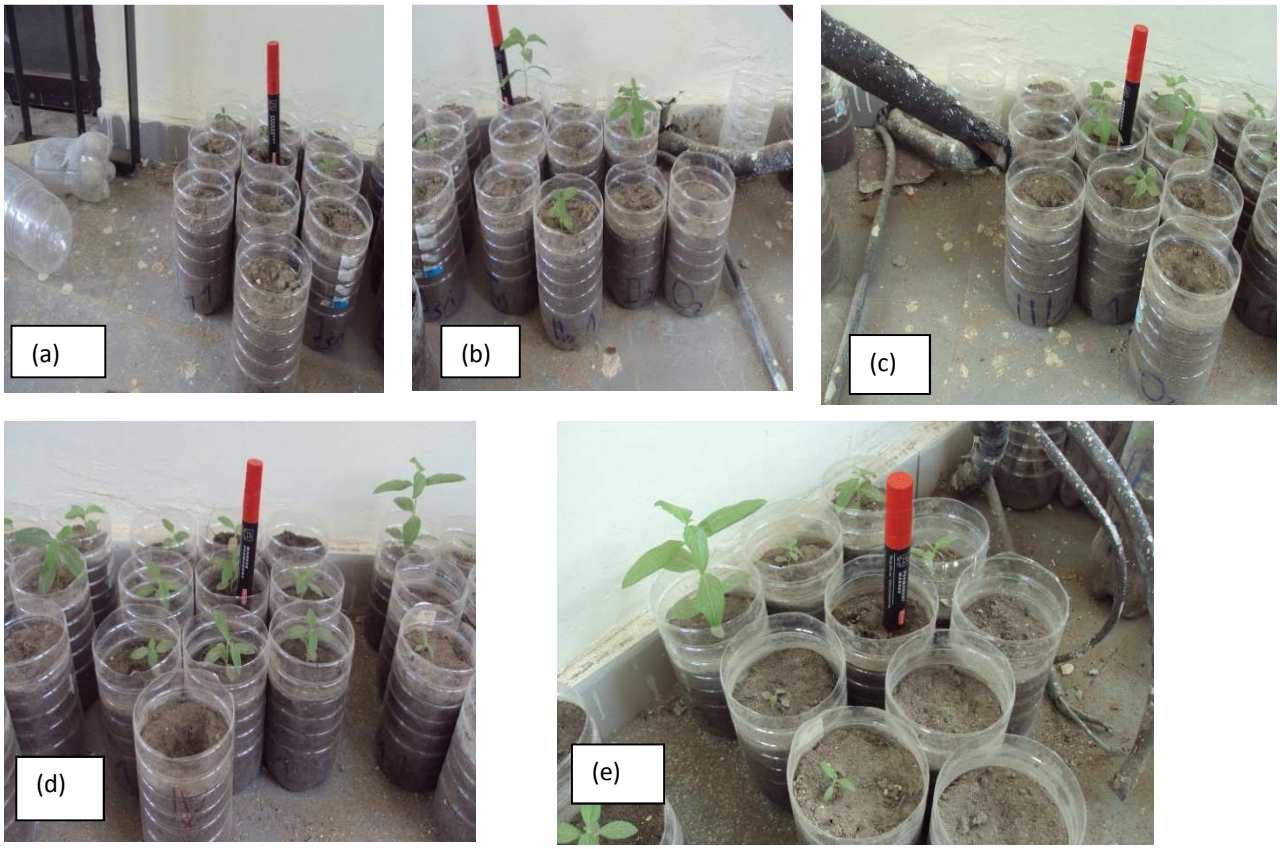


Figure 2: Comportement de plantules de L. multiflora issues de graines en fonction de l'apport d'eau par irrigation : (a) I_1, (b) I_2, (c) I_3, (d) I_4 et (e) I_5.

2.2.2 EVAPOTRANSPIRATION RÉELLE MESURÉE

Cette méthodologie consiste à peser les pots avec les plantes avant et après l'apport d'eau. La variation du poids reflète la perte en eau par évaporation et par transpiration, tout en négligeant l'accumulation de la matière sèche de la plante sur une période de 2 à 4 jours.

Soit P_s, le poids du pot (plante et sol) avant l'application de la dose d'eau et P_a, après l'arrosage. 2 ou 4 jours après, une pesée est faite. Et cette différence de poids obtenus divisée par le nombre de jours, représente l'évapotranspiration réelle (ETR) en gramme par jour. Le poids en gramme sur la surface du pot donne L'ETR en mm/j. Le pot a pour diamètre 8,5 cm, le rayon est de 4,25 cm donc la surface du pot est 56,72 cm². Par correspondance, 1g = 1 cm², on obtient donc 1/56,72 qui donne 0,0176 qu'on multiplie par 10 pour passer du cm au mm. Ainsi toute différence de poids doit être affectée par le coefficient 0,176 pour avoir l'ETR.

L'évapotranspiration est donnée par :

$ETR\ (mm/j) = ((P_a - P_s)/A_p) \times 10$;

$ETR\ (mm/j) = (P_a - P_s) \times 0{,}176$.

Où P_a: poids en gramme (g) du pot + la plante après arrosage

P_s: poids en gramme (g) du pot + la plante avant arrosage à la date suivante

A_p: surface du pot (cm^2)

ETR : évapotranspiration réelle

3 RÉSULTATS ET DISCUSSION

3.1 ETR DE *L. MULTIFLORA* EN PEPINIERE

La consommation en eau des plantes de *L. multiflora* issues des graines durant 3 mois a été observée sous abri. En général, les courbes présentent la même allure pour les 3 mois. L'évapotranspiration réelle (ETR) évolue avec la dose d'irrigation. Le mois de mai et de juin sont des temps d'intenses pluies avec de fortes insolations (Tableau I), permettant ainsi une ETR élevée (Figure 3). Le mois de juillet présente un temps généralement couvert, induisant donc une ETR basse (Figure 2). Le comportement des plantes selon les doses d'irrigation dans la figure 2 montre que ce sont les doses I_4 et I_3 qui permettent un développement homogène des plantules avec un taux de survie élevé et donnant ainsi l'évapotranspiration maximale (ETM). C'est pourquoi, elles seront utilisées dans la suite pour le calcul du coefficient cultural au stade pépinière de *L. multiflora*.

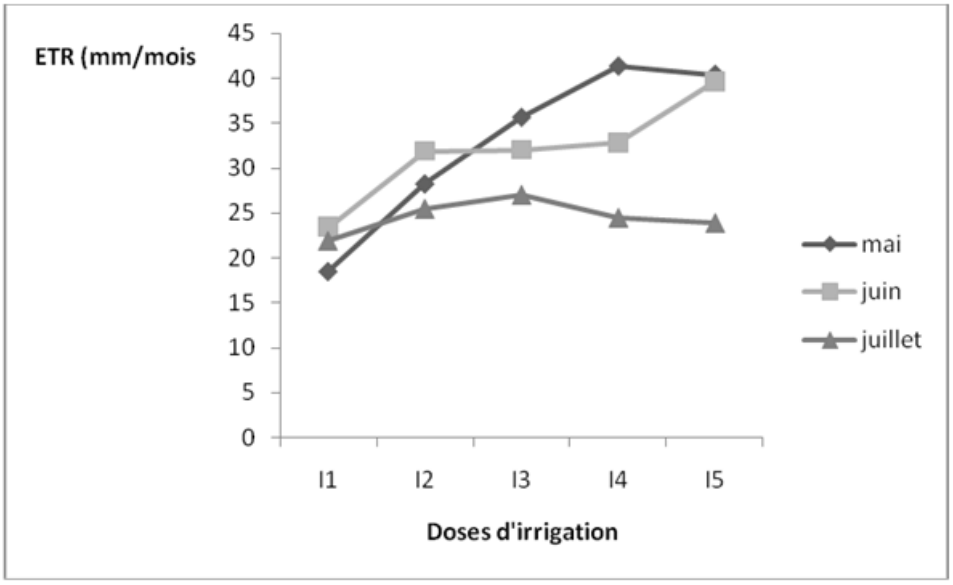


Figure 3: Evolution de l'ETR pour L. multiflora en fonction des doses d'irrigation (I_1, I_2, I_3, I_4 et I_5 respectivement 15, 30, 50, 70, et 100 p.c. RU).

La figure 5 montre l'évolution de l'ETR par jour, selon les doses d'irrigation. Pour les 3 mois, l'ETR évolue en fonction de l'apport d'eau. Plus, on apporte de l'eau, plus l'ETR est grande. Et l'ETR fluctue autour de 1mm.j^{-1} pour le mois de mai et de juin, mais de 0,84 mm.j^{-1} dans le mois de juillet. En général, l'ETR pour la dose I_1 reste faible durant les 3 mois, 0,5; 0,65 et 0,6 mm.j^{-1} pour respectivement les mois de mai, juin et juillet. Les autres doses d'eau I_2, I_3, I_4 et I_5 donnent une ETR qui fluctue entre 0,6 et 2 mm.j^{-1}. L'ETR des plantes sous les 3 doses d'irrigation les plus élevées (I_3 I_4 I_5) dépasse globalement 1 mm.j^{-1} quand le temps est ensoleillé comme c'est le cas en mai et juin Cependant, lorsque le temps est peu ensoleillé (cas de juillet), l'ETR devient faible et comparable pour l'ensemble des doses d'irrigation.

3.2 COEFFICIENT CULTURAL (KC)

La figure 4 présente le coefficient cultural de *Lippia multiflora* en pépinère estimé à partir d'un apport d'eau de 50 p.c. (I_3) et 70 p.c. (I_4) de la RU. Pour la dose d'irrigation I_3, le coefficient cultural varie de 0,25 à 0,30. Respectivement pour juillet et juin. La dose d'irrigation I_4 donne un coefficient cultural de 0,23 (juillet, temps couvert) et 0,32 en mai (mois ensoleillé). La figure 3 présente la courbe du coefficient cultural de *Lippia multiflora* en pépinère de 3 mois. Durant ces 3 mois, la demande en eau est restée sensiblement constante avec un coefficient cultural en moyenne de 0,28.

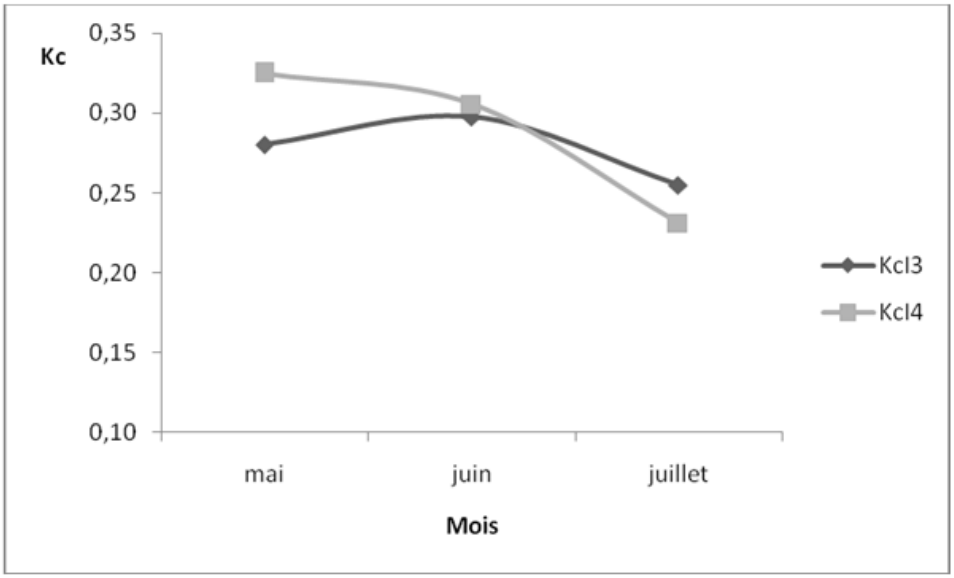


Figure 4: Courbe de coefficient cultural des plantes issues des graines de L. multiflora en pépinière sous abri

L'analyse des données de l'évapotranspiration réelle (ETR), de *L. multiflora* issues de graines en pépinière montre que généralement, l'ETR des plantes sous la dose d'irrigation I_1 est faible et peu variable, pendant les 3 mois de suivi avec une valeur moyenne de 0,5 mm.j^{-1}. Les ETR sous I_2, I_3, I_4 et I_5 fluctuent beaucoup de mai à juillet, et les plus grandes doses I_3, I_4 et I_5 ont les ETR les plus élevées, pendant, le mois le plus ensoleillé (mai). En effet, ces doses élevées d'eau permettent une plus grande évapotranspiration quand l'énergie disponible est forte comme c'est le cas en mai et juin. Par contre, lorsque l'énergie est faible comme en juillet, du fait de la nébulosité, les ETR enregistrées se rapprochent quelque soit la dose d'irrigation comme l'ont rapporté les travaux de Anonyme [15]. En fait, lorsque le ciel est couvert, l'évapotranspiration devient faible comme c'est le cas en juillet et élevée en temps ensoleillés pour les mois de mai et juin. Ces résultats suggèrent que les doses d'irrigations I_1 et I_2 sont déficitaires pour des journées très ensoleillées. Les doses favorables permettent d'obtenir des ETR pouvant atteindre 1,5 à 2,0 mm.j^{-1}. Les résultats suggèrent également que les doses d'irrigations I_4 (70 p.c.) I_3. (50 p.c.) de la RU, sont les doses d'apport d'eau pour un meilleur developpement de la plante *L. multiflora* en pépinière. Ces irrigations permettent à la plante d'avoir une croissance homogène de tous les paramètres, notamment un fort taux de survie et sont considérées comme l'évapotranspiration maximale (ETM). Les irrigations I_1 et I_2 sont déficitaires et I_5 paraît asphyxiant. Le coefficient cultural est de 0,30 pour la plante *L. multiflora* de 3 mois.

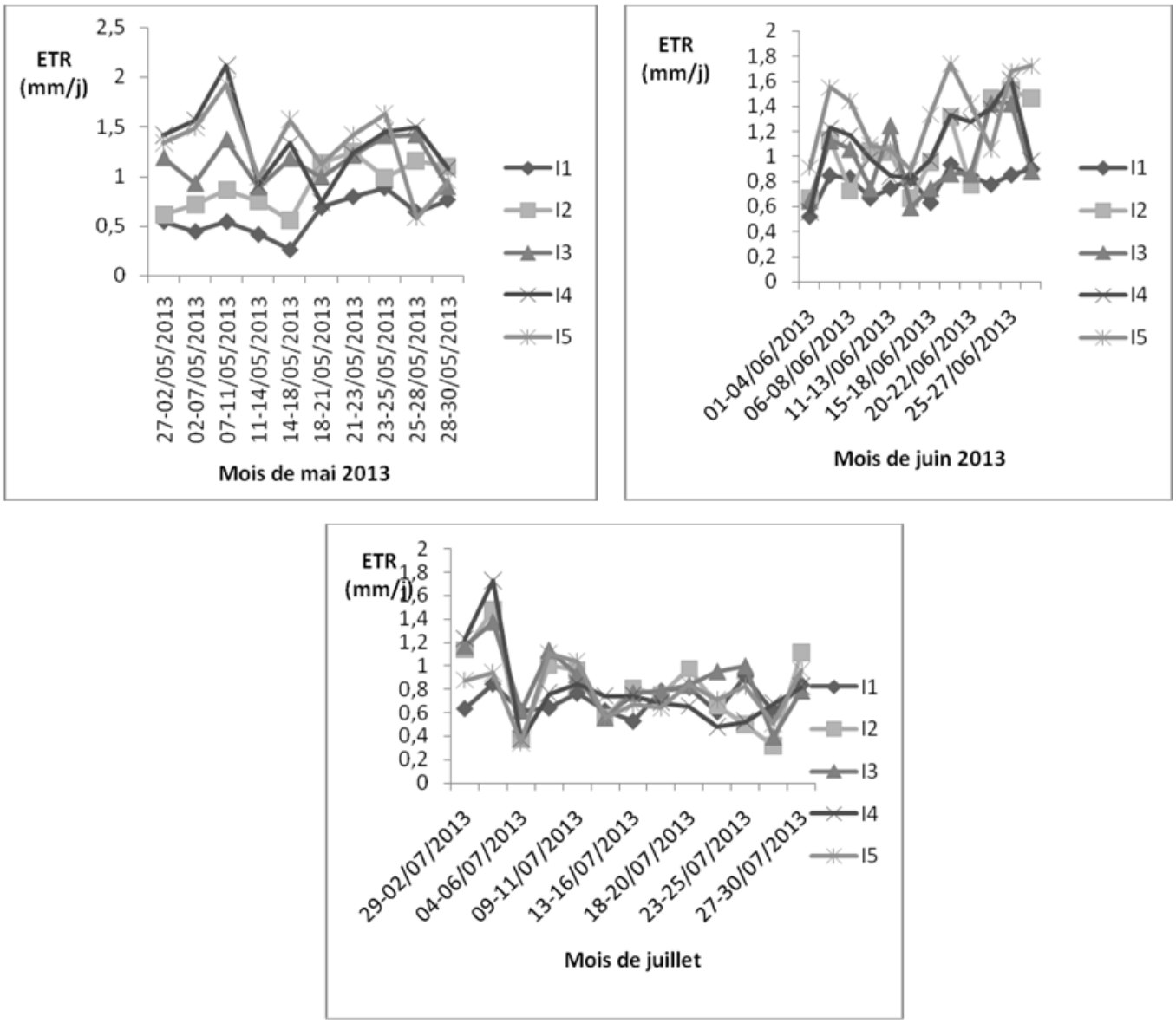


Figure 5 : Evolution de l'ETR par jour selon les doses d'irrigation pour des plantes L. multiflora issues de graines durant 3 mois (I_1, I_2, I_3, I_4 et I_5 respectivement 15, 30, 50, 70, et 100 p.c. RU).

4 CONCLUSION

L'évapotranspiration réelle de *L. multiflora* en pépinière est très faible (0,5 à 2,0 $mm.j^{-1}$) mais dépendante de la quantité d'eau reçue par la plante. Le coefficient cultural est de 0,32 en mai à 0,23 en juillet. Les doses d'irrigation I_3 ou I_4 sont les doses d'irrigation à apporter sur de pépinières de graines pour un développement optimal. La culture de *L. multiflora* devrait passer nécessairement par la phase de pépinière un développement optimal.

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Hydrograph recession analysis methods and its comparison using unsaturated moisture movement model

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ABSTRACT: Groundwater plays an important role in feeding springs and streams, supporting wetlands and land surface stability. In Finland, most water is held in the soil than the surface systems. Hence, Finland's water resources depend on groundwater and biogeochemical processes. The study of groundwater in peatland is important for maintaining ecological balance and conservation of water resources. The groundwater level is one of the key indicators of aquifer conditions and groundwater basins. It helps to interpret hydrogeology, groundwater flow, groundwater sustainability and land usability. The study tries to analyze ground water recharge on peatland catchments using hydrograph recession analysis. The equation for the hydrograph recession curve can be utilized to predict groundwater recharge during each recession period. The steps involved during recession curve analysis includes selection of analytical expression, derivation of recession characteristic and optimization of the parameters. While computing groundwater recharge with recession curve, the high variability of each recession segments creates major problem. Each segment shows the outflow process which creates short-term or seasonal influence. The variation in rate of recession which causes problems for derivation of recession characteristics. The computer software such as hydro-office, VBA macro excel and Matlab are used for recession analysis. The results obtained do not consider climatic influences. The results were then confirmed by using water balance model and statistical tests. The e-water toolkit is used for water balance model and statistical tests are performed using R-software. The rainfall-runoff data are used as input to the software used in each method. From the analysis, required output recession parameters are obtained for further calculation. These estimated recession parameters can be used to predict low flows (groundwater contribution to runoff) to understand catchment groundwater resources and as inputs for the rainfall-runoff model analysis. Hence, the objective of this study is to analyze groundwater recharge by studying the recession limb of the runoff hydrograph. The study work compares various recession analysis methods. It also tries to identify the better method by comparing groundwater recharge from different methods with groundwater recharge from unsaturated water balance model. Furthermore, the recession constants obtained from different methods are compared with the theoretical values. Statistical tests are used to identify the best method among recession analysis methods used in this study.

KEYWORDS: Runoff Hydrograph, recession Parameters, Runoff, Groundwater recharge, unsaturated water balance, Statistical tests

1 INTRODUCTION

Peatlands are major important part of global ecosystem. It shows significant interaction with natural hydrological system, biogeochemical cycling and terrestrial as well as aquatic biodiversity. In Finland, peatlands have high influence in ecological as well as socio-economic aspects. It covers one-third of Finnish land area which is 2.0 million ha of 9.3 million ha [1]. The hydrological study is used to develop the functions and process related peatlands system. Hydrological study is an important part of environmental and ecological study in Finland. In peatlands as in other soil formation there is interactive connection between the surface and subsurface hydrological water system. This study intends to calculate yearly groundwater recharge of two catchments using recession hydrograph. It includes study of various hydrograph recession analysis methods. It also

includes various climatic factors that influence runoff hydrograph. The amount of water received by catchment is disintegrated in different time period. The hydrological features of catchment influences runoff and water storage in the catchment. The runoff generated is highly influenced by upslope contributions from surface flow as well as interflow. The study of hydrological behavior in surface and subsurface of two peatlands catchment is the major objective of this study.

2 SITE DESCRIPTION

The two catchments studied in this study are Marjasuo and Röyvänsuo with four years data (2010-2013). Marjasuo peatland has been drained since 1968 for forestry and was restored in 2011.Röyvänsuo is a pristine peatland located in Isosyöte National park. Both of the study catchments are the part of larger Iijoki catchment [2]. The catchments lie in northern Finland at Taivalkoski municipality and both are state owned. The geographical locations of the catchments Marjasuo and Röyvänsuo are at 65o48'19.79'' latitude and 27o48'42.246''longitude and 65o49'12.213'' latitude and 27o48'13.978'' longitude respectively. Marjasuo covers land area of 65ha (0.65km²) and Röyvänsuo 75ha (0.75km²). The two catchments contain almost similar terrestrial and soil formations. Marjasuo has 2.27 ha (3.5%) open water or pond, 30.55 ha (47%) mineral soil, 16.5 ha (25.5%) fen or open mire and 15.6 ha (24%) forested Peatland and paludified forest. Similarly, Röyvänsuo contains 0.5 ha (<1%) open water, 44.25 ha (59%) mineral soil, 18.75 ha (25%) fen (open mire) and 11.25 ha (15%) forested peatland and paludified forest. The map with location of two catchments are shown in Fig. (1

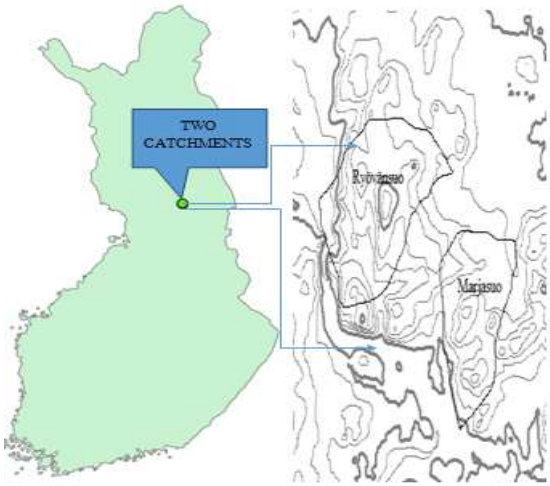


Fig. 1. Catchment location map [3].

3 METHODS

The recession constants and groundwater recharge of both sites Marjasuo and Röyvänsuo are computed using the recession analysis method and specific yield method. In this study the groundwater recharge obtained from unsaturated water balance model is considered to be precise. So, the groundwater recharge obtained from recession analysis methods and specific yield are compared to groundwater recharge from unsaturated water balance model. Finally, statistical tests are carried out to observe the significance of the results obtained. The basic approaches used for this study are discussed in the following sections.

3.1 HYGROGRAPH RECESSION ANALYSIS

3.1.1 INDIVIDUAL RECESSION ANALYSIS

The analysis of individual recession curves is carried out using RC 4.0 tool from hydro office software [4]. By using RC tool, an individual recession segments are separated from runoff hydrograph. The runoff data is the major input and rainfall is optional. An individual recession curve is selected for short time period with small numbers of declining runoff values. In an individual analysis there is different flow constant for the slow and fast runoff. It consists of two linear models. One represents fast flow and the other represents slow flow. For each model, recession curve is divided into two portions (upper

and lower).The initial flow and constant (k) are given by user. For the calibration of individual recession curve, a tool called single calibration in hydro office software is used. The outputs obtained from the software are initial flow, recession coefficient and recession time days. The output obtained is used to calculate final discharge and groundwater recharge during recession period.

i) FINAL RUNOFF AT TIME T

The output contains two initial flows and two constants for same time period. The initial flows and recession constants are added to get total flow and total constant for each individual recession curve. From total initial flow and total recession constant final discharge is calculated. The flow at the end of recession period is given by equation (1) [5]:

$$Q_t = Q_o K^t \quad (1)$$

Where Q_t is runoff at the end of recession period (m3/s) per unit area
Q_o is intial recession flow (m3/s)
t is recession period (d)

ii) CHANGE IN GROUNDWATER RECHARGE

The runoff and runoff time to complete one log cycle is given by equation (2) and (3) [6]:

$$Q = Q_o/10^{\,t/t1} \quad (2)$$

$$t_1 = t \ln(10)/\ln(Q_o/Q) \quad (3)$$

The calculated value t1 is used to find the groundwater recharge between each recession curve. In this method groundwater change is calculated based on each log cycle. Each individual volume is added to get total groundwater recharge volume. Individual ground water recharge volume in each log cycle is the difference between total potential groundwater runoff at beginning of recession and total groundwater potential at the end of recession.

The volume of groundwater runoff at the beginning and end of recession is given by equation (4) and (5) [4]:

$$V_{tp} = (Q_o \times t_1)/2.3 \quad (4)$$

$$V_r = (Q_o \times t_1)/(2.3 \times 10^{\,t/t_1}) \quad (5)$$

Where Q_0 is runoff when t = 0 (m3/s)

V_{tp} is total potential runoff at beginning (m3)

V_r is total potential runoff volume at end (m3)

t is total time of recession (d)

t_1 is time for 1 complete log cycle (d)

The volume of groundwater recharge is difference between volume at starting and ending of each recession event, which is shown in equation (6) [4]:

$$\mathbf{VR = Vtp - Vr} \quad (6)$$

Where VR is volume between recession (m3)

V_{tp} is total potential runoff volume at beginning (m3)

V_r is total potential runoff volume at end (m3)

The calculated recharge is converted to daily volume per unit area. The daily recharge volume is calculated as given in equation (7) [4]:

$$V_d = VR/A \quad (7)$$

Where A is Area of the catchment (m2)

V_d is storage volume between recession (m per day)

3.1.2 MASTER RECESSION ANALYSIS

In master recession curve analysis a single curve is obtained representing all individual recession curves. The analysis of master recession curve is carried out by separating each recession segment from yearly hydrograph. The adapted matching strip method is used for construction of master recession curve. A visual basic spreadsheet macro is used for master recession analysis. In VBA excel sheet, each individual recession curve is fitted to an exponential regression model to draw master recession curve. The date and runoff are initial inputs which gives runoff hydrograph. The automated VBA macro is used to separate individual recession and time of recession from hydrograph. The separation of individual recession is carried out with the separation criteria set by flow duration curve. The flow duration curve shows the percentage of time that a given flow rate is equaled or exceeded. The separation criterion of (10-70) % is selected for each year. The high runoff data value are selected as initial runoff exceeds the corresponding runoff values by (10-70) % in an individual recession curve. The process includes the selection of variable length of recession period from runoff data. The separated time is then ranked in descending order from which initial value of recession is obtained. Then the highest flow value are selected along with declining values. It is then plotted in semi-logarithmic scale in decreasing order which gives the equation with two variables x and y. In the semi-logarithmic plot, x represents time of flow and y represents flow rates. The second highest number gives the second recession. The curve obtained with second highest value is adjusted to the last point value of first recession curve. The adjustment is carried out with segment translation. In segment translation, the time of second recession is shifted to required place along axes till it fit to the end of first recession. The process continues till the last recession curve is combined. Finally a regression line is drawn with the best fitted model criteria. The regression line obtained is called master recession curve. The criteria are based on trend line R2 describing the data which varies from 0-1. The values approaching to 1 are the best fitted models. The data obtained from VBA macro excel sheet are runoff values for each individual recession, time of recession and equation for regression line. From the exponential regression equation recession constant is calculated. From the recession constant, runoff during each recession and time of recession groundwater recharge is calculated. The calculated processes are similar to individual recession analysis.

3.1.3 WAVELET TRANSFORMATION

Wavelet analysis is carried out to find centred frequency from time series runoff data. Hydrograph interflow is relatively faster than baseflow. The runoff is changed to frequency signal. The time of baseflow is longer. As a consequence, signal frequency is reduced. The central frequency is frequency at which there is change in signal behavior. The wavelength transformation of catchments is done using Matlab. The time series runoff data is converted to frequency signals. To obtain frequency signals from time series data Fast Fourier Transformation (FFT) is used. By using FFT the time domain data is decomposed to frequency signals. From the frequency signals center frequency is obtained. To find center frequency a band pass filter criteria called Nyquist rate is used. The Nyquist frequency and Nyquist rate are two different terms. Nyquist frequency is twice the highest frequency in the signal whereas Nyquist rate is used to obtain symmetric signal. The Nyquist rate is obtained from amplitude modulation which converts signals to symmetric signal within maximum amplitude. In this maximum amplitude is taken as 1. From the symmetric frequency signal center frequency is obtained. The centered frequency obtained from wavelet analysis is used to find the recession parameters for the catchment. The equation for calculation of recession parameter k using the centred frequency is shown in equation (8) [7]:

$$k = e^{-fc} \quad (8)$$

Where k is recession parameter

f_c is centered frequency from wavelet analysis

The wavelength transformation in this study is only used for comparison of recession constant. The process is relatively new and requires further study to relate with groundwater processes. The further calculation requires initial flow and recession period. The calculation of these flow characteristics further study on reconstruction of original signal. The original signals can be obtained from Short Time Fourier Frequency (STFT) transformation but phase angle cannot be regenerated. Due change in phase angle random data is obtained and data obtained is not equal to original data. The Fast Fourier Transformation (FFT) of signal results in randomization of phase. By doing Inverse Fast Fourier Transformation (IFFT) original signal can be regenerate but at random phase. By using this method the frequency at which baseflow occurs is only obtained. It is unable to determine the original runoff and time at which baseflow starts.

3.1.4 RECESSION CONSTANT AND RECHARGE FROM BASEFLOW SEPARATION

Baseflow is separated from total flow using smoothed minima technique. Baseflow program is used for baseflow separation. A Baseflow program is VBA excel which is used to separate surface and base flow [8]. For separation of base flow mean daily flow is divided into non-overlapping blocks of 5 days. The minima value is calculated for each block. The minima value is called central value. The separation criteria for each bock is as 0.9 × central value <original value. The central value gives ordinate for baseflow line. The process is continued to obtain baseflow ordinates from all values. Base flow index is obtained as the ratio of volume of water lying under base flow line to the volume of water below mean daily flow line (Institute of Hydrology, 1980).

The base from index obtained is used to calculate groundwater recharge volume and recession constant. The equation for calculating groundwater recharge volume from baseflow index is shown in equation (9) [9].

$$BFI = Q_b/Q = R \quad (9)$$

Where BFI is Base Flow Index

R is base flow volume (m3)

Q_b = base flow (m3/s)

Q = total flow (m3/s)

The equation for calculating recession constant from baseflow index is shown in equation (10) [10]:

$$BFI = (6k\ (1-k))/3k \quad (10)$$

Where k is recession constant

3.1.5 RECESSION CONSTANT AND STORAGE FROM SPECIFIC YIELD

The specific yield is related to groundwater table. The specific yield and change in groundwater level is used to calculate recession constant and groundwater recharge. The time series graph of groundwater level data is similar to runoff hydrograph. From the groundwater level data, the depletion curves are selected. The change in groundwater level during each depletion curve is used to calculate recession constants. The recession slope is calculated as the ratio of product of specific yield and time to the change in groundwater level as shown in equation (11). From recession slope recession constant is calculated using equation (12) [11].

$$S_y = (\alpha \times t)/\Delta h \quad (11)$$

$$k = e^{-\alpha} \quad (12)$$

Where Sy is Specific yield

t is time (days)

Δh is change in groundwater level

α is recession slope

For yearly groundwater recharge, the average groundwater level change in each depletion curve and average specific yield is used. The recharge calculation is based on the assumption that percolated water immediately goes to storage. This method is applicable for short recession periods [12].The calculation of groundwater volume change is shown in equation (13) [11].

$$G_r = h_{avg} \times S_y \quad (13)$$

Where Gr = groundwater recharge (m/d)

h_{avg}= Average water level (m)

3.2 UNSATURATED MOISTURE BALANCE COMPONENTS

The water balance model is used for each year. The calculations are carried out with daily data. The water balance model gives yearly groundwater recharge. The outputs obtained from unsaturated moisture balance are rainfall, infiltration,

contribution from upslope, total evaporation, recharge and saturated runoff. The groundwater recharge volume obtained as moisture balance output is used to compare the groundwater recharge obtained from different methods used. The outputs from unsaturated balance moisture model are computed using a software toolkit called class U3M-1D. This program uses Richard's equation for water balance calculation. The equation is applicable for any soil, weather conditions or vegetation type. The software toolkit contains three alternatives for soil hydraulic modeling: Van Genuchten soil hydraulic model, Vogel and Cislerova soil hydraulic model and Brooks and Corey soil hydraulic model. Brooks and Corey soil hydraulic model is chosen in this study. Brooks and Corey soil hydraulic model is chosen due to easy mathematical manipulation and flexibility of program allowing user input hydraulic parameters. The outputs obtained from the software are total evaporation (E), saturated runoff (Wdelta), infiltration runoff (Qtop) and infiltration recharge (Qbot). The soil moisture fluxes are separated in upward and downward direction. Total evaporation (E) and saturated runoff (Wdelta) represents upward flow. The total evaporation and saturated runoff lies above arbitrary plane called zero flux plane. The infiltration runoff (Qtop) and infiltration recharge (Qbot) represents downward flow. The infiltration runoff and infiltration recharge lies below zero flux plane.

4 CALCULATIONS

4.1 HYDROGRAPH RECESSION AND SPECIFIC APPROACH

The recession constants and groundwater recharge are calculated from individual recession, master recession and baseflow separation. From wavelet transformation, only recession constants are calculated. The recession constants are compared to theoretical values. The groundwater recharge obtained from various methods is compared to groundwater recharge from unsaturated water balance model. The obtained results are statistically compared. The summary of the results for Marjasuo (Table 1) and Röyvänsuo (Table 2) obtained from hydrograph recession methods and specific yield.

Table 1. Summary of the recharge volume and recession constant calculated from various methods for Marjasuo catchment

Methods	IRS		MRC		Wavelet	Base flow		Specific yield	
Results/ Years	Vd (m/d)	k (1/d)	Vd (m/d)	k (1/d)	k (1/d)	R (m/d)	k (1/d)	Gr (m/d)	k (1/d)
2010	0.0243	0.6916	0.023	0.82	0.96	0.0127	0.883	0.022	0.56
2011	0.0495	0.685	0.049	0.86	0.95	0.0206	0.885	0.046	0.62
2012	0.0685	0.6268	0.068	0.51	0.87	0.0273	0.95	0.054	0.66
2013	0.019	0.7766	0.019	0.74	0.97	0.0009	0.996	0.008	0.43

Table 2: Summary of the recharge volume and recession constant calculated from various methods for Röyvänsuo catchment

Methods	IRS		MRC		Wavelet	Base flow		Specific yield	
Results/ Years	Vd (m/d)	k (1/d)	Vd (m/d)	k (1/d)	k (1/d)	R (m/d)	k (1/d)	Gr (m/d)	k (1/d)
2010	0.035	0.598	0.038	0.86	0.95	0.0208	0.87	0.03	0.49
2011	0.02	0.834	0.02	0.72	0.91	0.0055	0.94	0.02	0.43
2012	0.0477	0.565	0.047	0.74	0.78	0.0969	0.86	0.03	0.46
2013	0.0213	0.745	0.021	0.76	0.96	0.0132	0.79	0.02	0.66

4.2 RECHARGE VOLUME FROM UNSATURATED WATER BALANCE

The output fluxes are the components of unsaturated water balance model. The output flux contains rainfall (R), total evaporation (E), saturated runoff (Wdelta), infiltration from soil surface (Qtop) and infiltration recharge (Qbot). All the obtained results are in meter per day (m/d). The output fluxes are summed up to get annual values of all components. From results obtained, groundwater recharge volume is separated. The results obtained with all output fluxes in meter per day (m/d) and output soil moisture is shown as Appendix 4. The outputs from unsaturated soil moisture balance are applicable for various hydrological processes. The components from unsaturated water balance are considered to be precise with some uncertainty. So, the recharge volume from soil moisture water balance is compared with groundwater recharge obtained from other methods. From yearly water balance, components for each year (Table 3) and (Table 4) recharge volume is used for comparison. The negative sign in Tables (3) and (4) indicates downward movement of soil moisture.

Table 3: Soil moisture balance components for Marjasuo catchment

Year	Evaporation(E)	Sat. runoff (Wdelta)	Recharge (Qbot)	Infil. Runoff (Qtop)
2010	0.000022	0.332178	-0.023804	-0.348257
2011	0.000026	0.497769	-0.049572	-0.403306
2012	0.000023	0.374437	-0.067326	-0.351485
2013	0.000024	0.367651	-0.019379	-0.218359

Table 4: Soil moisture balance components for Röyvänsuo catchment

Year	Evaporation(E)	Sat. runoff (Wdelta)	Recharge(Qbot)	Infil. Runoff (Qtop)
2010	1.73E-05	0.37532	-0.0366	-0.35964
2011	2.11E-05	0.41336	-0.01964	-0.39722
2012	1.67E-05	0.22122	-0.04778	-0.51866
2013	1.68E-05	0.34768	-0.0234	-0.22061

5 RESULTS

Analyzing the results obtained from hydrograph recession analysis and specific yield, the good method is identified. The most efficient method is determined from the following two approaches: a) box plots of recession parameters and recharge volume b) comparison with theoretical recession parameters.

The box plots for recession parameters (Fig. 2 and Fig. 3) show the plot of recession parameters from different methods for two catchments. The plot obtained is compared to theoretical value that ranges from 0.85 to 0.99 [13]. The box plots for (Fig. 4 and Fig. 5) reveal groundwater recharge from different methods and groundwater recharge from unsaturated water balance.

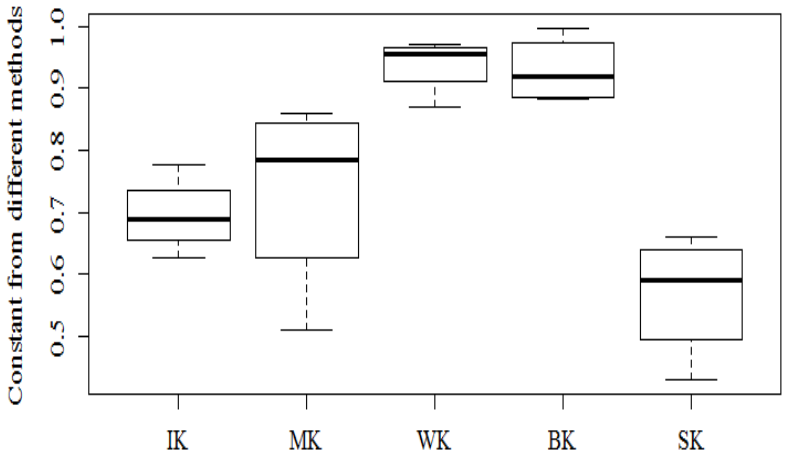


Fig. 2. Box plot for recession constants for Marjasuo catchment.

Note: In Fig. (2): BK = Base flow recession constant, IK = Individual recession constant, MK = Master recession constant, WK = Wavelet constant and SK = Specific yield constant.

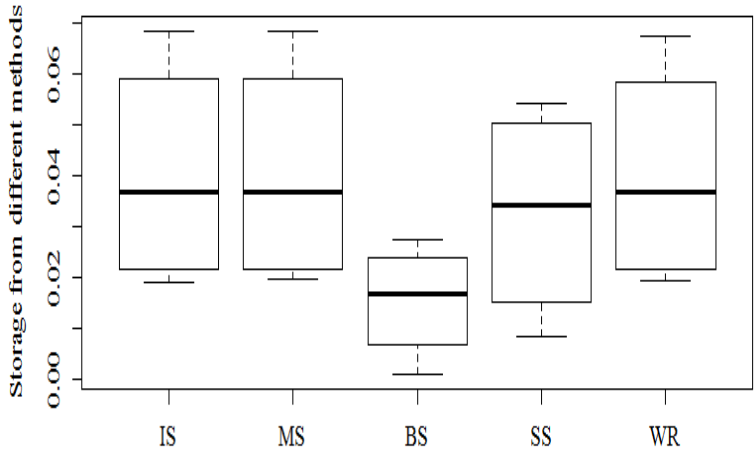


Fig. 3. Box plot for Groundwater recharge for Marjasuo catchment.

Note: In Fig. (3): IR = Recharge volume from Individual recession, MR = Recharge volume from Master recession, BR = Recharge volume from Base flow, SS = Recharge volume from specific yield and WR = Recharge volume from water balance.

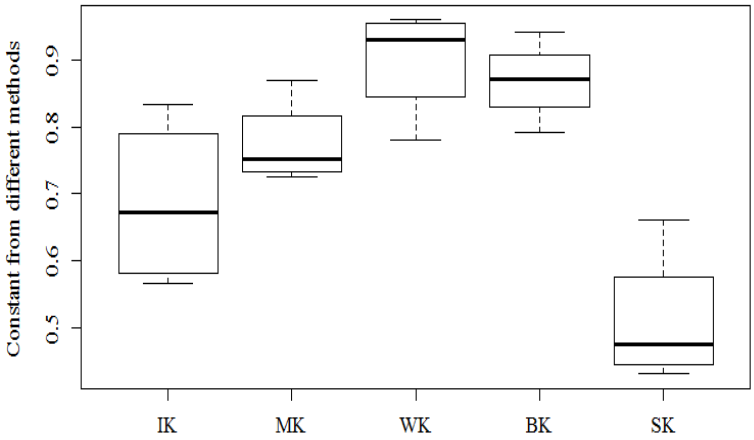


Fig.4. Box plot for Groundwater recharge for catchment.

Note: In Fig. (5): IK = Individual recession constant, MK = Master recession constant WK = Wavelet constant, BK = Base flow recession constant and SK = recession constant from specific yield.)

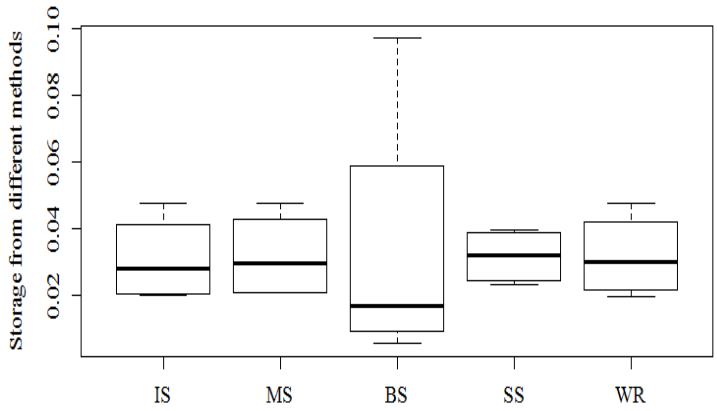


Fig. 5. Box plot for Groundwater recharge for Röyvänsuo catchment.

Note: In Fig. (4): IS = Recharge volume from Individual recession, MS = Recharge volume from Master recession, BS = Recharge volume from Base flow, BS = Recharge volume from specific yield method and WR = Recharge volume from water balance.

The theoretical value for groundwater recession lies in the range of 0.85 to 0.99 [13]. The box plot of recession parameters for Marjasuo (Fig. 16) and 63box-plot of recession parameters for Röyvänsuo (Fig.18) show the calculated results of recession constants. Both catchments show that the parameters calculated using wavelet transformation and baseflow lies within the range of theoretical values. The box plot of recharge volume for Marjasuo (Fig. 18) and box-plot of recharge for Röyvänsuo (Fig. 20) show the calculated groundwater recharge. Both catchments show that groundwater recharge volume calculated from Individual recession and Master recession are close to the recharge values calculated from water balance method. The recharge volume from baseflow method is not close to recharge calculated from Water balance. The recession parameters calculated from Master recession nearly lies in range of theoretical value. Also recharge volume from Master recession is close to recharge calculated from Water balance.

6 CONCLUSION

The study is based on comparison of different methods for calculation of recession constant and groundwater recharge using hydrograph recession analysis. Hydrograph recession analysis of catchments Marjasuo and Röyvänsuo is carried out with runoff data. Different recession analysis methods: individual recession, master recession, wavelet transformation and baseflow separation are used to compute recession constant and groundwater recharge. Wavelet transformation is only used for calculating recession constant. For further implication of wavelet analysis further work is required. The groundwater level change during recession is related to groundwater recharge. The recession constant and groundwater recharge can also be calculated with specific yield and groundwater level. So, the results from specific yield are used for comparison. The water balance parameters are computed by unsaturated moisture movement model. The unsaturated moisture model includes catchments parameters related to the runoff process. The water balance components obtained from water balance models are almost accurate and are used in various land use practices and effective soil-water conservation. The water balance model provides parameters for the purpose of rainfall designs, storage yield, and prediction of meteorological, study of hydrological and ecological processes. The statistical comparison of groundwater recharge method and groundwater recharge from unsaturated water balance model shows master recession analysis method is the most efficient hydrograph recession analysis techniques among the methods used in this study. Hydrograph recession also correlates climatic and geomorphologic features of the catchment. Hydrograph recession parameters contain embedded information about the flow regime and hydro geological characteristic of the catchment. Hydrograph recession analysis should be carried in fast and objective manner. The different recession analysis method used in this study gives recession parameters and groundwater recharge for the catchments. The recession parameters denote the slope of depletion curve. It also represents the rate by which water flow from the catchment to the runoff point. The flow in the catchment is also influenced by catchment slope and climate. The climatic information in hydrograph is further clarified by unsaturated moisture movement model. In unsaturated moisture model, soil moisture content in various soil layers are 67calculated at certain time period. It also contains the direction of flow at certain time. The amount and direction of flow is influenced by climatic condition and hydraulic conductivity of the catchment. The recharge component obtained from unsaturated moisture model is used to compare recharge calculated from different methods.

The recession parameters calculated from various methods differs from each other. The recession parameter depends on the selection of recession curve and procedure of its analysis. The calculation in this study also shows different recession parameters and groundwater recharge values. To identify the best method, statistical tests are carried out. The wavelet transformation is a recent method applied for qualitative analysis of data which gives recession constant close to theoretical values. The study provides adequate information about various methods of hydrograph recession analysis and specific yield by which recession constant and groundwater recharge are calculated.

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Impact of Bullish and Bearish Market on Investor Sentiment

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ABSTRACT: This paper measures the investor's sentiment in stock market. There are two indicators to measure investor sentiment either directly or indirectly, Closing price of stocks and traded volume as proxy variables (indirect method) were used for analyses. This study finds the connection between investor's sentiments, which depends upon the bullish and bearish market trends. After analysis, it is concluded that bullish and bearish trends in the stock market are appropriate measures for measuring the investor's sentiments as per results shown in this study.

KEYWORDS: Stock Price, Trading Volume, Causality and Regression.

1 INTRODUCTION

Several financial models and theories explain and present frame work and show the act of individual to maximize the utility through their own preferences and constraints, over the last three decades many psychologists and researchers studied the macro and micro behavior of different investors through the contribution of such behavioral finance models. There has been lacking of empirical evidence to confine sentiment to measure explicit sentiment.

The late 1990s Internet bubble pushed the prices upward and then downward, is known as period of extraordinary investor sentiment. Dramatic changes in the prices of security occurred due to the various stock market crashes in different period of time. Standard Finance model unanswered these sudden changes in the security prices. In these models, security traded in financial market is influenced by rational investor. Researchers working on alternative model to investor sentiments to support traditional financial model. Investor sentiment means expectation about future price of security, which is not augmented by fundamental Shleifer (1991).

Black (1986) found that sentiments unable the security to trade at its fundamental values. De Long et al (1990) assert that sentiment and sentiment free investor competition set the security price in the stock market. But firm with long earning history, tangible assets, and stable dividend are less affected by the investor sentiments. This paper used Granger causality analysis to identity the investor sentiments over the Bullish and Bearish market. We argue that Bullish and Bearish market provide a roadmap to decision makers, because Wall Street old saying is that trend is friend of investor.

The organization of paper is as follows. Next section briefly reviews the literature on investor sentiment and Bullish/Bearish Market. Theoretical framework includes in the third section. Fourth section contains the Descriptive statistics. Finally we discuss the managerial implication and conclusion of this study.

2 LITERATURE REVIEW

Before taking the descriptive point of view, the main aim of this paper is that how an individual investor makes his investment decision in the financial market. The investment decision behavior and psychology are based on review of existing study which has already conducted through different methodologies.

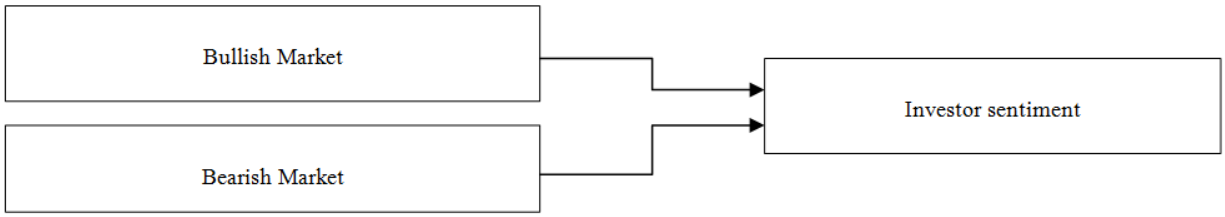
Prospect theory says that during Bullish period, the investor remains risk averse while the attitude of investor in bearish period remains risk seeker. It means Investor psychology play vital role in upward & downward movement of security prices traded in the financial market. Investor sentiment shows the trend of speculation in near future and drives the relative need of speculation (Baker and Wurgler, 2004). Investor sentiment is investor's expectation on future market with systematic deviation (Rao and Lee, 2003), which could be bullish or bearish trends in stock market (Avery and Chevalier, 1999).

Daniel et al (2002) considered sentiment as an ingredient of systematic risk which increases the systematic risk. Two difficulties arise in investor sentiment research, come to the choosing and quantifying of investor sentiment. It covers direct sentiment and indirect sentiment in light of quality and acquiring method. Direct sentiment is partial investors' expectation on the future market, and the research result is known as investor confidence index, The Yale Stock Market Confidence Index has drawn up by Shiller is one of them. Indirect sentiment refers to the economic variables that could affect investors' price assessing and expectation on market, for instance, closed-end fund discounts could function as the proxy variable of investor sentiment (Lee, Shleifer, Thaler, 1991). Direct sentiment and indirect sentiment proxy are correlated; Levels and changes of investor sentiments are strongly correlated with contemporaneous market returns (Brown and Cliff, 2004). But indirect approach is less biased measure of sentiment by Schmeling (2007). Clarke and Statman (1998) asserted that during bullish and bearish market there is no relationship of forecasted sentiment by newsletter editors and returns. Schemling and Verma (2007) study revealed that individual sentiments become negatively correlated with returns and these are narrowly related with noise and fundamental trading Individual investors are more affected by sentiments than institutional investors by (Hsu et al. 2005).

Danial et al (2002) explained the term noise trader means irrational investor behavior. Lee et al. (1991) asserted that noise traders temporarily affect the security prices. Baker and Stein (2004) found that noise trader trade more when market is bullish. They buy the security which leads to increase its demand and at last security prices move up by Banker and Wurgler (2006). Fisher and Statman (2000) found that Short-horizon market returns can be examined and predicted through a variety of technical variables. Brown and Cliff (2004) found that sentiment affected the stock returns for shorter period of time. While sentiment has little predictive power for near-term future stock returns (Brown and Cliff, 2004). (Neal and Wheatley, 1998; Fisher and Statman 2000), all together agree about the usefulness of adopting sentiment indices. Clarke and Statman (1998), Brown and Cliff (2004) offered a less confident assessment of the capability of such indices to forecast market prices.

Moreover, Simon and Wiggins (2001) expend the investor sentimental analysis to the futures market and found significant results. Recently Chinese scholars have not agreed on closed-end fund discounts (Jin et al.; Zhang and Zhang, 2002), and have deviate on the empirical work of relationship between stock market return and direct investor sentiment (Rao and Liu, 2003). Their empirical study shows that Chinese stock market still need to be improved regarding investor sentiments. For necessary statistics significant results, the sample range is not too short, which means the empirical conclusion is statistically acceptable.

THEORETICAL FRAME WORK



INVESTOR SENTIMENT

We consider trading volume as a proxy variable to measure investor sentiment. Hsu et al (2008) found that financial market trading volume influenced the sentiments of individual investor. Cochrane (2002) found that prices of security trades in stock markets are positively linked with the trading Volume. There are other proxies as well which used to measure investor sentiment index.

From last few decades the most debatable issue in behavior finance that how investor sentiment affect on stock price and normally a question arises that how to measure investor sentiment and their quantitative effect. So, give the answer of this question trough bottom up approach which bases on investor psychology and explain that how investor over/under react on past return. The purpose of this research work is to offer new cumulative approaching to check investor sentiment through bullish or bearish trend in stock market.

3 METHODOLOGY

Karachi Stock Exchange is the oldest stock exchange in Asia and today, it is the most popular stock exchange in the world in terms of number of transactions handled through its electronic trading system. KSE have smoothed the progress of growth of the Pakistani corporate sector through competent heave stage of capitalization. The 100KSE Index in Pakistan mostly admired and Benchmark Index in stock market with 652 listed companies with $32.50 million market capitalization in KSE.

Trading volume means the number of shares which traded during a definite time period. When volume is high it show that major changes in stock price which significantly generate some important news in stock market for the attraction of investor and financial institution.

We took the data for the years of 2005 to 2011 of Karachi Stock Exchange index. We used trading volume as a proxy variable to measure investor sentiments. Bullish and Bearish Trend found by the prices index of KSE 100. We used Granger Causality Analysis and SPSS test to find out the relationship between Bullish & Bearish Market and Investor Sentiment. Chosen the data period from 2005 to 2011 because during this period Pakistan stock markets have undergone no considerable policy changes characterized and the departure of private foreign capital flows due to big question small answer terrorism, inflexible exchange rates, weak economic growth, credit market crisis in the United States and spiky fell in Asian market. Stock market has affected by many ways such as the volatility of index and degree of volume which trades in market. Returns are lightening through the log difference movement in the price index, using the closing price to calculate the stock continuously-compounded return.

GRANGER CAUSALITY

The purpose of Granger causality investigate the usefulness of past information volatility and improve the forecasting of trading volume and deployed to estimate the short run relationship among all variables. In this research work study test that whether trading volume cause on stock price or stock prices cause on trading volume and how much their result effect on investor sentiment and decision making.

4 RESULTS

IMPULSE RESPONSE FUNCTION

The purpose of variance decomposition is to approximate the movement of n-step proportion and forecast the variable error variance in VAR system which mostly trait itself shock due to the existence of other variable in system, equally the impulse response of variable shows by impulse response function in VAR system currently through its own shocks or another variable.

We are using trading volume as a proxy variable for investigating the investor sentiments which will depends on the closing price of the shares which are traded daily bases on the floor of stock exchange. When the price of the stock going to be increase, and market is closed at high price it is considered the bullishness of market and inversely it is considered as a bearish trend.

When we take a graphical portray of our seven years closing prices as a variable with their respective daily dates the following fig #1 shows bullish and bearish trends in different time intervals within our sample period.

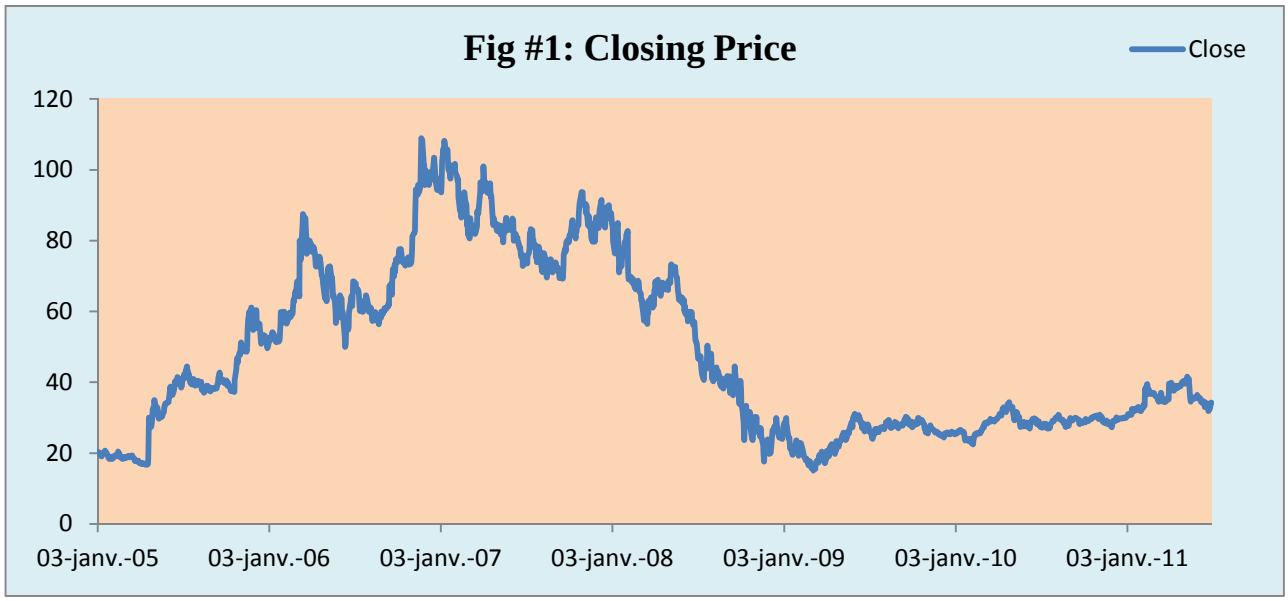


Figure 1 Bullish and bearish trends in the sample period of January, 2005 to June, 2011.

It's a phenomenon that the stock market never follows a stable pattern in the long run. Fluctuations are occurring continuously so we divide our sample period in to two segments bullish and bearish trend and these trends occurs more than a time in our sample period which can be seen in the following figures.

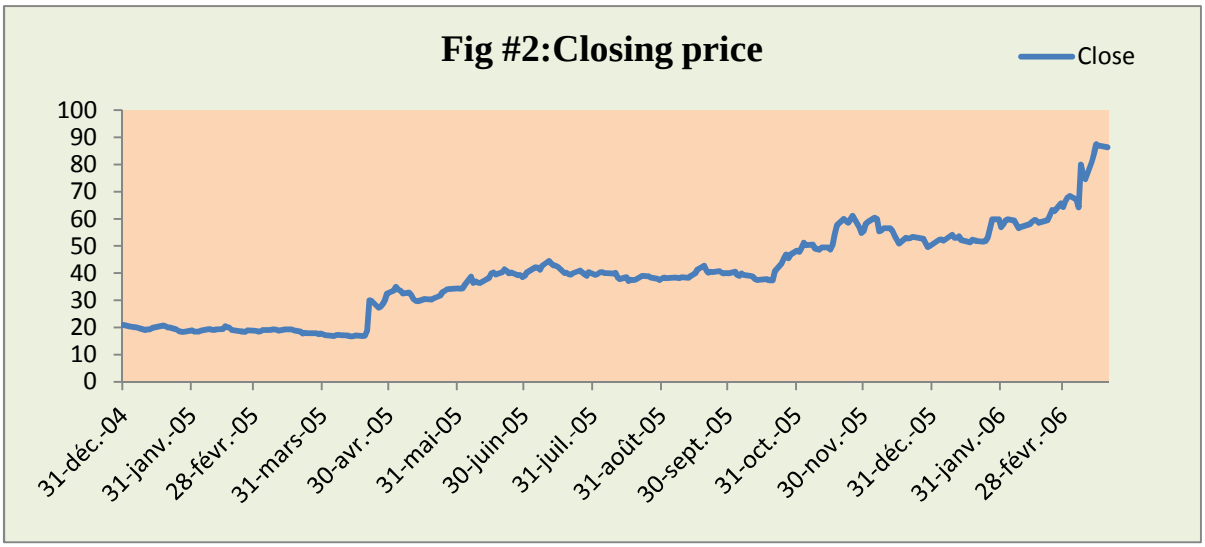


Figure 2 The bullish trend form December 31, 2004 to March 20, 2006.

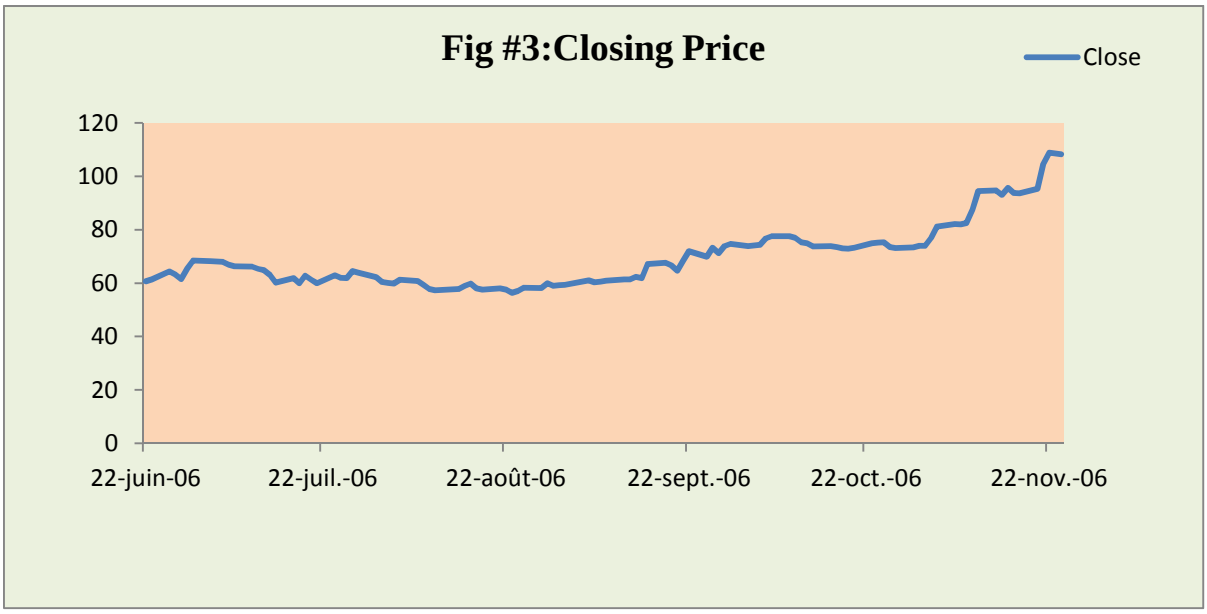


Figure 3 The bullish trend form June 22, 2006 to November 24, 2006.

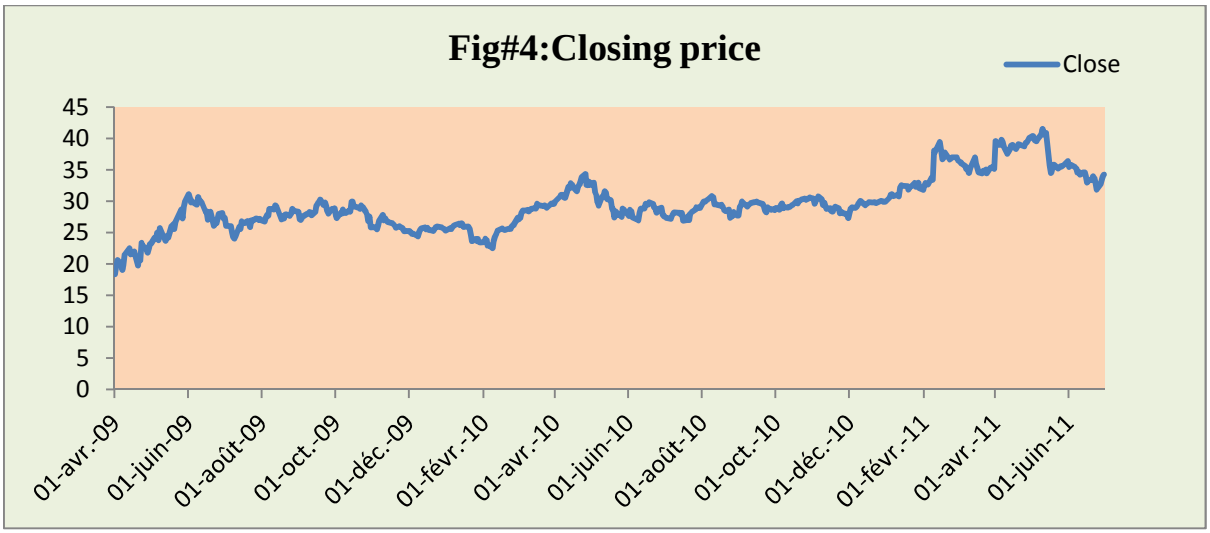


Figure 4 The bullish trend form April 1, 2009 to June 30, 2011.

From the above figures there are three different time intervals in which the market was showing bullish trends as it is roughly portrays in the graphs. Similarly the bearish trends are also occurs in our sample period more than a time which indicates that's the closing price at the end of the day after trading of different shares and stocks are decreases as compare to the opening price of the stock exchange which are clearly shown in the following figures.

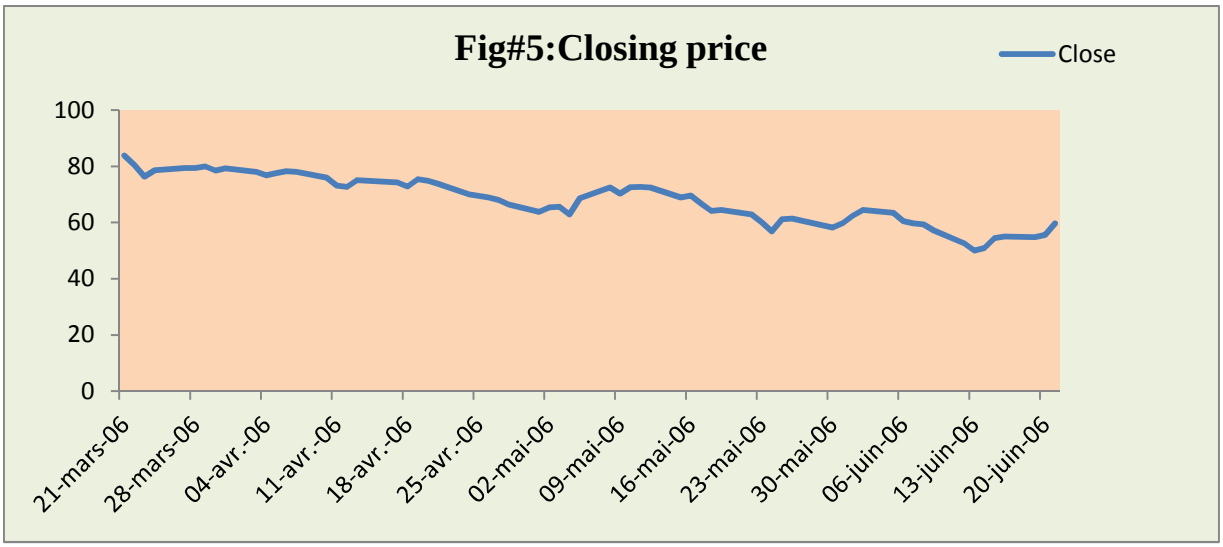


Figure 5 The bearish trend form March 21, 2006 to June 21, 2006.

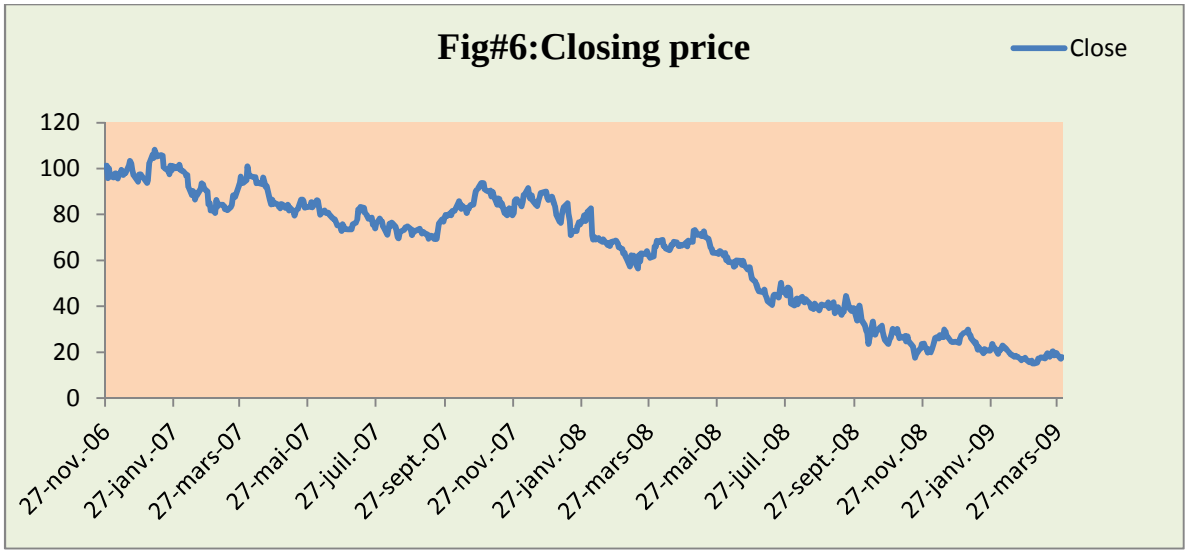


Figure 6 The bearish trend form November 27, 2006 to March 31, 2009.

Summary of the bullish and bearish market trends are given in the following table (1)

Table 1 Bullish and Bearish market trends

S.NO	Market trends	KSE 100
1.	Bullish Market:	
	December 31, 2004 to March 20, 2006.	305
	June 22, 2006 to November 24, 2006.	110
	April 1, 2009 to June 30, 2011.	558
	Total Days	**973**
2.	Bearish Market:	
	March 21,2006 to June 21,2006	65
	November 27,2006 to March 31, 2009	589
	Total Days	**654**

The second statistical test which is applied to investigate the impact of bullish and bearish market on the investor's sentiment is Granger Causality test although the regression analysis deals with the dependence of one variable on other variables but it does not necessary imply causation other words the existence of a relationship does not prove causality or the direction of influence. As the purpose of our study is that the closing price of the shares and stocks become the cause of motivation to invest in the stock market for the investors so it is the appropriate test to apply this type of empirical study.

Following are the two equations for unidirectional causality in the model of our study as per Granger Causality test.

$$\mathbf{Vt = \alpha + \sum_{i=1}^{n} \beta Vt - i + \mu 1t} \quad \textbf{(1)}$$

$$\mathbf{Vt = \alpha + \sum_{i=1}^{n} \gamma Pt - i + \sum_{i=1}^{n} \beta Vt - i + \mu 2t} \quad \textbf{(2)}$$

Where

Vt= volume of trade at current time period.

Vt-1=Lag volume of trade at preceding time period.

Pt-1=Lag values of closing price of stocks and shares.

Appropriate test statistic for Granger Causality test is

F = [(RSSr - RSSur)/q] / [RSSur/ (n-k)].

Where

RSSr = Restricted residual sum of squares.

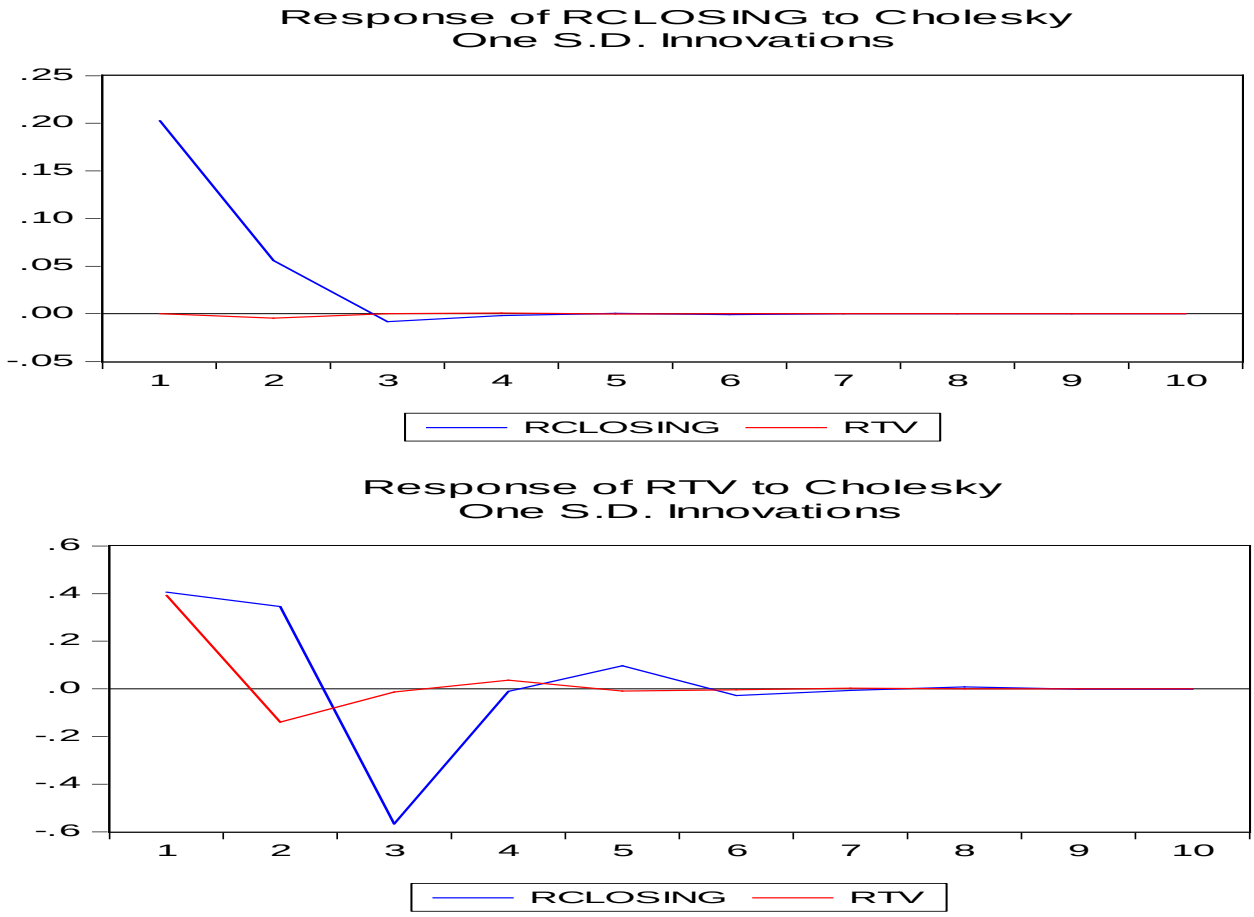
RSSur = Unrestricted residual sum of squares.

Calculated value of F-test = 327310.885 are highly rejected Ho: that indicates that there is impact of Bullish and bearish factor on the investor's sentiments. This test also indicate the Direction of Causality that is Closing price → trading Volume which is our proxy variable to measures the investor's sentiments to invest in stock exchange market.

Table 2 Uni-directional causality

Null Hypothesis	lag	Obs	F- Statistic	Prob
R CLOSING does not Granger Cause R TV	02	1971	9.28492	.0001
R TV does not Granger Cause R CLOSING			0.56145	.5705

Table 2 contains the results that there is uni- directional causality between daily closing price (stock prices) and trading volume which indicate that the movement of stock price in any direction is a sign of information and prediction about future trading activities.



Figure# 7 Impulse Response Function

According to Fig # 7 movement of stock prices not disturb the trading volume movement as shown in above figure after 3 lag periods the movement of stock prices are moves in a same direction with trading volume without any positive or negative reaction so the volatility of stock prices is slightly effect on trading volume but trading volume have largely effect stock prices either positively or negatively.

This study shows that investor trade more during the bullish period and less during the bearish period. So during the bullish period when investor sentiment is positive, it is the good time for financial manager to make some corporate decision. These corporate decisions are fruitful for the firm which ultimately increases the wealth of the shareholder. When market is bullish more buyer of security and fewer sellers which raise the security prices very high. So it is the right time for the manager to issue new shares of company. So he sell share at high price than normal period price. Other decisions like Dividend payments, merger of firms and seasoned equity issue are fruitful to take benefit of high trading valuation. The firm will not issue the share during the bearish period. If firm has sufficient amount of cash so it will repurchase share at that time. As result suggest that trading volume is affect by the bullish and bearish market. An individual investor must have an understanding of these trends.

Especially professionals like Firms Managers, Brokers and Mutual fund Managers can use various kinds of investment strategies like diversification of portfolio and short selling of various stocks to get benefit from this pattern of market. So they perform well in this competitive world of financial market where so many securities and investors are traded. Understanding these well founded strategies will surely improve the chances to perform better in both the markets. Broker must keep in mind the sentiments of Investor before prescribing the stock specifically during the bullish and bearish period. Policy maker should consider investor sentiment when they tradeoff risk and return.

5 CONCLUSION AND RECOMMENDATIONS

We conclude that bullish and bearish trends are the important factors, which play with the emotion of the noise traders and affect their sentiments. Investors trade less money when market is bearish and greater amount of money when market is

bullish. This can be shown by the trading volume during the bullish period and bearish period. The result is contradicted with the prospect theory, which describes that investor is more risk averse when market is bullish and risk prone when market bearish.

After analysis the data series shows that high existence of volatility in stock prices still lacks the trader confidence which not only affect investor sentiment but also different broker, regulator and analysis must review their portfolio. Stock price can be predicted through past volatility of trading volume but unfortunately the existence of asymmetric investment environment investor does not rationally act in stock market and this is the big cause of inefficiency in Pakistani stock market. So, the uncertainty and lack of trader confidence in stock market study suggests that domestic economic policies must be restructured by authorities for stable stock market activities.

Future research is required to find the relationship of bullish and bearish market with other measures of Investor sentiment in Pakistani context. Further which stocks perform well during the bullish and bearish period and which do not perform well.

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Routing and spectrum assignment in flexible optical networks using hybrid transponders

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ABSTRACT: The continuous growth of IP traffic in combination with other emerging high rate applications, such as high definition TV, video on demand, cloud computing and grid applications require more scalable and cost-effective networking infrastructure. To cope with this ever increasing bandwidth demand, we are moving towards more sophisticated communication systems, advanced modulation schemes, resources flexibility and more intelligent devices. While moving toward more agile networks flexible resources have clear edge on static resources in terms of reconfigure ability without manual intervention but this solution is not cost effective though. However high cost of flexible and intelligent resources has drawn attention toward hybrid environment where flexible resources join already existing infrastructure to meet bandwidth demands. This study is supported by simulative results derived from a sample optical network. The results give an insight of the spectrum resources utilization and efficiency benefits that can be obtained using hybrid transponder schemes in optical networks.

KEYWORDS: 400G systems, RAMAN, EDFA, Frequency Slots, Resource utilization, QAM, Simulations, Network Planning.

1 INTRODUCTION

Networks today must support a variety of traffic types, including legacy traffic based on regional SONET ring structures that require multiple traffic adds/drops (that is, voice, asynchronous transfer mode [ATM], frame relay) but must also support high-speed Internet backbones that are typically express lanes that require little add/drop multiplexing. Deploying the hybrid Raman amplifier and erbium-doped fibre amplifier (EDFA) amplification application in the L-band enables extended long-haul reach for this express Internet traffic, while still allowing deployment of the C-band as traditional long haul for legacy-type traffic, a deployment that requires multiple traffic add/drop sites. This mix of traditional long haul in the C-band and extended long haul in the L-band allows for better network flexibility. The ongoing advances in photonic technologies, such as optical multilevel modulation, optical orthogonal frequency-division multiplexing (OFDM) [2], and the seamlessly bandwidth-variable wavelength selective switch (WSS) [5] make it possible to treat optical fibre as a sharable continuous resource pool. Taking advantage of these concepts, a highly efficient spectrum resource allocation scheme adaptive to the client data rate in SLICE has been realized using the concepts of sub wavelength, super wavelength, and multiple-rate accommodation including future novel bit rates. In addition, spectrum resource allocation adaptive to the available spectral resources on the route is highly appreciated and enables flexibility in a network.

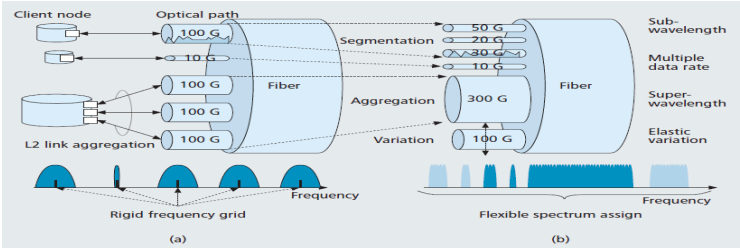


Figure 1.1 Static vs. Flexible spectrum assignment

In this work, we have evaluated how the performance of a transponder (i.e. its optical reach at a given data rate) influences the number of required spectrum resources in a realistic network scenario using different routing algorithms. Introducing 1+1 protection in the network even increases the margin of dynamic data rate DWDM compared with static data rate DWDM. We have presented a cost comparison for adaptive data rate transponders and traditional static data rate transponders which show a remarkable cost reduction capability of nearly 50% for adaptive flexible transponders.

2 EXPERIMENTAL SETUP

100 G systems are in market to fulfill the increasing demand of new services and 400 G systems are seeking their way to market. They are supposed to improve the economics and performance of 100G systems - broadening and accelerating 100G market adoptions. As 400 G innovation is seen as the gateway to a long, successful future. In this proposed study we are focusing on 400 G systems.

2.1 NETWORK MODEL

Network model considered is consisting of 30 nodes connected with each other in a unidirectional orientation. Each link between two pairs consists of 80 frequency slots. Number of slots assigned during connection setup is based on QAM flavour. Two different amplification scenarios (EDFA and RAMAN (+EDFA)) are considered, guaranteeing different optical reach.

QAM Flavour	EDFA Reach ability	Raman Amplifier Reach ability	No. of Slots
64 QAM	263 km	300km	3 slots
16 QAM	590 km	700km	5 slots
4 QAM	1457 km	1800km	9 slots

Listing 2.1 Statistics for 400 G with QAM Flavours, EFDA and RAMAN based amplification

Following topology is used in this research activity. This is layout of Spanish national backbone network and is named as Spanish topology.

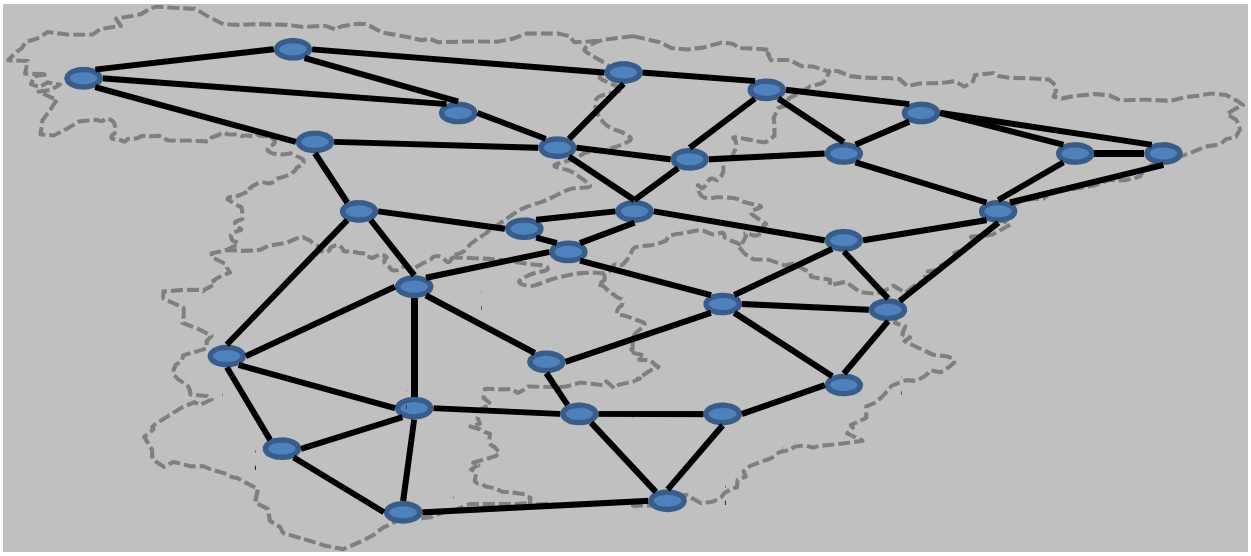


Figure 2.1 Prototype Topology

Based on reach estimations provided in Table (2.1) the RWA decides which flavour to use and how many slots to occupy. As light path is established for both primary and backup paths we have to make a decision about transponder type. If path length of backup path and primary exists in different QAM flavours we have two choices either to choose static transponder or flexible one. The first choice is cost-effective but expensive in terms of resource utilization while the second choice is optimum in terms of resource utilization but with increased budgeting due to higher complexity of flexible technologies.

RWA scheme is applied to identify the resources guaranteeing the adequate signal quality while solving the wavelength/slot contention issue. Results show that the number of resources required for the flexible network is much less than compared to the network with static transponders.

2.2 ROUTING AND WAVELENGTH ASSIGNMENT STRATEGIES

For each simulation a random traffic matrix is generated on the above topology. This helped us to collect very diverse statistics. Different routing schemes have been considered. In each of the following routing scheme we used First Fit (FF) strategy for resource allocation.

1. Shortest Path first (OSPF)(primary path)
2. Shortest (+1) path first (Backup path)
3. Shortest distance first
4. Longest distance first

However this study is based on single data rate system. We are using 400 G system to analyze resource utilization considering EDFA and RAMAN (+EDFA) amplifications. We are focusing on performance evaluation of static and flexible transponders.

3 RESULTS AND DISCUSSION

Here we are giving statistics calculated during this study and research activity using EDFA and RAMAN Amplifiers. Based on the reach ability constraints, if active and backup paths can be accomplished using same number of slots we will use a static transponder otherwise a flexible transponder would be used. But this is purely based on network model. So every time we use a different network model we will have different listings.

3.1 TRAFFIC MATRIX GENERATION AND RESOURCE ALLOCATION

For resource utilization statistics each simulation is done for dynamic traffic matrix and thousands of connection establishment requests. Here each simulation consists of 5000X 50 requests. So there are 250,000 requests to be established. A request is established using static transponder if resource allocation needs equal number of spectrum resources for both active and backup path, otherwise we use flexible transponder. Following results indicates the resource utilization for 10 simulations which are averaged for 50 requests. As we are using two types of amplifiers EDFA and RAMAN amplifiers in this study and their reach-ability is different from each other. So we calculate their statistics separately for static transponders and hybrid transponders scheme (static + flexible). Following listing shows results of 10 simulations each consisting of averaged 50 requests.

No. of Static Transponders	Hybrid Orientation Static | Flexible		Resource used with all static transponders	Resource used with hybrid transponders
50	37	13	5921	3192
50	31	19	5116	2070
50	30	20	5099	1839
50	34	16	5912	2307
50	32	18	4838	2124
50	30	20	4851	1780
50	27	23	5913	1904
50	33	17	4705	2074
50	32	18	4772	3102
50	31	19	5968	2909

Listing 3.1 Resource utilization using EDFA

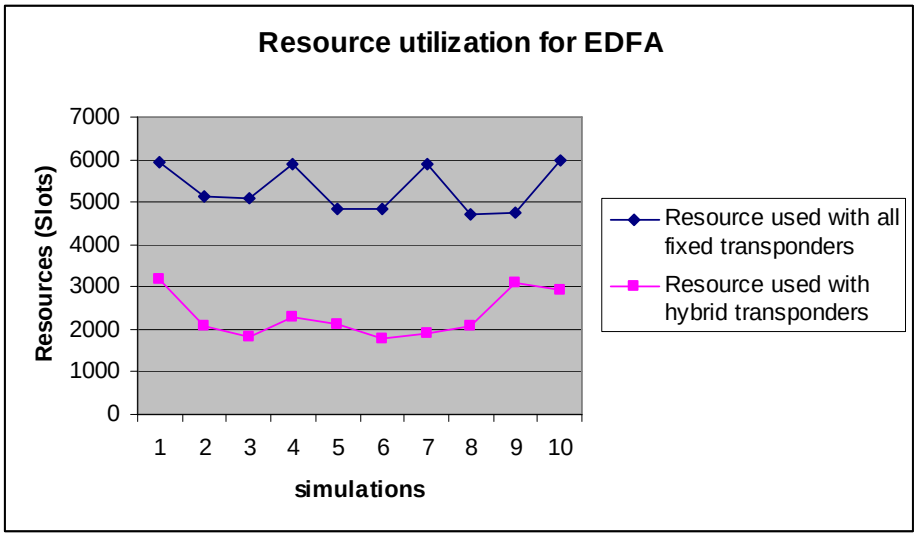


Figure 3.1 (EDFA) Resource utilization graph

Following listing shows overall resource utilization using static and hybrid transponders with RAMAN amplification scheme.

No. of Static Transponders	Hybrid Static | Orientation Flexible		Resource used with all static transponders	Resource used with hybrid transponders
50	32	18	5848	2631
50	35	15	5324	2328
50	31	19	5907	2588
50	34	16	4009	1679
50	33	17	5595	2416
50	32	18	4879	2165
50	34	16	6390	2766
50	33	17	3856	1701
50	32	18	5477	2320
50	33	17	5143	2018

Listing 3.2 Resource utilization using RAMAN Amplifiers

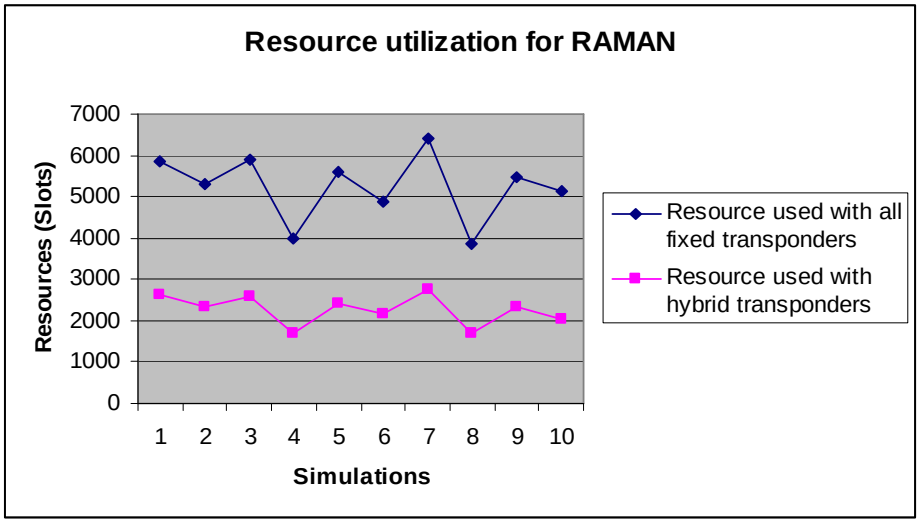


Figure3.2 (RAMAN) Resource utilization graph

Resource utilization trends shown by graph for the above mentioned simulations.

Using EDFA Amplifications

On average:

Resources used per simulation for all static transponder scenario = 5310

Resources used per simulation for hybrid transponder scenario = 2330

So all static transponders uses about 2.27 times more resources compared to the hybrid environment.

Using Raman Amplifications:

On average:

Resources used per simulation for all static transponder scenario = 5242

Resources used per simulation for hybrid transponder scenario = 2261

So all static transponders uses about 2.3 times more resources compared to the hybrid environment.

Static and flexible transponder utilization ratio

For the given network model using OSPF algorithm we computed number of static and flexible transponders for 10 simulations each consisting of 5000X 50 requests. So in total we have 250,000 requests and we got following statistics.

@ EDFA:

Requests established using static transponders= 161380

Requests established using hybrid transponders= 88620

Out of 50 Requests established using static transponders=
161380 / 250000 X 50 = 32.2= 32 approx.

Out of 50 Requests established using hybrid transponders=
88620 / 250000 X 50 = 17.8 = 18 approx.

On average, out of 50 requests, 32 are established using static transponders while 18 are established using hybrid transponders for this specific network model. This result is similar to that shown in listing 4.3 where 10 simulations are done with each having 50 requests and hybrid and static scenarios are compared. So taking averages of these 5000 simulations for static and hybrid transponders we get following listing.

Static transponders	Hybrid Transponders
34.532	15.468
31.725	18.275
30.2	19.8
33.463	16.537
32.125	17.875
30.092	19.908
28.639	21.361
33.567	16.433
32.563	17.437
31.879	18.121

Listing 3.3

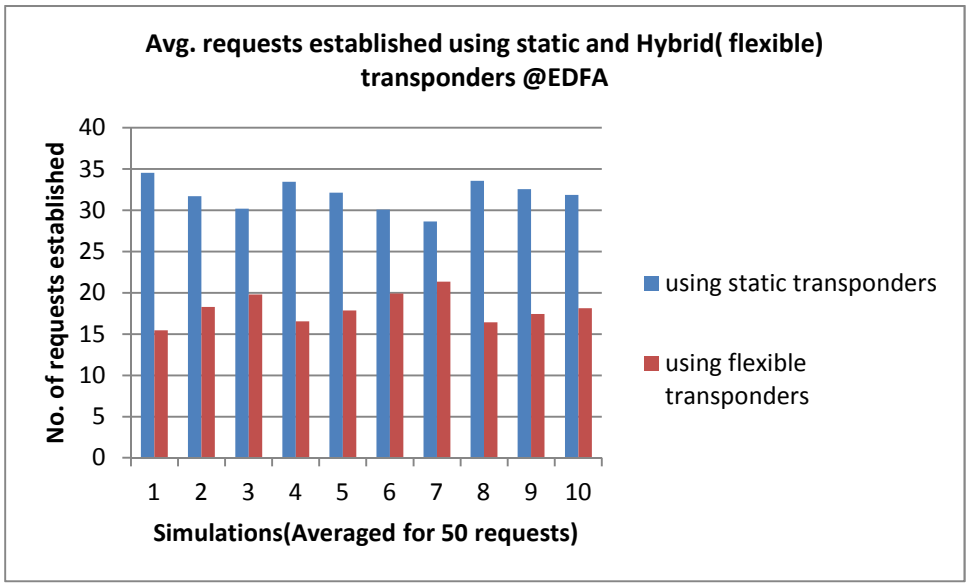


Figure 3.3

@ RAMAN:

Requests established using static transponders= 152100

Requests established using hybrid transponders= 97900

Total connection requests= 250000

Out of 50 Requests established using static transponders= 152100/250000 X 50 = 30.42= 30 approx.

Out of 50 Requests established using hybrid transponders= 97900/250000 X 50 = 19.58 = 20 approx.

On average out of 50 requests 30 are established using static transponders while 20 are established using hybrid transponders for this specific network model. This result is similar to that shown in listing 4.4 where 10 simulations are done with each having averaged 50 requests and hybrid and static scenarios are compared. So taking averages of these 5000 simulations for static and hybrid transponders we get following listing.

Static transponders	Hybrid Transponders
28.54	21.46
31.72	18.28
30.6	19.4
31.46	18.54
29.12	20.88
30.09	19.91
28.64	21.36
30.56	19.44
32.56	17.44
31.879	18.121

Listing 3.4

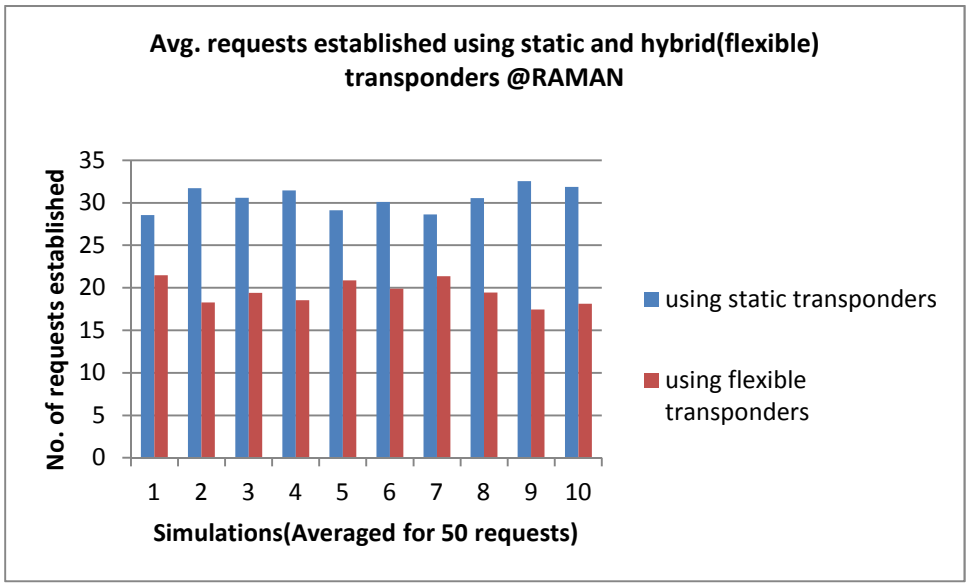


Figure 3.4

4 CONCLUSIONS

Adaptive hybrid transponders in optical networks provide high data rates while utilizing minimum spectrum resources. Hybrid transponders can be used to increase the total network capacity on the expenses of a potential increase in the network cost due to the higher complexity of adaptive technologies. In this work, we have evaluated how the performance of a transponder (i.e. its optical reach at a given data rate) influences the number of required spectrum resources in a realistic network scenario using different routing algorithms. Using flexible transponders has remarkable advantage as it is possible to increase the reach by reducing the capacity while changing the modulation format. Therefore, for longer links, it is still possible to find a feasible routing with worse performing adaptive data rate transponders than with static data rate transponders. Considering this, it might be cost effective for an ISP to deploy more transponders with a lower optical reach, but still keeping the logistical convenience to only deal with a single type of transponder for spares, upgrades, etc. Introducing 1+1 protection in the network even increases the margin of dynamic data rate DWDM compared with static data rate DWDM. We have presented a cost comparison for adaptive data rate transponders and traditional static data rate transponders which show a remarkable cost reduction capability of nearly 50% for adaptive flexible transponders. Furthermore, the ability of flexible transponders to extend the reach by decreasing the data rate shows significant benefits, as adaptive flexible transponder allows feasible planning solutions even for much shorter reference distances.

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Sociological Analysis of Trainings for Motorbike Riders among Educated Youth: A case of Bahauddin Zakariya University, Multan

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ABSTRACT: Motorbike collision affects the victim as well as other members of community and society around the victim, training of motorbike rider play vital role in this social event. Objective of the study was that to investigate and quantify the trainings among educated youth which responsible to reduce the road accidents of motorbikes. Methodology was consisted of the students of Bahauddin Zakariya University, Multan as universe with 500 sample size which was selected through convenient sampling and data was collected with the help of questionnaires. Greater proportion of respondents was without license of motorbike riding, greater proportion license holder got license without skill test, respondents had little awareness about road sigs, Personal Protective Equipments related motorbike riding and First Aid, 70.2% respondents had no book of traffic codes, 84.6 respondents had faced motorbike collision but greater part of respondents had no training of First Aid. Mostly respondent gave the opinion that motorbike collision effect on economic, education and family behavior, in spite of this 40.2% respondents said trainings for motorbike riders should no be compulsory and 45.6% gave opinion that there is no need to repeat the trainings and skill test. This research article suggest that traffic or road safety department should improve the law enforcement, licensing system, encourage monitor the riding schools with international standard and do campaigns about motorbike riding trainings for motivating to motorbike riders.

KEYWORDS: Training, Motorbike Riding, Educated youth, Road accident, collision

1 INTRODUCTION

There are four provinces Punjab, Sindh, Khyber Piketon Khan and Baluchistan and Multan City is situated in Punjab Province of Pakistan. Multan City is the capital of Multan District and 5th biggest city of Pakistan. Multan covers an area of 3,721 square Kilometers (City District Government, Multan).The population of Pakistan has increased from 136 million in 1999 to 162 million in 2008. The increase was twice as high in urban areas than rural areas (28% versus 14%) and urban population was 42% of total population. This urban population growth, coupled with an expected increase in road transport, will certainly lead to an increase in road crashes specially bike crashes injuries in Pakistani cities such as Multan (Pakistan economic survey, 2009). Multan is economically developing area of Pakistan and Pakistan is also considering developing country and Motorcycle riding is rapidly increasing in popularity in Multan because it is cheap and economic private conveyance. Unfortunately, the part of motorbike-related collisions has been rising in recent years. Further, the amount of motorbike-related crashes in Multan is inaptly high compared to other vehicles.

The official data of Rescue 1122, Multan (2013) showed that motorbike crashes were greater than other vehicle comparatively in Multan in 2013. Total numbers of road crashes were 11131 in 2013 at Multan City but 8036 were motorbike

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crashes with the percentage of 72.19% and the percentage of other vehicles was 27.81% with 3095 total crashes in a year of 2013. The ratio of motorbikes and other vehicles was 5:2 with sequence.

Lin and Kraus (2009) exposed that without training and inexperience riding of motorbike has greater risk of death in a collision than people driving other types of motor vehicles and this risk is being increased with increasing of per mile traveling.

Savolainen and Mannering (2008) said that appropriate safety awareness, trainings, education of motorbike riders increase the skills of riding and better skills and training of riding pay vital role in reducing continual amount of accidents. Less skilled, beginner in experience of riding and unsuitable course material also becomes the cause of increasing the risk of motorbike's collisions.

Haworth and Mulvihull (2006) described about licensing systems that better licensing system projected to improved safety outcomes included to increase minimum age, prolong training duration and provisional period.

Baldi and Baer (2005) indentified that the causes of road accidents are not clear but the practices of motorbike licensing play vital role in reducing of motorbike crashes and fatalities, most excellent practices and the soundness of the model having the lowest rates of motorcycle victims with fatal injuries.

According to Wick at all (1998) that mostly motorbike accidents occurred by youth riders in Bochum, Germany. The 90.7% patients of motorbike collision were men with average age of 28.8 years and 27.9% percent accidents occurred by 25 year to 30 years-old age group. The use of helmet in Germany was high with 98.8 percentages and in spite of this motorbike riders had faced head injuries but only 2.3 percent respondents were involved in head injuries.

2 SOCIOLOGICAL SIGNIFICANCE OF THE STUDY

The study has been conducted by a sociologist and sociology is the organized and planned study of social events because all social behaviors are social events of man. Sociology mainly focuses on social systems including social behaviors of individuals, social actions and social structure and function of society. When an individual who is motorbike rider involves in any motorbike collision then there is not a individual phenomenon of collision because that event effects the other people like other effected person of collision directly and his family members, relative, friends, colleagues or business partner and economy of his or her designated society. So that motorbike collision is become the social event and motorbike has many factors of road accidents like age of motorbike riders, millage of journey, experience of motorbike riders, type of journey, skill and safety training of motorbike riders and social format of traffic laws enforcement departments. On the behalf of all these reasons, researchers selected the sociological perspectives to investigate this event through quantify the trainings of motorbike riders. The other reason to select the study on trainings of motorbike riders was the official data of Rescue 1122, Multan which was showing that the number of motorbike accidents were greater than other vehicles comparatively.

3 OBJECTIVE OF THE STUDY

To investigate and quantify the trainings of youth which are responsible for helping to reduce the road accidents of motorbikes.

4 METHODOLOGY

4.1 UNIVERSE

The universe for the present study was consisted of motorbike riders in district Multan. The researchers selected the area of Bahuddin Zakariya University, Multan as universe because it was easy to approach educated youth who were motorbike riders. The main focus of the present research was to identify the trainings of motorbike riders which are responsible for helping to reduce motorbike accidents.

4.2 SAMPLING

In order to select a comprehensive sample the researchers selected a sample size of 500 motorbike riders as respondents and convenient sampling technique was used to select the sample from the universe by students of Bahauddin Zakariya University, Multan. The 1st reason was to select the students of university for sampling because the students are mostly bike riders and it was easy for researcher to select sample and the 2nd reason was that it is general perception about the educated

persons that they have more tendency to participate in awareness sections and training workshops comparatively. So according to the researcher's point of view, the students of university were best source to estimate the actual level of trainings on motorbike riding.

4.3 TOOL FOR DATA COLLECTION

Keeping in observation the particular nature of the study, it was conducted by survey method through questionnaire as tool for data collection. The questionnaire looked to be the most reasonable tool for data collection. In case of questionnaire as tool of data collection there was greater probability of the collection of appropriate data by respondents.

4.4 PRETESTING AND FINALIZING THE QUESTIONNAIRE

After building the questionnaire, it was pretested prior or actually going to the field. Pretesting was held on the same universe. The outcome of pretesting exposed certain shortcomings in the questionnaire. In the light of the experiences of pretesting the researcher included certain changes before finalizing the questionnaire.

5 RESULT AND DISCUSSION

Table no.1 Percentage distribution of respondents with respect to age

Category	Frequency	Percentage
Male	490	99.0
Female	5	1.0
Total	500	100.0

Statistical analysis of this study shows that 99.0 percent of the respondents were male but only 1.0 percent of the respondents were female. According to the result of gender distribution, we can perceive that the female do not like to ride the motorbikes and the other factor is that the cultural values of Multan (Pakistan) do not allow the female for motorbike riding frequently.

Table no.2 Percentage distribution of respondents with respect to Age

Category	Frequency	Percentage
Below 20 years	34	6.9
20 or Above 20 yes	466	93.1
Total	500	100.0

Age category of this study shows that only 6.9 percent of respondents were below 20 years age and 93.1 were 20 years or above 20 years age.

Table no.3 Percentage distribution of respondents with respect to Education

Category	Frequency	Percentage
Below Graduate	36	7.2
20 or Aboce 20 yes	464	92.8
Total	500	100.0

The 7.2 percent of respondent were having below graduate education and 92.8 were having graduation or above graduate education.

Table no.4 Percentage distribution of respondents with respect Awareness about inspection of bike

Category	Frequency	Percentage
Know completely	134	26.8
Know partly	306	61.2
Know nothing	60	12.0
Total	500	100.0

Research based data shows that 26.8 percent of motorbike riders were having complete awareness about basic inspection of motorbike which to do before long journey, 12 percent of motorbike riders were known about inspection of motorbike with some extent and 61.2 percent of motorbike riders did not know about inspection of motorbike.

Table no. 5 Percentage distribution of respondents about collision of bike

Category	Frequency	Percentage
Never	77	15.4
One time	102	20.4
Two time	141	28.2
More than two time	180	36.0
Total	500	100.0

The table shows that 36.0 percent of motorbike riders had face motorbike collision for more than tow time, 28.2 percent of motorbike riders had faced motorbike collision for tow times, 20.4 percent of motorbike riders had faced motorbike collision for one times and 15.4 percent of motorbike riders had faced no motorbike collision.

Table no.6 Percentage distribution of respondents with respect to injuries in result of collision

Category	Frequency	Percentage
Soft tissues	210	42.0
Fracture	119	23.8
Head injury	61	12.2
Nothing	110	22.0
Total	500	100.0

Distribution table of injuries in result of motorbike collision shows that 42.0 percent of motorbike riders faced soft tissue injuries, 23.8 percent of motorbike riders faced fractures, 12.2 percent of motorbike riders faced head injuries but only 22.0 42.0 percent of motorbike riders did not face any collision of motorbike.

Table no.7 Percentage distribution of respondents with respect to Repeating of test

Category	Frequency	Percentage
Annually	139	27.8
After Six moth	133	26.6
No need to repeat	228	45.6
Total	500	100.0

The data of table shows that 27.8 percent of respondents stated that test of riding by related department should be repeated annually, 26.6 percent of respondents stated that should be repeated six monthly and majority of respondents 45.6 percent of respondents stated that there is no need to repeat the test.

Table no.8 Percentage Distribution of respondents on Dichotomous scale

Category	Yes	No
Having License	47.6	52.4
Training of traffic codes	38.4	61.6
Having book of traffic codes	29.8	70.2
PPE's Knowledge	29.8	70.2
Training should compulsory	59.8	40.2
Having first aid training	24.6	75.4

The analysis of this study shows that only 47.6 percents of motorbike riders were having motorbike riding license and 52.4 were not having license, the greater proportion rides the motorbike on the roads of Multan (Pakistan) without license and this thing shows the weak implement of traffic law in Multan. The non license holders riders are less experienced and not know the traffic rules and road signs properly so this thing have more probability of road crashes.

The data shows that only 38.4 percent riders got training of traffic codes, 61.6 percent were not have any training about traffic codes. The reason of this, licensing procedure gives awareness of traffic codes and mostly respondents did not face the licensing procedure.

This table shows that only 29.8 percent of respondents were having book of traffic codes and 70.2 percent motorbike riders had no book of traffic codes.

The table of distribution about PPE,s related motorbike shows that 29.8 percent respondents were having awareness about Personal Protective Equipments related motorbike riding, 70.2 percent of respondents had no awareness about Personal Protective Equipments related motorbike riding and this behavior of motorbike riders shows the carelessness of self-safety.

The data of table shows that 40.2 percent of respondents stated that the training should not be compulsory, 59.8 percent of respondents stated that the training should be compulsory.

The data of table shows that 24.6 percent of respondents stated that they have awareness about First Aid, 75.4 percent of respondents stated that they have no awareness about First Aid and the majority of the respondents already faced injuries due to motorbike collision in spite of this they are not ready to get any First Aid training because they have rigidity in their behavior which tend to ignorance and carelessness.

Table no.9 Percentage distribution of respondents on likert scale

Category	To some extant	To some extant	Not at all
Collision impact on economic	32.8	38.2	29.0
Collision impact on education	34.4	44.4	21.2
Family behavior	31.6	49.6	18.8
Collision due to other negligence	52.0	42.8	5.2

The data of table shows that 33.1 percent respondents were thought with great extent, the motorbike collision have impact on economic, 38.6 percent respondents were thought with some extent, the motorbike collision have impact on economic and 28.3 percent respondents said, there is no impact of motorbike collision on economic,

The data of table shows that 34.4 percent respondents were thought with great extent, the motorbike collision have impact on education, 44.4 percent respondents were thought with some extent, the motorbike collision have impact on education and 21.2 percent respondents said, there is no impact of motorbike collision on education,

The data of table shows that 31.6 percent respondents were thought with great extent, the motorbike collision have impact on family behavior, 49.6 percent respondents were thought with some extent, the motorbike collision have impact on family behavior and 18.8 percent respondents said, there is no impact of motorbike collision on family behavior.

The data of table shows that 52.0 percent of respondents gave the opinion with to great extent that accidents occur by others negligence, 42.8 percent of respondents said with to some extent that accidents occur by others negligence and 5.2 percent of respondents said that accidents do not occur by others negligence.

6 SUMMARY AND CONCLUSION

With the passage of time population and traffic is increasing as well as road traffic accidents are also increasing. Road traffic accident has become common phenomenon of the world and become the cause of many deaths, injuries and material loss and these factors effect the economy, education, behavior of individuals and also other social institutions of society. Road traffic accidents occur by almost every vehicle but motorbike has more tendency of road traffic accident. Many factors are involved in accidents of motorbike like trainings for motorbike riders. This study was conducted in Multan city of Pakistan and Pakistan faces about 10,000 deaths every year due to road traffic accidents and more likely motorbikes are involved. The youth generation is more involve in collisions of motorbike due to their less experience of riding, inappropriate riding skills and lack of different trainings which is related to safety of motorbike riders. Pakistan is a developing country and having low tendency of awareness programs specially about safety of motorbike riding, so the collision ratio of motorbikes is three time more than collision of other types of vehicles. The present study was conducted among educated youth through questionnaires and result shows that

6.1 RECOMMENDATIONS

Licensing system should be improved by traffic department, do not issue license without skill test & written test and improve the traffic law implement and given below recommendations should follow to improve the system.

a) Provisional license duration should be for 2 years so that applicant of motorbike riding license can learn appropriate riding skills and other related trainings of motorbike riding.

b) Maximize the age minimum age limit, 18 years age should be compulsory for provisional license and 20 years age for permanent license.

6.1.1 AWARENESS WORKSHOP

Before issuing permanent license, traffic department should conduct the awareness workshop to empower the competence of motorbike riders with two parts.

a) First part of bike riders should be consisted of sensitizing to bike riders about hazards and risks of motorbike riding and how to reduce them.

b) The second part should be consisted of traffic rules and regulation, road signals, road signs and skill based awareness.

6.1.2 CAMPAIGNS

Traffic department or road safety department should campaigns for getting professional training of motorbike riding in schools, colleges, different organizations and through mass media periodically which base on aggressive marketing style.

6.1.3 RIDING SCHOOLS

A certificate of riding skills training should be compulsory by registered riding school before permanent license.

All riding schools should be registered on international standard by concern department and periodically monitored by traffic department, road safety department and others concern departments.

The contents, format, durations and standard of training should be registered and same for all riding schools.

6.1.4 TRAINING BY RIDING SCHOOL SHOULD BE CONSISTED OF:

a) Riding skills
b) Road signs and signal
c) Traffic rules and regulations

d) Basic inspection of motorbike before long journey
e) Use of PPE,s related bike riding because it responsible to minimize the hazards of injury in case of road crash
f) First Aid training to control or minimize the life threatening conditions in case of road traffic crashes
g) All above contents of training should be compulsory with updates annually to renewal of riding license.

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Activités antioxydantes des polyphenols extraits de plantes médicinales de la pharmacopée traditionnelle d'Algérie

[Antioxidant activities of polyphenol extracts from medicinal plants in Algerian traditional pharmacopoeia]

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ABSTRACT: Oxidative stress is responsible for several diseases. This phenomenal has moved researchers into action in looking for new remedies «antioxidants». In this context, the study of the antioxidant activity of hydro-ethanolic extracts of eight (08) plants used in Algerian pharmacopoeia has been performed. These plants are from Laghouat region ((Atlas Sahara). The extracts from these eight plants were obtained by *ultrasound* assisted *extraction.* The quantitative estimation of flavonoids, flavanones and total phenols by the spectophotometric method showed that the eight extracts contain these compounds. The evaluation of antioxidant capacity by the method of free radical scavenging test showed that all of the extracts have a very good reductive activity, especially for *Arbutus undo* extract which presented a percentage of inhibition equal to 90% with an EC50 estimated to 0.006 mg/ml. On the other hand, the FRAP test revealed that the *Zizyphus lotus* extract has the best reducing power than those of the other extracts, but it remains relatively low compared to the ascorbic acid used as positive control.

KEYWORDS: Medicinal plants, flavonoids, flavanones, total phenols, antioxidant activity.

RESUME: Le stress oxydant, cause de plusieurs maladies, suscite la recherche de nouveaux remèdes antioxydants. Dans cette optique, l'étude de l'activité antioxydante des extraits hydro-éthanoliques de huit (08) plantes utilisées dans la pharmacopée algérienne a été réalisée. Ces plantes sont issues de la région de Laghouat (Atlas Saharien). Les extraits des huit plantes sont obtenus par la sonication. L'estimation quantitative des flavonoïdes, des flavanones et des phénols totaux par la méthode spectrophotométrique a montré que ces huit extraits contiennent ces composés. L'évaluation du pouvoir anti-oxydant par la méthode du piégeage des radicaux libres a montré que les extraits étudiés ont tous une très bonne activité réductrice, surtout pour l'extrait *d'Arbutus unedo* ayant présenté un pourcentage d'inhibition égale à 90% avec une EC50 égale à 0,003 mg/ml. D'autre part, le test de FRAP a révélé que l'extrait *Zizyphus lotus* a le meilleur pouvoir réducteur par rapport ceux des autres extraits, mais qui reste, toutefois, relativement faible par rapport à celui de l'acide ascorbique utilisé comme contrôle positif.

MOTS-CLEFS: Plantes médicinales, flavonoïdes, flavanones, phénols totaux, activité anti-oxydante.

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1 INTRODUCTION

Artemisia campestris (Asteraceae), *Anthemis arvensis* (Asteraceae), *Haloxylon scoparium* (Chenopodiaceae), *Juniperus phoenicea* (Cupressaceae), *Arbutus unedo* (Ericaceae),*Cytisus monspessulanus* (Fabaceae), *Thymus algeriensis* (Lamiaceae), *Zizyphus lotus* (Rhamnaceae) font partie des plantes de la gamme des plantes médicinales algerienne. les résultats de nos travaux ayant pour objet une démarche contributive sur le screening phytochimique et antioxydant des extraits organiques des nos plantes; ce qui a permis d'une part, de mettre en évidence leur richesse en métabolites secondaires et de dépister d'autre part, leur pouvoir antioxydant.

Le présent travail se propose de quantifier les teneurs en composés phénoliques que renferment ces espèces végétales et d'évaluer leur pouvoir antioxydant.

2 MATERIEL ET METHODES

2.1 MATÉRIEL VÉGÉTAL

Le matériel végétal est constitué du la partie aérienne de différentes plantes utilisées, récoltées de la région de Laghouat (400 km *de la* capitale Alger) en Avril 2010. Les échantillons sont séchés à l'abri de la lumière et de l'humidité, à température ambiante et stockés soigneusement dans des sacs propres en vue de leur analyse (Tableau1). Les plantes ont été identifiées par monsieur M. KOUIDRI, botaniste au département de biologie à université de Laghouat (Algérie).

Table 1. Liste des plantes médicinales utilisées pour l'étude

Noms des plantes	Nom local	Famille	Organe utilisé
Artemisia campestris L.	Dgouft	Asteraceae	Fruites + Feuilles
Anthemis arvensis L.	Negd	Asteraceae	Fruites + Feuilles
Haloxylon scoparium Pomel	Remeth	Chenopodiaceae	Fruites + Branches
Juniperus phoenicea L.	Aar-aar	Cupressaceae	Fruites + Feuilles
Arbutus unedo L.	Lendj	Ericaceae	Fruites + Feuilles
Cytisus monspessulanus L.	Gassa	Fabaceae	Parie aérienne
Thymus algeriensis Boiss et Reut	Djertil	Lamiaceae	Feuilles + Branches
Zizyphus lotus L. (Desf.)	Cedra	Rhamnaceae	Feuilles

2.2 EXTRACTION DES POLYPHENOLES

La méthode d'extraction des polyphenoles à été réalisée par la sonication sur un bain de glace pendant 6 min en utilisant un appareil à ultrasons VIBRACELL VC300 avec une fréquence de 20 kHz. Un gramme de poudre sèche dans 7 ml d'une solution hydro-éthanolique (70%) a été utilisé. Après sonication, les échantillons ont été centrifugés pendant 20 min à 3000 tours/min à 20 °C et le surnageant a été prélevé et conservé à -20°C.

2.3 DOSAGE DES PHÉNOLS TOTAUX

Les teneurs en composés phénoliques totaux ont été évaluées suivant la méthode colorimétrique de Folin-Ciocalteu [1].

2.4 DOSAGE DES FLAVONOÏDES

Les teneurs en flavonoïdes totaux ont été quantifiés par dosage direct par le trichlorure d'aluminium [2].

2.5 DOSAGE DES FLAVANONES ET DIHYDROFLAVONOLS

Les teneurs en flavanones et en dihydroflavonols ont été déterminées selon la procédure décrite par Popova et al., 2004 [3].

2.6 EVALUATION DE L'ACTIVITE ANTI-OXYDANTE PAR LE TEST DPPH

Cette activité est déterminée selon la méthode de Brand-Williams et al., 1995 [4]. Le radical DPPH est dissous dans du méthanol à une concentration de 6.10^{-5} mol.l-1 et gardé à -20 °C à l'abri de la lumière avant utilisation. A chaque extrait (0,1 ml) sont ajoutés 4 ml de solution de DPPH et l'absorbance est mesurée après 60 minutes à 517 nm. Le résultat est exprimé en micromoles d'équivalent Trolox par gramme de matière sèche.

2.7 ACTIVITE ANTIOXYDANTE MESUREE PAR LE RADICAL CATION ABTS

Le radical cation ABTS est généré en mélangeant à volume égal une solution de 2,45 mM de persulfate de potassium $K_2S_2O_8$ et une solution stock d'ABTS à 7 mM, le tout est conservé à l'abri de la lumière et à la température ambiante durant 16 h avant utilisation [5]. La solution obtenue est diluée avec l'éthanol pour obtenir une absorbance comprise entre 0.7 et 0.8 à 734 nm. 990 µl de cette solution fraichement préparée sont ajoutés à 10 µl d'extrait et la lecture est faite à 734 nm après 6 min pour chaque série d'analyses. Le BHT est utilisé pour le contrôle positif.

2.8 EVALUATION DU POUVOIR CHELATEUR DU FER FRAP

Le pouvoir réducteur des extraits est déterminé selon la méthode d'Oyaisu., 1986 [6]. Dans un tube à essai contenant 0.1 ml de solution d'échantillon sont ajoutés 2ml de tampon phosphate (0,2M, pH 6,6) puis 2 ml d'hexacyanoferrate de potassium [$K_3Fe(CN)_6$] (10g/l). L'ensemble est chauffé à 50°C au bain marie pendant 20 minutes. Un volume de 2 ml d'acide trichloracétique (100 g/l) est ensuite ajouté et le mélange est centrifugé à 3000 tours/min pendant 10 minutes. Enfin, 2 ml du surnageant ont été mélangés avec 2 ml d'eau distillée et 0,4 ml de chlorure ferrique [$FeCl_3$] (1g/l). Un blanc sans échantillon est préparé dans les mêmes conditions. La lecture est mesurée à 700 nm. L'acide ascorbique est utilisé pour le contrôle positif.

2.9 ANALYSE STATISTIQUE

Chaque expérience a été répétée trois fois. Les données obtenues ont été traitées par analyse de la variance et les moyennes significativement différentes ont été séparées en utilisant le logiciel SPSS au seuil de probabilité de 5 %.

3 RESULTATS ET DISCUSSION

3.1 TENEURS EN PHENOLS TOTAUX ET EN FLAVONOÏDES

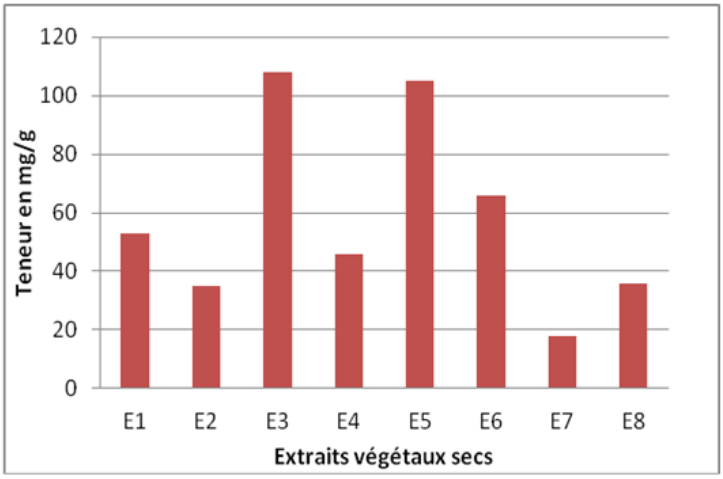
La teneur en composés phénoliques de chaque extrait de plante est exprimée en milligrammes équivalents en acide gallique par gramme de la matière sèche, La teneur des flavonoïdes est exprimée en milligrammes équivalents en quercetine par gramme de la matière sèche et la quantification en flavanones et dihydroflavonols est exprimée en milligrammes équivalents en équivalent d'eriodictyol par gramme de la matière sèche.

La teneur en phénols totaux dans les extraits (E1-E8) varie entre 18,73± 4,59 et 108,41 ± 4,59 mg EAG/g de matière sèche (Figure 1). Les résultats indiquent que deux plantes ont les teneurs les plus élevées en phénols totaux à savoir: *H. scoparium* (108,41±4,59 mg EAG/g)et *A. unedo* (104.98±4,59mg EAG), ensuite viennent *C. monspessulanus* et *A. campestris* avec des teneurs en phénols totaux respectives de 66.25±4,59mg EAG et 53.84±4,59 mg EAG. Les quatre autres plantes ont des teneurs variant de 18.73±4,59 mg EAG à 46.61±4,59 mg EAG. Si l'on compare nos résultats avec ceux obtenus par *rached et al,. 2010* [7], l'on peut dire que presque tous nos extraits notamment *H. scoparium*, *A. unedo*, *C. monspessulanus* et *A. campestris* sont particulièrement très riches en substances phénoliques.

Au vu de la Figure 2, nous notons que la teneur en flavonoïdes totaux varie d'une plante médicinale à une autre (Figure 1). L'extrait *C. monspessulanus* enregistre la plus forte teneur (20.44 ± 0,54 mg EQ/g de matière sèche) suivies des extraits *A. unedo* (17.46 ±0,54 mg EQ/g), *A. campestris* (15.58 ± 0,54 mg EQ/g), *Z. lotus* (14,79 ±0,54 mg EQ/g) et *A. arvensis*(10,92±0,54 mg EQ/g).par contre les teneurs les plus faibles remarquer dans les extraits *H. scoparium* et *T. algeriensis* avec des teneurs 2,72 et 2,10 ±0,54 mg EQ/g respectivement.

Pour les différentes teneurs en flavanones et dihydroflavonols (Figure 3). Les valeurs les plus élevées sont observées avec les extraits de *A.arvensis* (6,70 ± 0,60 mg/g de matière sèche). *C. monspessulanus (*5,46 ± 0,60 mg/g) et de *Z.lotus* (5,00 ± 0,60 mg/g). Les teneurs les moins élevées sont *H. scoparium (*1,52 ± 0,60 mg/g) et *T. algeriensis (*3,24 ± 0,60 mg/g).

Cette augmentation des teneurs phénoliques résulte vraisemblablement du fait que le dosage par le réactif Folin-Ciocalteu n'est pas spécifique aux polyphénols, mais beaucoup de composés peuvent réagir avec ce réactif comme les protéines, les sucres, donnant un taux phénolique apparent élevé.



E1 : A.campestris ; E2 : A.arvensis ; E3 : H. scoparium ; E4 : J. phoenicea ; E5 : A. unedo ; E6 : C. monspessulanus ; E7 : T. algeriensis ; E8 : Z. lotus

Figure 1: Histogramme de la teneur en phénols totaux dans les extraits E1-E8

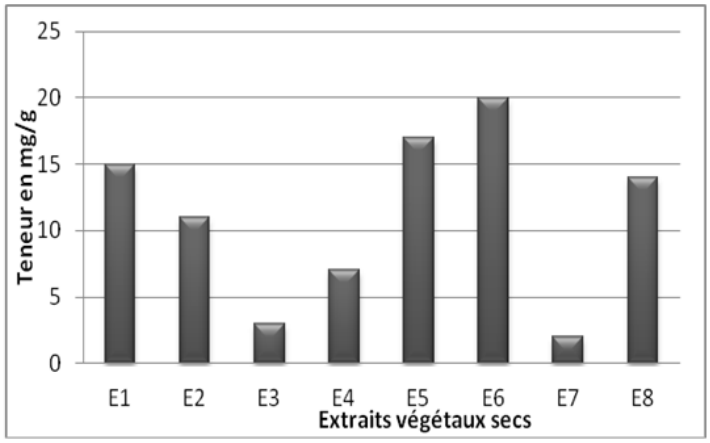


Figure 2: Histogramme de la teneur en flavonoïdes totaux dans les extraits E1-E8

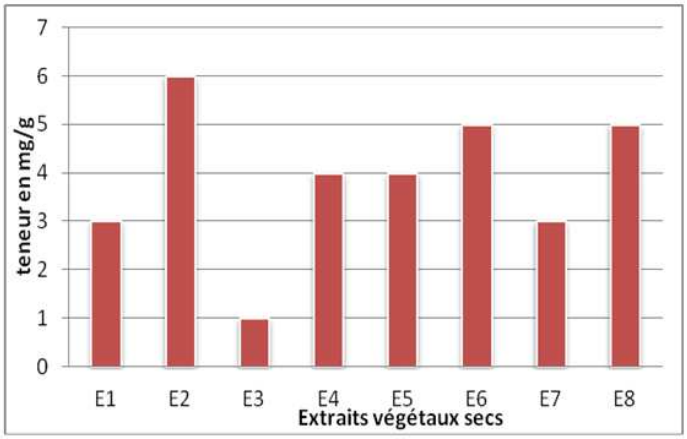


Figure 3: Histogramme de la teneur en flavanones et dihydroflavonols dans les extraits E1-E8

3.2 ACTIVITÉ ANTIOXYDANTE

L'activité antioxydante in vitro a été évaluée de trois manières différentes : le test au DPPH, la technique de décoloration du radical cation ABTS et la mesure du pouvoir réducteur. Pour ce dernier test, les résultats obtenus (Tableau II) montrent que nos extraits présentent des absorbances élevées par rapport au control négatif. Les deux extraits de *A. unedo* et *Z. lotus* sont les plus actifs parmi les extraits testés suivi les extraits *A.arvensis, H. scoparium* et *T. algeriensis* respectivement, mais ces activités restent significativement identique à celle de l'acide ascorbique utilisé comme control positif. En ce qui concerne les activités de piégeage du radicaux DPPH et ABTS (Tableau II), nous remarquerons que les huit extraits réduisent la concentration de ce radical libre DPPH.

L'activité varie entre 0.006 et 0.235 mg/ml pour la méthode DPPH et 0.009 et 0.150 mg/ml pour la méthode ABTS (Tableau II). Les valeurs trouvées par le radical ABTS sont plus importantes que celles trouvées par le radical DPPH. Les extraits *A. unedo* et *C. monspessulanus* ont l'activité antioxydante la plus élevée par les deux méthodes de dosage par comparaison à celle de l'antioxydant synthétique BHT. Seules extraits présentant les valeurs les plus élevées en phénols, flavonoides totaux et dihydroflavonols ce qui suggère que les deux activités antioxydante soient en grande partie dues à la présence et la quantité en composés phénoliques.

Une corrélation négative a été trouvée entre la teneur des phénols totaux et l'activité anti-oxydante ABTS et DPPH (figures 4 et 5). Telle n'a pas été observé pour les flavanones et dihydroflavonols qui peut révéler l'importance d'autres groupes phénol dans la capacité de piéger les radicaux libre. Telle à également été déjà signalé par *Albano et Miguel 2011* [8] pour des extrais d'autres plantes. En conclusion, ces résultats préliminaires montrent que les huit extraits témoignent d'activités antioxidantes in vitro. D'autres études sont nécessaires pour évaluer le potentiel in vivo de ces extraits sur des modèles animales.

Tableau 2: Activités antioxydante mesurées par DPPH, ABTS et FRAP dans les extraits E1-E8

Extraits	Activité antioxydante (CE_{50} mg/ml)		
	DPPH	ABTS	FRAP
A. campestris	0.039 ± 0.018^{cd}	0.015 ± 0.002^{e}	ND
A.arvensis	0.191 ± 0.018^{b}	0.083 ± 0.002^{d}	0.017 ± 0.006^{cd}
H. scoparium	0.044 ± 0.018^{cd}	0.027 ± 0.002^{de}	0.002 ± 0.006^{d}
J.phoenicea	0.029 ± 0.018^{d}	0.019 ± 0.002^{e}	ND
A. unedo	0.006 ± 0.018^{d}	0.009 ± 0.002^{e}	0.001 ± 0.006^{d}
C. monspessulanus	0.014 ± 0.018^{d}	0.009 ± 0.002^{e}	ND
T. algeriensis	0.235 ± 0.018^{b}	0.150 ± 0.002^{c}	0.025 ± 0.006^{c}
Z. lotus	0.042 ± 0.018^{cd}	0.049 ± 0.002^{de}	0.001 ± 0.006^{d}
Acide ascorbique	ND	ND	0.001 ± 0.006^{d}
BHT	0.089 ± 0.018^{c}	0.004 ± 0.002^{e}	ND

♦ *Les valeurs avec les mêmes lettres ne sont pas significativement différentes à P≤ 0.05 avec le test de Newman*
♦*ND : non déterminer*

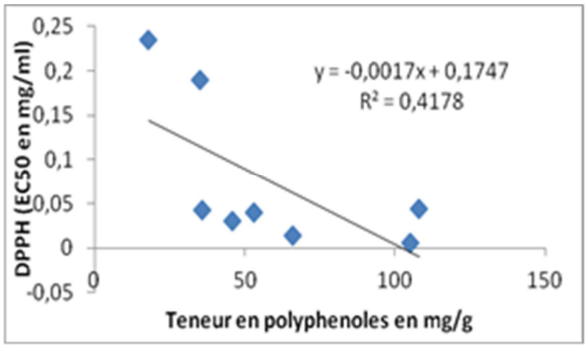


Figure 4 : Corrélation entre les valeurs d'activité antioxidante DPPH et des teneurs en phénols totaux

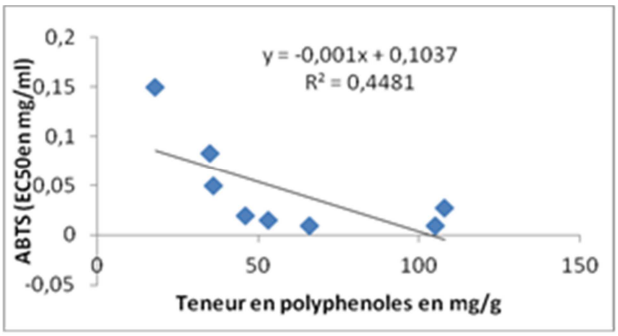


Figure 5 : Corrélation entre les valeurs d'activité antioxidante ABTS et des teneurs en phénols totaux

4 CONCLUSION

La présente étude s'est proposé de réaliser la quantification de composés polyphénoliques et l'évaluation par spectrophotométrie de l'activité antioxydante de huit plantes de la flore algérienne utilisées dans le traitement traditionnelle.Les résultats de cette présente étude indiquent que les plantes aromatiques sélectionnées sont riches en antioxydants tels que les composés phénoliques, les flavonoides et flavanones et dihydroflavonols qui possèdent la propriété de piéger les radicaux libres et de réduire les oxydants. L'étude confirme également une certaine corrélation entre la teneur en composés phénoliques et l'activité anti-radicalaire.

Un des résultats le plus important, c'est que l'extrait de la plante *A.unedo* découvre partiellement des activités antioxidantes très intéressantes, ce qui nous encourage d'investir dans ce domaine afin de caractériser les molécules responsables de ces activités par des méthodes chromatographiques tel que LC-MS. Ce travail a fourni de nouvelles connaissances ethnopharmacologiques et phytochimiques au sujet des plantes locales de la région de Laghouat et constitue une contribution à l'étude du rôle des polyphénols naturels dans la régulation du stress oxydatif.

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Calcul mathématique des courbes de remous dans les canaux découverts de profil non prismatique par intégration directe (méthode de bakhmeteff)

[Mathematical calculation of the backwater curves in open channels of non-prismatic profile by direct integration (method bakhmeteff)]

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ABSTRACT: In this work we have presented aims to study the calculation backwater curves for gradually varied flow with a free surface in open channels of non-prismatic profile with the use of mathematical methods, which allow drawing the line water to various sections, and specifying the general appearance of the different forms of the water surface. The proposal has many advantages and disadvantages, role being the knowledge of the construction works on the water level upstream the passage of a flood, to assess and reduce the risk of flooding. After the definition of modeling resolution, we need to apply the characteristics of non-prismatic channels. This project presents a study of mathematical calculation (Method Bakhmeteff) with different sections chosen because they are shorter and less complicated than other methods.

KEYWORDS: water surface, modeling, flow, risk of flooding, section.

RESUME: L'objectif du travail que nous avons présenté est l'étude du calcul les courbes de remous pour les écoulements graduellement variés à surface libre dans les canaux découverts de profil non prismatique, avec l'utilisation des méthodes mathématiques ,qui permettent de tracer la ligne d'eau à de diverses sections, et de préciser l'aspect général des différentes formes de la surface d'eau. La proposition a de nombreux avantages et inconvénients, le rôle étant la connaissance de la construction des ouvrages sur le niveau de l'eau en amont au passage d'une crue, pour évaluer et éviter les risques d'inondations. Après la définition du modelé de résolution, on nécessite d'appliquer les caractéristiques des canaux non prismatiques. Ce projet présente une étude de calcul mathématique (Méthode de Bakhmeteff) avec de différentes sections choisies, puisqu'elles sont moins longues, et moins compliquées que les autres méthodes.

MOTS-CLEFS: surface d'eau, modelé, écoulements, risques d'inondations, sections.

1 INTRODUCTION

La connaissance et le calcul des courbes de remous pour les écoulements graduellement variés à surface libre dans les canaux découverts présentent un très grand intérêt tant industriel, qu'économique occupent une place importante dans la pratique de l'ingénieur hydraulicien. Cette opération permet de poser un problème de déterminer la position, x, et la forme, h(x), B(x), de la surface libre pour un débit (Q), et une forme géométrique de section (S) donnés.

Ce problème désigné par courbe de remous, consiste l'intégration de l'équation différentielle simplifiée de Saint Venant qui s'impose des méthodes de calculs reposant sur le même principe et visant le même objectif de déterminer la profondeur

finale de l'écoulement se produisant sur un tronçon du canal donné. Mais avant d'examiner ces méthodes d'intégration, il convient d'analyser qualitativement les formes des courbes de remous.

Dans l'écoulement graduellement varié, l'équation de la surface d'eau permet de tracer les formes de la surface libre (ligne d'eau), par les différents cas possibles, le calcul et la construction exacte de ces formes nécessitent l'intégration de l'équation différentielle de l'écoulement graduellement varie des canaux non prismatique. Dans le cas général on utilise diverses méthodes mathématiques ou graphiques.

L'application de ces méthodes de calcul ne donnera qu'un résultat de l'équation de la ligne d'eau à un constant pré. Il est toutefois évident que la position de cette ligne par rapport au fond du canal est unique n'est pas arbitraire ; pour lever l'indétermination il faudra obligatoirement connaitre l'un de ces points ; appelé point de repère, ou de contrôle, sera généralement calculable à partir des propriétés hydrauliques de la singularité qui est à l'origine de mouvement graduellement varié considéré.

2 EQUATION SIMPLIFIEE DE SAINT VENANT

Dans un écoulement graduellement varié, l'application des équations de Saint Venant permet de calculer les hauteurs d'eau et les vitesses moyennes le long de la direction d'écoulement en fonction du temps. Ces équations sont l'ensemble d'équation de continuité et l'équation dynamique de mouvement après des simplifications, et les solutions en sont souvent extrêmement compliquées. Dans certains cas physiquement simples mais réalistes, explicites sont possible.

Dans le cas général l'équation dynamique pour un écoulement non permanent et non uniforme dans un canal découvert ce donne comme suit :

$$\frac{1}{g}\frac{\partial U}{\partial t}+\frac{U}{g}\frac{\partial U}{\partial x}+\frac{\partial h}{\partial x}-J_f=-J_e \quad (1)$$

Où :

J_f : Pente du fond.

J_e ; Pente énergétique.

h : la hauteur moyenne ou la profondeur hydraulique dans la section(m).

U : vitesse moyenne dans la section (m/s).

g : accélération gravitationnelle (m/s^2).

t : temps (s).

L'étude d'un écoulement permanent et non uniforme rend l'équation (1) se forme:

$$\frac{U}{g}\frac{\partial U}{\partial x}+\frac{\partial h}{\partial x}-J_f=-J_e \quad (2)$$

Peut aussi s'écrire ainsi :

$$\frac{1}{g}\frac{\partial}{\partial x}\left(\frac{Q^2}{s}\right)+S\frac{\partial h}{\partial x}+S\frac{\partial z}{\partial x}=-S\,J_e \quad (3)$$

Où :

Z ; la cote du fond de canal

S : surface (m).

3 EQUATION DE LA SURFACE LIBRE

La dérivation de l'équation d'énergie par rapport a x et lorsque on utilise une relation de type Chézy fonction de x et de h donne :

$$\frac{d}{dx}\frac{(Q/S)^2}{2g}+\frac{dh}{dx}-J_f=-J_e=-\frac{(Q/S)^2}{C^2R_h} \quad (4)$$

Où :

R_h : Rayon hydraulique (s/p).

C : coefficient de Chéz $(m^{\frac{1}{2}}/s)$.

A noter que l'équation (4), tout comme l'équation (3), est l'équation simplifiée de Saint Venant ; elle est valable pour les canaux prismatiques et non prismatiques. Si le canal est non prismatiques $S = f(h(x), x)$ et $\frac{dS}{dx} = B$ dont la pente où la géométrie de section variante dans la direction longitudinale du canal.

Par cette définition on exprime le premier terme de l'équation (4) par :

$$\frac{d}{dx}\left(\frac{Q^2}{2\,S^2 g}\right) = \frac{Q^2}{2g}\left(-\frac{2}{S^3}\frac{dS}{dx}\right) = -\frac{Q^2}{g\,S^3}\left(\frac{dS}{dh}\frac{dh}{dx} + \frac{dS}{dx}\Big|_{h=cte}\right) \quad (5)$$

Cette équation constitue une équation différentielle du premier ordre. S'écrit par conséquent:

$$-\frac{(Q/S)^2}{g\,s}\left(\frac{dS}{dh}\frac{dh}{dx} + \frac{dS}{dx}\right) + \frac{dh}{dx} - J_f = -\frac{(Q/S)^2}{C^2 R_h} \quad (6)$$

Elle permet de déterminer la profondeur d'eau $h(x)$, en fonction de la distance x, par un débit *Q*, donné.

Après des simplifications j'obtiens une équation différentielle de l'écoulement graduellement varié des canaux non prismatiques de forme :

$$\frac{dh}{dx} = J_f\,\frac{1-\frac{(Q/S)^2}{C^2 R_h J_f}+\frac{(Q/S)^2}{gSJ_f}\frac{ds}{dx}}{1-\frac{(Q/S)^2}{Sg}B} \quad (7)$$

Où le terme $\frac{(Q/S)^2}{gSJ_f}\frac{dS}{dx}$ exprime le changement de section (largeur au miroir).

Cette équation permet de définir l'inclinaison (pente) par rapport au fond du canal et non pas la pente de la ligne d'eau, et la profondeur , h, pas la cote. Prend la valeur positive si la profondeur d'eau , h, croit et négative dans le cas contraire.

L'équation de l'écoulement graduellement varie équation (7) peut aussi être écrire en utilise la notion de la débitance :

$$K(h) = \frac{1}{n}{R_h}^{2/3}\,S = C\,{R_h}^{1/2}\,S \quad (8)$$

Où $K(h)$ est la débitance, représente uniquement une fonction de la profondeur d'écoulement h, équivalent à la profondeur normale, h_n, déterminée comme suit :

Pour l'écoulement uniforme, cette relation prend la valeur suivante :

$$K_n(h) = Q/\sqrt{J_f} \quad (9)$$

Lorsque la vitesse moyenne donnée par la formule de Manning dans sa forme particulière. On a donc

$$Q = \frac{1}{n}{R_h}^{2/3}{J_f}^{1/2}\,S \quad (10)$$

On compare l'égalité (8) et (10) on obtient :

$$Q = K(h){J_f}^{1/2} \quad (11)$$

Où

$$Q/\sqrt{J_f} = f(h) \quad (12)$$

Peut-être tracer point par point pour une forme de section donnée.

La débitance K, caractérise le canal, elle représente une mesure de la capacité de transport d'eau dans cette section.

La pente critique d'un canal, quelle qu'en soit sa forme, peut être calculée par

$$J_c = \frac{gS}{C^2 R_h B} \quad (13)$$

Donc l'expression dans le dénominateur de l'équation différentielle équation (7), peut alors être exprimée ainsi :

$$\frac{Q^2}{g\,S^3}B = \frac{Q^2}{C^2S^2R_hJ_f}\frac{C^2S^2R_hJ_f}{g\,S^3/B} = \frac{(Q/\sqrt{J_f})^2}{(C\,S\,R_h^{1/2})^2}\frac{J_f}{g\,S/C^2\,B\,R_h} = \frac{K_n^2}{K^2}\frac{J_f}{J_c}$$

En utilise les trois relations des équations (13) et (8)-(9) pour exprimer le numérateur d'équation (7).

$$\frac{Q^2}{g\,S^3J_f} = \frac{Q^2}{C^2S^2R_hJ_f}\frac{C^2S^2R_hJ_f}{g\,S^3J_f} = \frac{(Q/\sqrt{J_f})^2}{(C\,S\,R_h^{1/2})^2}\frac{C^2R_h}{g\,S} = = \frac{K_n^2}{K^2}\frac{C^2R_h}{g\,S}$$

Par cette définition nous avons proposé de multiplier et diviser ce terme par la largeur de miroir (B), ainsi on obtient :

$$\frac{K_n^2}{K^2}\frac{C^2R_h}{g\,S}\frac{B}{B}\frac{1}{} = \frac{K_n^2}{K^2}\frac{1}{J_c\,B}$$

$$\frac{(Q/S)^2}{C^2R_hJ_f} = \frac{Q^2}{C^2S^2R_hJ_f} = \frac{(Q/\sqrt{J_f})^2}{(C\,S\,R_h^{1/2})^2} = \frac{K_n^2}{K^2}$$

Donc l'équation (7) devient :

$$\frac{dh}{dx} = J_f\frac{1-(\frac{K_n}{K})^2+(\frac{K_n}{K})^2\frac{1}{J_cB}\frac{ds}{dx}}{1-(\frac{K_n}{K})^2\frac{J_f}{J_c}} \qquad (14)$$

Forme générale de l'équation de mouvement des canaux non prismatiques.

4 FORME DE LA SURFACE D'EAU

Dans les écoulements graduellement variés les différentes courbes intégrales obtenue par l'équation (7) en fonction de la pente du fond J_f qui définit leurs classification pour un débit Q donné.

Ces courbes ne cherchent pas à donner une solution explicite mais on s'intéresse à donner les formes semi quantitatives de la variation de la profondeur , h, avec la distance x par des conditions à la limite permet de tracer la surface d'eau pour les différents cas possibles. On distingue les cinq cas suivants. :

Tableau 1. Les classifications de la ligne d'eau

$J_f > 0$	$J_f < J_c$	Canaux à pente faible	M
	$J_f > J_c$	Canaux à pente forte	S
	$J_f = J_c$	Canaux à pente critique	C
$J_f = 0$	Canaux a pente zéro		H
$J_f < 0$	Canaux a contre pente		A

Chaque courbe comporte différente branches qui donnent leur ensemble ne représentant pas une ligne réelle de la surface d'eau, mais plutôt un ensemble de divers cas possibles. Une surface d'eau réelle est alors représentée par une seule branche.

5 MÉTHODE PAR INTEGRATION DIRECTE

Cette méthode est plus valable et directe quelle que soit la distance entre ces sections, que la méthode par approximation successive qui passe d'une section à l'autre d'une petite distance. L'intégration de l'équation différentielle du mouvement dans les canaux non prismatiques en forme générale permet de calculer et tracer la surface d'eau, si on connait le débit Q, la pente du fond J_f , et le coefficient de frottement n ou c, par conséquent les variables sont l'abscisse x, largeur B, et la profondeur d'eau h, correspondent. Pour quelques sections du canal, tel que la forme rectangulaire, trapézoïdale, triangulaire et parabolique.

5.1 METHODE DE BAKHMETEFF

Cette méthode plus utilisée à des canaux de section transversale de forme quelconque. Pour le Calcul des courbes de remous, elle est assez longue à utiliser mais elle est précise à condition d'adopter des intervalles d'intégration suffisamment petits.

L'expression de la débitance K pour un tel canal est donnée par l'équation (8) on peut exprimer par une relation exponentielle :

$$K^2 = C^2 R_h S^2 = C^{te} h^N \quad (15)$$

Par cette définition le rapport $(\frac{K}{K_n})^2$donne :

$$(\frac{K}{K_n})^2 = \frac{C^2 R_h S^2}{(C^2 R_h S^2)_n} = (\frac{h}{h_n})^N \quad (16)$$

Où :

h_n : Profondeur normal

N : exposant hydraulique, qui est à déterminer pour chaque forme de canal.

On suppose que le rapport

$$\frac{J_f}{J_c} = \beta = J_f \frac{C^2 B R_h}{gS} \quad (17)$$

Si on considère comme une constante dans un tronçon. L'équation différentielle équation (14) écrit alors :

$$\frac{dh}{dx} = J_f \frac{1-(\frac{h_n}{h})^N + (\frac{h_n}{h})^N \frac{1}{J_c B} \frac{dS}{dx}}{1-\beta(\frac{h_n}{h})^N} \quad (18)$$

5.1.1 SECTION RECTANGULAIRE

$$S = Bh \Rightarrow \frac{dS}{dx} = \frac{dB}{dx} h \quad (19)$$

$$dx = \frac{1}{J_f} \frac{-(\frac{h_n}{h})^N \frac{J_f}{J_c} \frac{dB}{B} h + dh(1-(\frac{h_n}{h})^N \frac{J_f}{J_c})}{1-(\frac{h_n}{h})^N} \quad (20)$$

En posant $h/h_n = \eta$, $dh = h_n d\eta$ et $\frac{J_f}{J_c} = \beta$

En intégrant cette relation entre deux sections d'abscisses x_i et x_{i+1} et en admettant β et N comme constante, on obtient :

$$\int_{x_{i+1}}^{x_i} dx = \frac{-\beta h}{J_f(\eta^N - 1)} \int_{B_{i+1}}^{B_i} \frac{dB}{B} + \frac{h_n}{J_f} \int_{\eta_{i+1}}^{\eta_i} \left[1 + \frac{1-\beta}{\eta^N - 1}\right] d\eta \quad (21)$$

$$(x_i - x_{i+1}) = \frac{-\beta h}{J_f(\eta^N - 1)} [\ln B_i - \ln B_{i+1}] + \frac{h_n}{J_f} [(\eta_i - \eta_{i+1}) - (1 - \beta)(\Phi(\eta_i) - \Phi(\eta_{i+1})] \quad (22)$$

Avec l'intégrale

$$\Phi(\eta . N) = -\int \frac{d\eta}{\eta^N - 1} \quad (23)$$

Forme générale pour section rectangulaire :

$B \ll h \quad N = 2.0$
$B = 2h \quad N = 2.5$
$B = \infty \quad N = 3.0$

5.1.2 SECTION TRAPÉZOÏDALE

$$S = (B - mh)h = Bh - m h^2 \Rightarrow \frac{dS}{dx} = \frac{dB}{dx} h$$

$$(x_i - x_{i+1}) = \frac{-\beta h}{J_f(\eta^N - 1)} [\ln B_i - \ln B_{i+1}] + \frac{h_n}{J_f} [(\eta_i - \eta_{i+1}) - (1 - \beta)(\Phi(\eta_i) - \Phi(\eta_{i+1})] \quad (24)$$

Même Forme de section rectangulaire mais $3 < N < 4$

5.1.3 SECTION TRIANGULAIRE

$$S = \frac{1}{2}\, B\, h \;\Rightarrow\; \frac{dS}{dx} = \frac{1}{2}\, h\, \frac{dB}{dx}$$

$$(x_i - x_{i+1}) = \frac{-\frac{1}{2}\beta h}{J_f(\eta^N - 1)}[\ln B_i - \ln B_{i+1}] + \frac{h_n}{J_f}[(\eta_i - \eta_{i+1}) - (1 - \beta)(\Phi(\eta_i) - \Phi(\eta_{i+1})] \quad (25)$$

Forme générale pour section triangulaire $5.3 < N < 5.5$

5.1.4 SECTION PARABOLIQUE

$$S = \frac{2}{3}\, B\, h \;\Rightarrow \frac{dS}{dx} = \frac{2}{3}\, h \frac{dB}{dx}$$

$$(x_i - x_{i+1}) = \frac{-\frac{2}{3}\beta h}{J_f(\eta^N - 1)}[\ln B_i - \ln B_{i+1}] + \frac{h_n}{J_f}[(\eta_i - \eta_{i+1}) - (1 - \beta)(\Phi(\eta_i) - \Phi(\eta_{i+1})] \quad (26)$$

Forme générale pour section parabolique N = 4.0

6 CARACTÉRISTIQUES GÉOMÉTRIQUES DU CANAL NON-PRISMATIQUE

Un canal dont la section varie et dont la pente longitudinale et la rugosité ne reste pas constantes (la hauteur d'eau peut cependant varier). Si non, on l'appelle canal prismatique.

6.1 RUGOSITÉ COMPOSÉE

Pour des sections à périmètre mouille non homogène le lit et chaque paroi (berge) ont des rugosités différentes (voir figure. 1) il faut alors calculer un coefficient de frottement équivalent, selon Einstein (voir Chow 1959 p.136) on y divise de manière raisonnable la surface mouillée S en N part chacune ayant un périmètre mouille $p_1, p_2, p_3, \ldots, p_N$, et son coefficient de frottement : $n_1, n_2, n_3, \ldots, n_N$. Le coefficient de frottement équivalent d'une rugosité composée se calcule par équation (27):

$$n = \left(\frac{\sum_1^N \left(p_N\, n_N^{3/2}\right)}{p}\right)^{2/3} \quad (27)$$

6.1.1 PENTE MOYENNE

Une pente moyenne de fond peut être approximativement obtenue en utilisant les cotes de niveau (thalweg) z(x) (ligne fictive qui relie les points les plus bas des sections transversales le long du lit du canal) des sections ainsi que la distance entre elles.

$$J_f = \frac{\Delta z}{\Delta x} \simeq \sum_1^N \frac{Jf_N}{N} \quad (28)$$

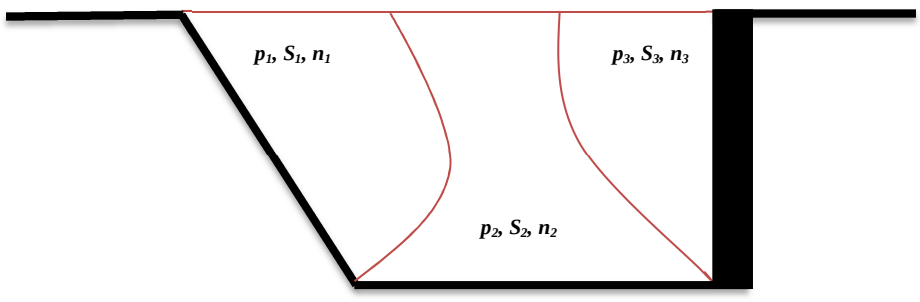


Fig. 1. Section a rugosité composée

➢ **EXEMPLE DE CALCUL 1**

Un canal de section trapézoïdal de profil non prismatique d'une largeur b = 7 [m] ayant une pente de talus m = 1.5 transporte un débit de Q = 28 [m^3/S] la pente du fond varie le long du lit du canal Jf_1 = 0.0030, Jf_2 = 0.0017, Jf_3 = 0.0024, Jf_4 =

0.0017, voir (figure.2) et le coefficient de rugosité est déterminé comme n [$m^{-1/3}$ S], coefficient de frottement du béton lisse varient selon le lit et les parois (berges) du canal n_1 = 1/75 = 0.013 [$m^{-1/3}$ S], n_2 = 1/80 = 0.012[$m^{-1/3}$ S], n_3 = 1/95 = 0.010[$m^{-1/3}$.S], la profondeur d'eau h = 1.5[m] .

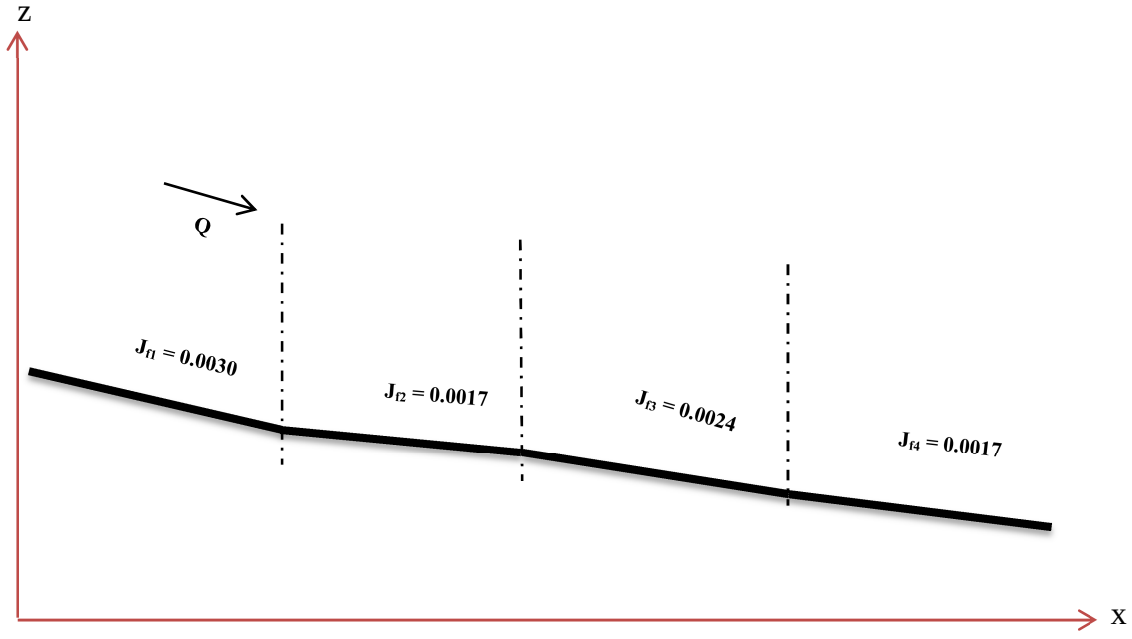


Fig. 2. Exemple de calcul pour un canal non-prismatique

En utilisant la méthode que nous avons vue précédemment, pour déterminer la forme de la surface d'eau, et les résultats se présentant comme suit :

$$n = \left(\frac{\sum_1^N \left(p_N\, n_N^{3/2}\right)}{p}\right)^{2/3} = 0.012[m^{-\frac{1}{3}} S]$$

$$J_f = \frac{\Delta z}{\Delta x} \simeq \sum_1^4 \frac{Jf_N}{N} = \frac{0.0024+0.0017+0.0030+0.0017}{4} = 0.0022$$

A l'aide d'un tableur, l'équation (10) est résolue par une procédure itérative afin de déterminer la profondeur normale.

Tableau 2. Calcul itératif de la profondeur normal

b = 7 [m], m = 1.5, n = 0.012 [$m^{-1/3}$ S], J_f = 0.0022, Q = 28 [m^3 /S]						
essais	h_n [m]	S[m^2]	P[m]	R_h [m]	Q_{calc} [m^3 /S]	Remarques
1	0.9860	8.360	10.555	0.792	27.971	Non! 27.971 < 28.00 Essayer: h_n > 0.9860 [m]
2	0.9875	8.375	10.560	0.793	28.045	Non! 28.045 > 28.00 Essayer: 0.9860 [m]< h_n < 0.9875[m]
3	0.9868	8.368	10.558	0.792	27.999	oui! 27.999 ≈ 28.00 h_n = 0.9868 [m]

Dans le cas d'un écoulement critique on a :

$$\frac{U_c}{\sqrt{gD_{h_c}}} = 1 \qquad (27)$$

Où $U_c x = {}^{Q}/_{S_c}$. En introduisant les expressions pour U_c et gD_{h_c} dans l'équation (27).

$$Q = \sqrt{gS_c^3/_B} \tag{28}$$

Cette équation est résolue par une procédure itérative afin de déterminer la profondeur critique.la feuille de calcul est présentée ci-dessous.

Comme $h_n < h_c$ et J_f (= 0.0022) >J_c (= 0.0016) l'écoulement est à forte pente. La ligne de la surface d'eau sera donc une courbe de type S. Puisque $h > h_c > h_n$; $J_f > J_c$ donc $Fr < 1$; dh/dx positif. Le type de courbe de remous obtenue est S de branche S1. L'ensemble de résultats obtenus par cette méthode sont regroupés dans le tableau (4) et présenté sur la figure (3)

Tableau 3. Calcul itératif de la profondeur critique

b = 7 [m], m = 1.5, n = 0.012 [$m^{-1/3}$ S], J_f = 0.0022, Q = 28 [m^3 /S]						
essais	h_c [m]	S_c [m^2]	B[m]	g [m^3 /S]	Q_{calc} [m^3 /S]	Remarques
1	1.200	10.560	10.600	9.81	33.012	Non! 33.012 > 28.00 Essayer: h_c < 1.200 [m]
2	1.000	8.500	10.000	9.81	24.545	Non! 24.545 < 28.00 Essayer: 1.000 [m]< h_c < 1.200[m]
3	1.085	9.258	10.254	9.81	27.999	oui! 27.999 ≈ 28.00 Essayer: h_c = 1.085 [m]

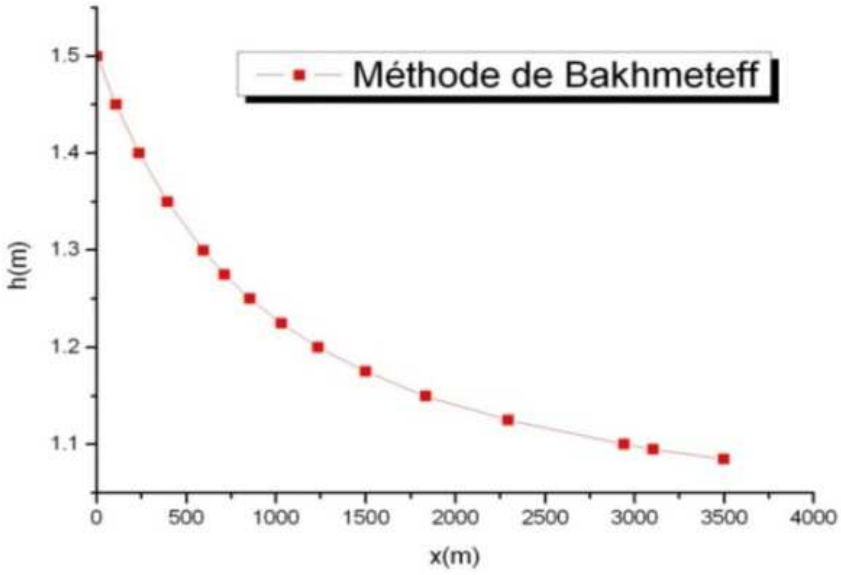


Fig. 3. Calcul de la ligne d'eau avec la méthode de Bakhmeteff pour une forme de section trapézoïdale du canal de faible rugosité ($n=0.012m^{-1/3}$ s)

Tableau 4. Calcul de la ligne d'eau avec la méthode de Bakhmeteff pour une forme de section trapézoïdale du canal de faible rugosité :

b = 7 [m] ; m = 1.5 ; n = 0.012 [$m^{-1/3}$ S] ; J_f = 0.0022 ; Q = 28 [m^3 / S]							
h_n = 0.9868 [m] ; h_c = 1.085 [m] ; h_c/h_n = 1.0995 [-] ; J_c = 0.0016							
1	2	3	4	5	6	7	8
h [m]	$\boldsymbol{\beta}$[-]	N [-]	B [m]	$\boldsymbol{\eta}$[-]	Φ ($\boldsymbol{\eta}$, N)	x'	x
1.500	1.375	3.56	11.500	1.52	0.149	41.361	0
1.450	1.375	3.55	11.350	1.469	0.167	-66.617	107.979
1.400	1.375	3.54	11.200	1.419	0.187	-195.280	236.641
1.350	1.375	3.53	11.050	1.368	0.212	-352.668	394.029
1.300	1.375	3.52	10.900	1.317	0.242	-552.764	594.125
1.270	1.375	3.52	10.750	1.287	0.261	-672.686	714.048
1.250	1.375	3.52	10.735	1.267	0.275	-814.483	855.845
1.225	1.375	3.51	10.720	1.241	0.299	-988.691	1030.053
1.200	1.375	3.51	10.705	1.216	0.323	-1194.310	1235.672
1.175	1.375	3.50	10.690	1.191	0.352	-1459.173	1500.535
1.150	1.375	3.50	10.675	1.165	0.386	-1792.560	1833.921
1.125	1.375	3.49	10.660	1.140	0.428	-2252.564	2293.925
1.100	1.375	3.49	10.645	1.115	0.475	-2899.338	2940.700
1.095	1.375	3.49	10.630	1.110	0.487	-3063.798	3105.160
1.085	1.375	3.48	10.612	1.100	0.514	-3455.802	3497.163

- **EXEMPLE DE CALCUL 2**

Un canal de section rectangulaire de profil non prismatique d'une largeur b = 2h [m] transporte un débit de Q = 28 [m^3/S] la pente du fond varie le long du lit du canal Jf_1 = 0.0030, Jf_2 = 0.0017, Jf_3 = 0.0024, Jf_4 = 0.0017, et le coefficient de rugosité est déterminé comme n [$m^{-1/3}$ S], coefficient de frottement de béton lisse varient selon le lit et les parois (berges) du canal n_1 = 0.013 [$m^{-1/3}$ S], n_2 = 0.012[$m^{-1/3}$ S], n_3 = 0.010[$m^{-1/3}$ S]], la profondeur d'eau h = 1.5[m] .

Tableau 5. Calcul itératif de la profondeur normal

b = 2*h [m], n = 0.012 [$m^{-1/3}$ S], J_f = 0.0022, Q = 28 [m^3 /S]						
Essais	h_n [m]	S[m^2]	P[m]	R_h [m]	Q_{calc} [m^3 /S]	Remarques
1	1.75	6.125	7.00	0.875	21.90	Non! 21.60 < 28.00 Essayer: h_n > 1.75 [m]
2	2.00	8.00	8.00	1.00	31.269	Non! 31.269 > 28.00 Essayer: 1.75 [m]< h_n < 2.00[m]
3	1.919	7.365	7.676	0.959	27.999	oui! 27.999 ≈ 28.00 Essayer: h_n = 1.9190 [m]

Comme $h_n > h_c$ et J_f (= 0.0022) < J_c (= 0.0071) l'écoulement est à pente faible. La ligne de la surface d'eau sera donc une courbe de type M.

Puisque $h_n > h_c > h$ et $J_f < J_c$ donc Fr > 1 et dh/dx positif.

Le type de courbe de remous obtenue est M de branche M3.

L'ensemble de résultats obtenus par cette méthode sont regroupés dans le tableau (2) et présentés sur la figure (4).

Tableau 6. Calcul itératif de la profondeur critique

b = 2h [m], m = 1.5, n = 0.012 [$m^{-1/3}$ S], J_f = 0.0022, Q = 28 [m^3 /S]						
Essais	h_c [m]	S_c [m^2]	B[m]	g [m^3 /S]	Q_{calc} [m^3 /S]	Remarques
1	1.850	6.845	3.7	9.81	29.160	Non! 29.160 > 28.00 Essayer: h_c < 1.850 [m]
2	1.800	6.48	3.6	9.81	27.230	Non! 27.230 < 28.00 Essayer: 1.800 [m]< h_c < 1.850[m]
3	1.8201	6.626	3.64	9.81	27.999	oui! 27.999 ≈ 28.00 Essayer: h_c = 1.8201 [m]

Tableau 7. Calcul de la ligne d'eau avec la méthode de Bakhmeteff pour une forme rectangulaire du canal de faible rugosité :

b = 2*h [m] ; n = 0.012 [$m^{-1/3}$ S] ; J_f = 0.0022 ; Q = 28 [m^3 / S]							
h_n = 1.9190 [m] ; h_c = 1.8201 [m] ; h_c/h_n = 0.8303 [-]							
1	2	3	4	5	6	7	8
h [m]	**β**[-]	**N [-]**	**B [m]**	**η**[-]	Φ (η, N)	**x'**	**x**
1.5000	0.75862069	2.50	3.000	0.782	0.967	1714.030	0
1.5201	0.75862069	2.50	3.040	0.792	0.989	1802.741	88.711
1.5451	0.75862069	2.50	3.090	0.805	1.020	1924.627	210.598
1.5701	0.75862069	2.50	3.140	0.818	1.052	2062.702	348.672
1.5951	0.75862069	2.50	3.190	0.831	1.086	2220.553	506.523
1.6201	0.75862069	2.50	3.240	0.844	1.123	2403.040	689.011
1.6451	0.75862069	2.50	3.290	0.857	1.162	2617.297	903.267
1.6701	0.75862069	2.50	3.340	0.870	1.203	2873.025	1158.995
1.6951	0.75862069	2.50	3.390	0.883	1.255	3182.367	1468.337
1.7201	0.75862069	2.50	3.440	0.896	1.303	3569.576	1855.547
1.7451	0.75862069	2.50	3.490	0.909	1.359	4065.352	2351.322
1.7701	0.75862069	2.50	3.540	0.922	1.408	4728.391	3014.362
1.7951	0.75862069	2.50	3.590	0.935	1.5	5648.534	3934.504
1.8201	0.75862069	2.50	3.640	0.948	1.601	7034.787	5320.757

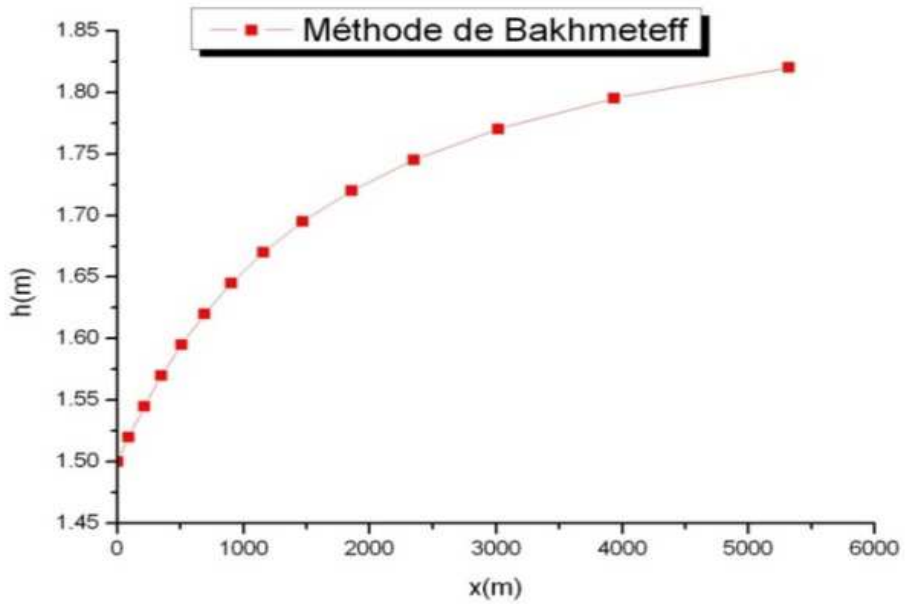


Fig. 4. Calcul de la ligne d'eau avec la méthode de Bakhmeteff pour une forme de section rectangulaire du canal de faible rugosité ($n=0.012 m^{-1/3} s$)

➢ **EXEMPLE DE CALCUL 3**

Un canal de section triangulaire de profil non prismatique ayant une pente de talus m = 1.5 transporte un débit de Q = 28 [m^3/S] la pente du fond varie le long du lit du canal Jf_1 = 0.0030, Jf_2 = 0.0017, Jf_3 = 0.0024, Jf_4 = 0.0017, et le coefficient de rugosité est déterminé comme n [$m^{-1/3}$ S], coefficient de frottement de béton lisse varient selon le lit et les parois (berges) du canal n_1 = 0.013 [$m^{-1/3}$ S], n_3 = 0.010[$m^{-1/3}$ S]], la profondeur d'eau h = 1.5[m]

Tableau 8. Calcul itératif de la profondeur normal

b = 2*m*h [m], m = 1.5, n = 0.012 [$m^{-1/3}$ S], J_f = 0.0022, Q = 28 [m^3 /S]						
Essais	h_n [m]	S[m^2]	P[m]	R_h [m]	Q_{calc} [m^3 /S]	Remarques
1	2.215	7.426	8.022	0.926	27.576	Non! 27.576 < 28.00 Essayer: h_n > 2.215 [m]
2	2.555	9.792	9.212	1.063	39.865	Non! 39.865 > 28.00 Essayer: 2.215 [m]< h_n < 2.555[m]
3	2.2380	7.513	8.069	0.931	27.999	oui! 27.999 ≈ 28.00 Essayer: h_n = 2.2380 [m]

Comme h_n < h_c et J_f (= 0.0022) >J_c (= 0.0017) l'écoulement est à forte pente. La ligne de la surface d'eau sera donc une courbe de type S. Puisque h_c > h_n > h et J_f > J_c donc Fr > 1 et dh/dx positif. Le type de courbe de remous obtenue est S de branche S3. L'ensemble de résultats obtenus par cette méthode sont regroupés dans le tableau (3) et présentés sur la figure (5).

Tableau 9. Calcul itératif de la profondeur critique

b = 2*m*h [m], m = 1.5, n = 0.012 [$m^{-1/3}$ S], J_f = 0.0022, Q = 28 [m^3 /S]						
Essais	h_c [m]	S_c [m^2]	B[m]	g [m^3 /S]	Q_{calc} [m^3 /S]	Remarques
1	2.400	8.640	7.20	9.81	29.644	Non! 29.644 > 28.00 Essayer: h_c < 2.400 [m]
2	2.335	8.178	7.005	9.81	27.676	Non! 27.676 < 28.00 Essayer: 2.335 [m]< h_c < 2.400[m]
3	2.3458	8.254	7.037	9.81	27.999	oui! 27.999 ≈ 28.00 Essayer: h_c = 2.3458 [m]

Tableau 10. Ccalcul de la ligne d'eau avec la méthode de Bakhmeteff pour une forme triangulaire du canal de faible rugosité :

b = 2*m*h [m] , m = 1.5 ; n = 0.012 [$m^{-1/3}$ S] ; J_f = 0.0022 ; Q = 28 [m^3 / S]							
h_n = 2.2380 [m] ; h_c = 2.3458 [m] ; h_c/h_n = 1.0482 [-]							
1	2	3	4	5	6	7	8
h [m]	**β**[-]	**N [-]**	**B [m]**	**η**[-]	Φ (η, N)	**x'**	**x**
1.500	1.294118	5.33	4.500	0.670	0.685	1639.557	0
1.536	1.294118	5.33	4.608	0.686	0.704	1706.276	66.719
1.5860	1.294118	5.33	4.758	0.709	0.731	1805.352	165.795
1.6360	1.294118	5.33	4.908	0.731	0.758	1913.425	273.868
1.6860	1.294118	5.33	5.058	0.753	0.786	2033.386	393.829
1.7360	1.294118	5.33	5.208	0.776	0.818	2169.762	530.205
1.7860	1.294118	5.33	5.358	0.798	0.848	2325.999	686.442
1.8360	1.294118	5.33	5.508	0.820	0.882	2511.737	872.180
1.8860	1.294118	5.33	5.658	0.843	0.920	2739.281	1099.724
1.9360	1.294118	5.33	5.808	0.865	0.959	3028.181	1388.624
1.9860	1.294118	5.33	5.958	0.887	1.004	3416.599	1777.042
2.0360	1.294118	5.33	6.108	0.910	1.058	3978.393	2338.836
2.0860	1.294118	5.33	6.258	0.932	1.123	4883.100	3243.543
2.1360	1.294118	6.408	6.408	0.954	1.210	6634.168	4994.611
2.1860	1.294118	5.33	6.558	0.977	1.355	11666.140	10026.583
2.2360	1.294118	5.33	6.708	0.999	1.947	264894.402	263254.845

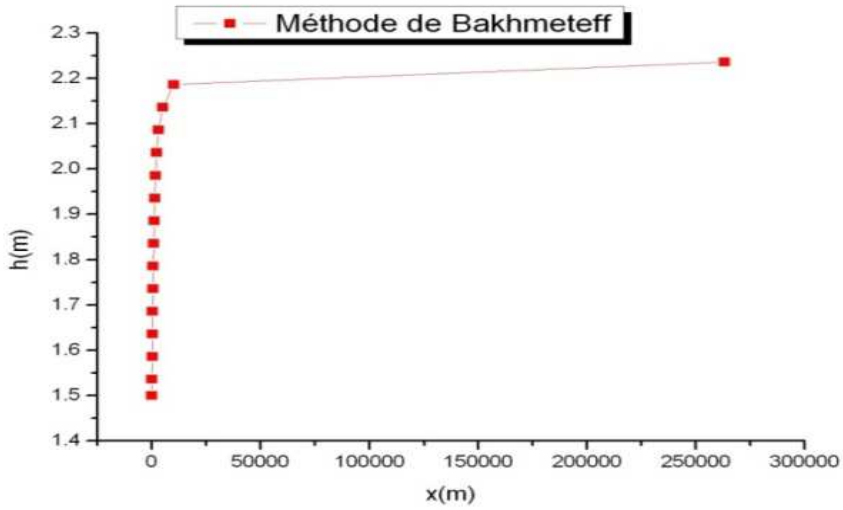


Fig. 5. Calcul de la ligne d'eau avec la méthode de Bakhmeteff pour une forme de section rectangulaire du canal de faible rugosité ($n=0.012 m^{-1/3} s$)

➢ **EXEMPLE DE CALCUL 4**

Un canal de section parabolique de profil non prismatique transporte un débit de Q = 28 [m^3/S] la pente du fond varie le long du lit du canal J_{f1} = 0.0030, J_{f2} = 0.0017, J_{f3} = 0.0024, Jf_4 = 0.0017, et le coefficient de rugosité est déterminé comme n [$m^{-1/3}$ S], coefficient de frottement de béton lisse varient selon le lit et les parois (berges) du canal n_1 = 0.013 [$m^{-1/3}$ S], n_3 = 0.010[$m^{-1/3}$ S], la largeur au miroir B = 3[m], $\xi = \frac{4h}{B}$, la largeur au miroir B = 12[m], $\xi = \frac{4h}{B}$,]et profondeur d'eau h = 1.5[m] .

Tableau 11. Calcul itératif de la profondeur normale

B = 12 [m], m = 1.5, n = 0.012 [$m^{-1/3}$ S], J_f = 0.0022, Q = 28 [m^3 /S]						
Essais	h_n [m]	S[m^2]	P[m]	R_h [m]	Q_{calc} [m^3 /S]	Remarques
1	1.110	8.880	12.2738	0.7235	27.9727	Non! 27.700 < 28.00 Essayer: h_n > 3.800 [m]
2	1.112	8.896	12.2748	0.7247	28.054	Non! 28.054 > 28.00 Essayer: 1.11 [m]< h_n < 1.112[m]
3	1.1106	8.885	12.2741	0.7239	27.999	oui! 27.999 ≈ 28.00 Essayer: h_n = 1.1106[m]

Tableau 12. Calcul itératif de la profondeur critique

B = 12 [m], n = 0.017 [$m^{-1/3}$ S], J_f = 0.0022, Q = 28 [m^3 /S]						
Essais	h_c [m]	S_c [m^2]	B[m]	g [m^3 /S]	Q_{calc} [m^3 /S]	Remarques
1	1.300	10.40	12.00	9.81	30.32	Non! 30.32 > 28.00 Essayer: h_c < 1.300 [m]
2	1.230	9.840	12.00	9.81	27.908	Non! 27.908 < 28.00 Essayer: 1.230 [m]< h_c < 1.30[m]
3	1.2326	9.8608	12.00	9.81	27.999	oui! 27.999 ≈ 28.00 Essayer: h_c = 1.2326 [m]

Comme $h_c > h_n$ et J_f (= 0.0022) > J_c (= 0.0016) l'écoulement est à pente faible. La ligne de la surface d'eau sera donc une courbe de type S. Puisque $h > h_c > h_n$; $J_f > J_c$ donc $Fr < 1$; dh/dx positif. Le type de courbe de remous obtenue est S de branche S1. L'ensemble de résultats obtenus par cette méthode sont regroupés dans le tableau (4) et présentés sur la figure (6).

Tableau 13. Calcul de la ligne d'eau avec la méthode de Bakhmeteff pour une forme parabolique du canal de faible rugosité :

B = 12.00 [m] , n = 0.017 [m-1/3 S] ; J_f = 0.0022 ; Q = 28 [m^3 / S]							
h_n = 5.285 [m] ; h_c = 3.106 [m] ; h_c/h_n = 1.0482 [-]							
1	2	3	4	5	6	7	8
h [m]	**β**[-]	**N [-]**	**B [m]**	**η**[-]	Φ (η, N)	**x'**	**x**
1.5000	1.37500000	4.00	12.00	1.351	0.157	44.307	0
1.4777	1.37500000	4.00	12.30	1.331	0.166	-20.933	65.240
1.4554	1.37500000	4.00	12.60	1.310	0.176	-93.411	137.718
1.4331	1.37500000	4.00	12.90	1.290	0.187	-174.665	218.972
1.4108	1.37500000	4.00	13.20	1.270	0.199	-266.687	310.994
1.3885	1.37500000	4.00	13.50	1.250	0.212	-372.107	416.414
1.3662	1.37500000	4.00	13.80	1.230	0.252	-489.549	533.856
1.3439	1.37500000	4.00	14.10	1.210	0.244	-638.110	682.417
1.3216	1.37500000	4.00	14.40	1.190	0.262	-810.751	855.058
1.2993	1.37500000	4.00	14.70	1.170	0.283	-1022.084	1066.391
1.2770	1.37500000	4.00	15.00	1.150	0.308	-1287.675	1331.982
1.2547	1.37500000	4.00	15.30	1.130	0.337	-1633.027	1677.334
1.2360	1.37500000	4.00	15.60	1.113	0.372	-2016.969	2061.275

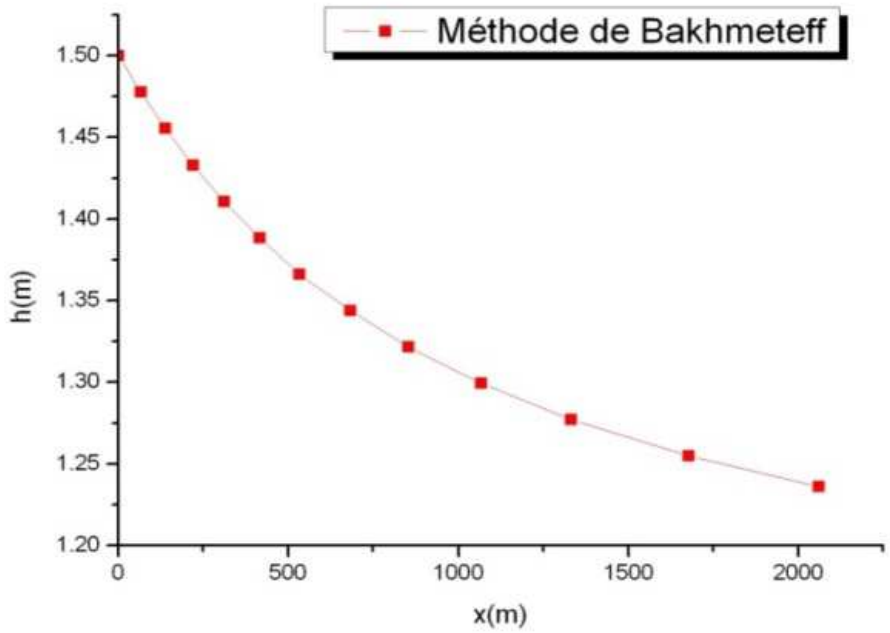


Fig 6. Calcul de la ligne d'eau avec la méthode de Bakhmeteff pour une forme de section parabolique du canal de faible rugosité ($n=0.012 m^{-1/3}$ s)

7 CONCLUSION

La présente étude a pour objet la classification des courbes de remous dans un canal de profil non prismatique à des sections diverses, selon la méthode de résolution que nous avons élaborée. Cette méthode a avant que faire se peut qui a permis de visualiser le profil en long de la ligne d'eau pour des écoulements de débit connus.

Au vu des résultats obtenus, nous pouvons conclure d'une façon générale que le calcul des courbes de remous pour les écoulements graduellement variés à surface libre dans les canaux découverts de profil non prismatique permet de déduire la profondeur à tout point du canal, il consiste à suivre l'évolution de la ligne d'eau sur toute la longueur du canal considéré. Et par conséquent nous avons observé les remarques suivantes :

- Bien que la ligne d'eau soit calculée par intégration directe (méthode Bakhmeteff), converge plus lentement vers la profondeur normale ou critique, la méthode des tronçons qui est en général plus longue à appliquer, mais souvent aussi elle est plus précise.
- L'intégration de l'équation différentielle est directe. Cela veut dire qu'on peut passer d'une section à l'autre quel que soit la distance entre ces sections, ce qui n'est pas le cas avec les autres méthodes où il faut avancer par petites distances. On trouve évidemment ces avantages dans la méthode par intégration direct.

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Utilization of Flue Gas as Carbon Source to Grow *Scenedesmus quadricauda* for Simultaneous CO_2 Reduction and Biodiesel (FAME) Production

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ABSTRACT: In the present study *Scenedesmus quadricauda* was grown in laboratory flasks and outdoor open raceway ponds using industrial flue gas as carbon source to achieve CO_2 reduction from the flue gases along with biomass, lipid and FAME (biodiesel) yields. Three sets of experiments were carried out out of which two experiments were carried out in laboratory culture flasks using 6% flue gas-air mixture at a flow rate of 0.1vvm for a minute per every half an hour and per every one hour. The third experiment was planned in the outdoor open raceway ponds using 6% flue gas-air mixture at a flow rate of 0.1vvm for a minute per every one hour. The maximum algal biomass growth of 1.28 g/L, lipid yield of 0.20 g/L and fatty acid methyl esters (FAME) of 0.091 g/L were obtained in 6% flue gas concentrations aerated into culture flasks at 0.1vvm for every one hour. On the other hand the CO2 removal efficiency reached upto 75% along with SOx and NOx reductions upto 50%. Hence in the present study it was observed that the micro alga *S. quadricauda* utilized the flue gas-air mixture for CO_2 reduction and in turn it produced biomass, lipids and FAME yields efficiently.

KEYWORDS: Flue gas, *Scenedesmus quadricauda*, Open raceway pond, Biomass, Lipid, FAME, Biodiesel.

1 INTRODUCTION

The increase of world energy demand and greenhouse gas (GHG) emission has been concerning all sectors since last decades. An economic growth combined with a rising population has led to a steady increase in global energy demands. If the governments around the world stick to current policies, the world will need almost more percent of energy in 2030 than today. Of this 45% will be accounted by China and India together [1], [2]. Since the onset of the industrial revolution about 150 years ago, human activities such as the burning of fossil fuels and deforestation have accelerated, and both have contributed to a long-term rise in atmospheric burning fossil fuel (oil, natural gas and coal) releases carbon into the atmosphere far more rapidly than it is being removed, and this imbalance causes increase carbon dioxide (CO_2) concentrations in the atmosphere. Power generation, transport, industry and domestic uses are also contributing for increasing CO_2. However; CO_2 produced by combustion of fossil fuels is a major source of GHG

A typical coal-fired power plant emits flue gas from their stacks containing 5-15% CO_2. In India, In addition to high amounts of CO_2, flue gas also contains several other chemical species such as sulfur oxides (referred to as SOx and comprising mostly SO_2 and SO_3), nitrogen oxides (referred to as NOx and comprising mostly NO and NO_2) [8], heavy metal species including Ag, As, Cd, Co, Cr, Cu, Hg, Ni, Pb, Se, and Zn [9], [10], and carbon compounds including polycyclic aromatic hydrocarbons (PAHs) [11].

It is estimated that CO_2 emission may be expected to increase at an annual rate of 3% between 2005 and 2030. The long term demand for coal brings with it a demand for technologies that can mitigate the environmental problems associated with coal. While control technologies will be used to reduce air pollutants, no technologies exist today, which address the

problem of GHG emissions. A sustainable approach to the capture and removal of CO_2 and retain CO_2 from the atmosphere in a self-sustaining manner is the need of the hour. In addition, it is necessary to enhance the carbon sink capacity of the biosphere (e.g. forests). Meeting the energy demand without huge increases in CO_2 emissions requires more than merely increasing the efficiency of energy production. Since coal is much more plentiful than oil or gas, reducing coal emissions is absolutely essential to avoid dangerous effect of climate change.

The field of algal cultivation for CO_2 fixation and/or its conversion to biofuels is not new, having been suggested as early as 1955 [3], [4] and the earliest internal combustion engines were run on biologically derived molecules (plant oils for diesel engines and bioethanol for spark-ignition engines) until plentiful petroleum- derived fuel stock over due to their lower price. There are many reports on the potential and bio-economics of algal biomass to generate fuels and most of these are based on the premise that one would utilize the CO_2 emitted from fossil-fuelled power stations or other industrial sources of CO_2 such as cement processing [5], [6]. There are comparatively few, but valuable, studies in the literature exploring algal capture of either simulated or actual flue gas CO_2. Microalgae appear to represent the only current renewable way to generate biofuels [7], [13]. Microalgae biofuels are also likely to have a much lower impact on the environment and on the world's food supply than conventional biofuel-producing crops. *Scenedesmus quadricauda* is considered as one of the best candidates for biodiesel production among several microalgae species due to highest total fatty acid and lipid contents of 22.29 mg/g dry weight and 27.4 ± 0.75% respectively, and oleic acid (11.77 mg/g dry weight) [14]. Therefore, it is a promising approach to cultivate *Scenedesmus quadricauda* for nutrient removal and CO_2 fixation.

The aim of this research was to utilize the flue gas from coal burning industrial plant as a carbon source to cultivate *Scenedesmus quadricauda* in turn to produce lipids and fatty acid methyl esters (FAME) and to study the effect of various parameters like pH, alkalinity, carbonates, bicarbonates, aqueous CO_2, nitrates, sulphates, NOx, SOx, outlet flue gas CO_2 on algal biomass growth, lipid and fatty acids of methyl esters (FAME) yields.

2 METHODOLOGY

2.1 MICRO ALGAE CULTURE AND CULTIVATION

The presence of *Scenedesmus quadricauda* was identified in a local freshwater body by microscopic examinations under Olympus CX21 light microscope according to morphological properties [20] Pure colonies of *S. quadricauda* (Figure. 1) were then isolated and purified by micro-capillary pipetted method [21], serial dilution and plating techniques accordingly.

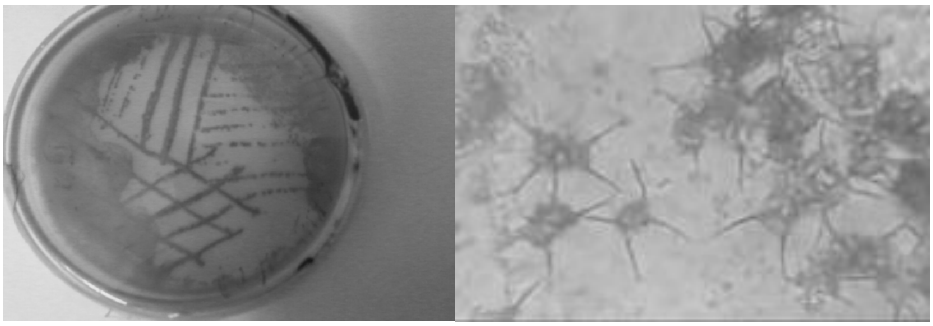


Figure 1: Representing the streak plates and 100X microscopic view of S. quadricauda

2.2 FLUE GAS SAMPLE COLLECTION

Flue gas sample was collected in 3 liters and 5 liter capacity tedlar bags from a coal burning boiler outlet at Sri Chaitanya Chlorides industrial plant, Isnapur, Hyderabad. The collected gas sample was analyzed for the presence of CO_2 (%) by using Gas Chromatography.

2.3 ALGAE CULTIVATION AND NUTRITION

The flue gas from coal-fired industrial plant was used to cultivate the microalgae *S. quadricauda* in indoor culture flasks of 500 mL capacity and in outdoor open raceway pond of 200L capacity (2m x 1m x 0.5m).

The nutrient media used to grow the algae was BG-11 and the composition was Citric acid 6.0 mg/L, Ferric ammonium citrate 6.0 mg/L, EDTA 1.0 mg/L, $NaNO_3$ 1.5 g/L, $K_2HPO_4.2H_2O$ 0.051 g/L, $MgSO_4.7H_2O$ 0.075 g/L, $CaCl_2$ 0.024 g/L, Na_2CO_3

0.02 g/L, H_3BO_4 2.86 g/L, $MnCl_2.4H_2O$ 1.81 g/L, $ZnSO_4.7H_2O$ 0.222 g/L, Na_2 $MoO_4.2H_2O$ 0.391 g/L, $CuSO_4.5H_2O$ 0.079 g/L, $Co(NO_3)_2.6H_2O$ 0.049 g/L. The culture was maintained at 27 ºC temperature and 99 µmol.photons m^{-2} s^{-2} light intensity in a culture rack. Parameters like pH, alkalinity, carbonates, bicarbonates, aqueous CO_2, nitrates, sulphates, NOx, SOx, outlet flue gas CO_2, algal biomass growth, lipid and FAME content were monitored in flasks using 6% flue gas for every half an hour and one hour in the flasks.

2.4 EXPERIMENTAL DESIGN

The flue gas from the coal industrial plant (containing 6% CO_2) was diluted with air mixture (6 ml flue gas in 100 ml of air) using compressed air to produce 6% flue gas-air mixture and supplied for a minute once half an hour and for a minute once one hour daily in flasks as well as in open raceway pond. The mixing and aeration was provided by bubbling the flue gas in to microalgae pond systems with the flow rate of 0.1vvm. A pipeline was connected from flue gas filled tedlar bag to the rotameter inlet and another pipeline of air comes from the compressor connected to another rotameter inlet. The outlets of the two rotameters are connected to a common pipe where the flue gas and air are mixed according to the appropriate experiment and passed into the algae medium in both culture flasks and open raceway pond (Figure. 2).

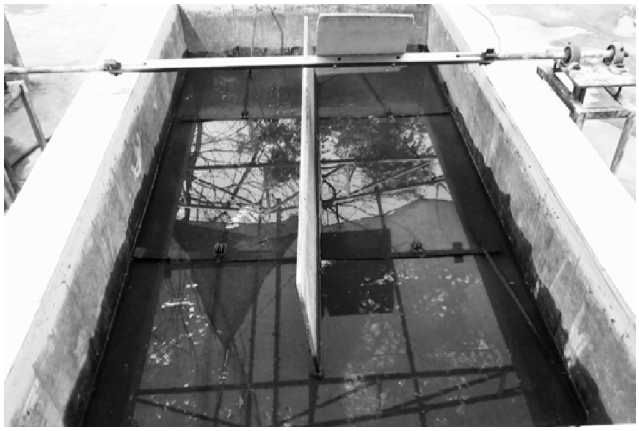


Figure 2: Representing the Growth of S. quadricauda in open raceway pond

2.5 DETERMINATION OF ALGAL GROWTH

Algal growth was analyzed in terms of optical density (absorption) which was daily read at 680nm using a spectrophotometer. A growth curve was generated based on the optical density readings. Algal dry cell weight was determined daily by filtering 10 mL of the culture sample onto Glass Microfiber Filters, GF/C (Whatman). The filtered sample was then washed with distilled water to remove adhering microalgae biomass, dried at 100°C for 24 h. The dried sample was immediately transferred to desiccators over silica gel for dehydration for at least 2 h before weighing. Cell or biomass dry weight productivity was calculated on a daily basis and/or at the end of the experiment.

2.6 DETERMINATION OF TOTAL ALGAL BIOMASS YIELD

Algae were harvested in the culture flasks after they reached late stationary phase by filtering on to a pre weighed dry Whatmann no. 1 filter paper. The algae cells trapped on the filter paper were dried under natural sunlight. Whereas from the raceway ponds the harvesting was carried out using a stainless steel harvester equipped with a double layer nylon polyester cloth to trap the algae. The harvested algae from the ponds were spread evenly on stainless steel plates and let dry under direct sunlight. The dried biomass from both indoor and outdoor cultures were collected and powdered in a mortar and pestle and weighed.

2.7 EXTRACTION OF LIPIDS

The lipids were extracted from powdered biomass with hexane. The dry algae was put directly into the solvent and heated under reflux inside a round bottom flask. A hot water bath was used because it makes controlling the temperature of the extraction easy and it ensured uniform heating. The water cooled condenser was connected directly to the round bottom

flask. Solvent (mL) to algae (g) ratio was taken to be 30:1 to ensure efficient extraction. The solvent, algae, and stir bar were combined in the round bottom flask and heated for 60 minutes at 70°C temperature. After the extraction time was up, the round bottom flask was removed from the hot water bath and allowed to cool. Cold water should be running through the condenser for the entire extraction and cool down processes. Once the round bottom flask cooled down, the algae cells were removed using filtration. Whatman no. 1 filter papers were used for the filtrations. After filtering, the lipids and solvent were in a flask. Then, the solvent was evaporated which left the lipids in the flask. The mass of lipids recovered were determined and used to calculate the extraction yield.

2.8 TRANSESTERIFICATION

The lipids obtained were subjected to transesterification process. This chemical process was carried out in a 100 ml Erlenmeyer flask. The lipid was first poured into the flask then a mixture of methanol and KOH (2.5 g in 100 ml methanol) was added to the lipid in a ratio of 1:5. The mixture was vigorously shaken for 15-30 minutes till an emulsion was formed. Then the flask was placed in an oven maintained exactly at 65 ºC and left for 12-24 hours until two distinct immiscible layers were formed. After cooling down the entire suspension was transferred into a separating funnel and shaken vigorously for 15-30 minutes for the two layers to settle down. The bottom layer was glycerol which settled down first due to its high density and the top layer was fatty acid methyl esters (FAME) termed as biodiesel. Glycerol was eluted first into a separate flask and the remaining FAMEs were washed twice with distilled and finally collected into a fresh clean 25 ml bottle.

2.9 LIPID AND FAME (BIODIESEL) CHARACTERIZATION USING GC-MS

The lipids and FAME obtained from extraction and transesterification were subjected to Gas Chromatography Mass Spectroscopy analysis to know the major components present in both the samples.

3 RESULTS AND DISCUSSION

CO_2 concentration present in the collected flue gas sample found to be 6% which was used in all the three experiments.

Scenedesmus quadricauda cultivated in laboratory culture flasks and outdoor open raceway pond with flue gas inputs delivered the biomass growth (Figure 3), lipid (Figure 4) and FAME (Figure 5) yields in spite of the toxicity of the flue gas components like SOx. The biomass growth, lipid and FAME yields reached maximum on 7^{th} day in culture flasks whereas on 12^{th} day in open raceway pond. Two different time intervals of flue gas air mixture inputs were studied in the culture flasks which are 0.1vvm of 6% flue gas air mixture inputs for every 30 minutes and for every 1 hour. Best result was noted at every one hour interval. Hence the one hour time interval was applied for raceway pond cultivation. Thus among the three experiments conducted, *S. quadricauda* grown in culture flask aerated with 6% flue gas mixture at 0.1vvm flow rate for every one hour showed little higher (biomass growth 1.28 g/L, lipid 0.20 g/L and FAME 0.091 g/L) as shown in the figures below:

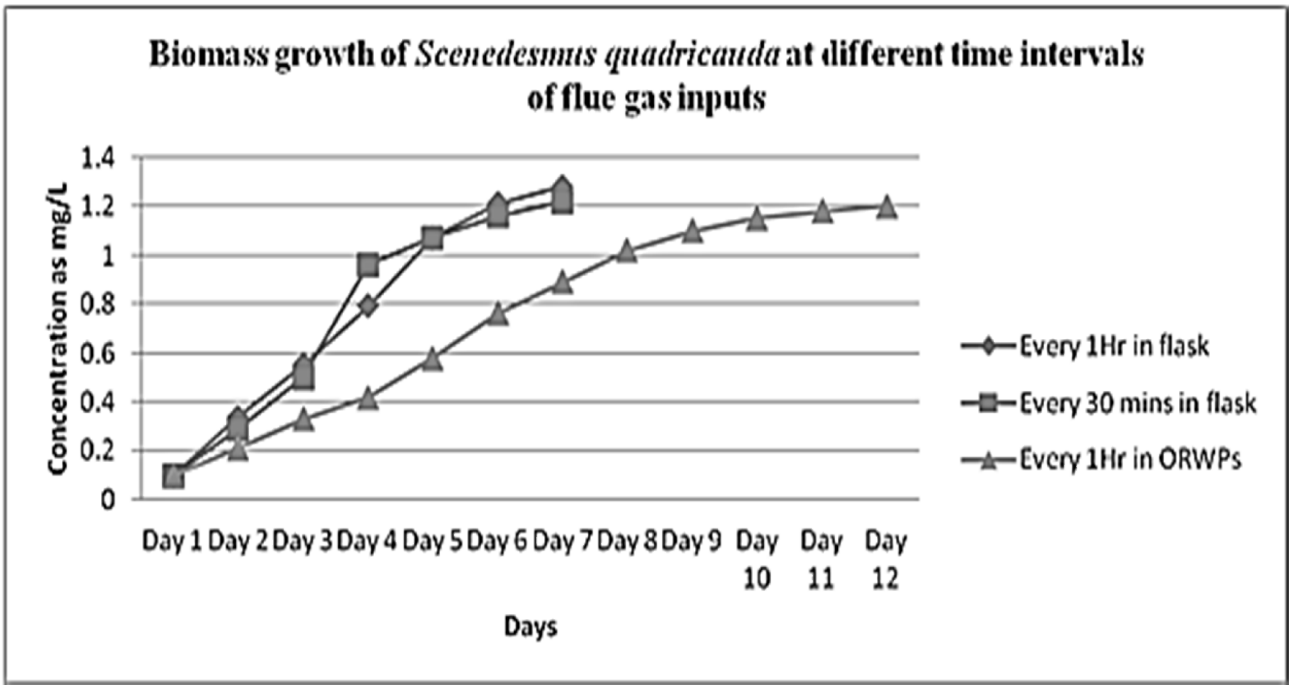


Figure 3: Graph representing biomass growth of S. quadricauda at different time intervals of flue gas inputs

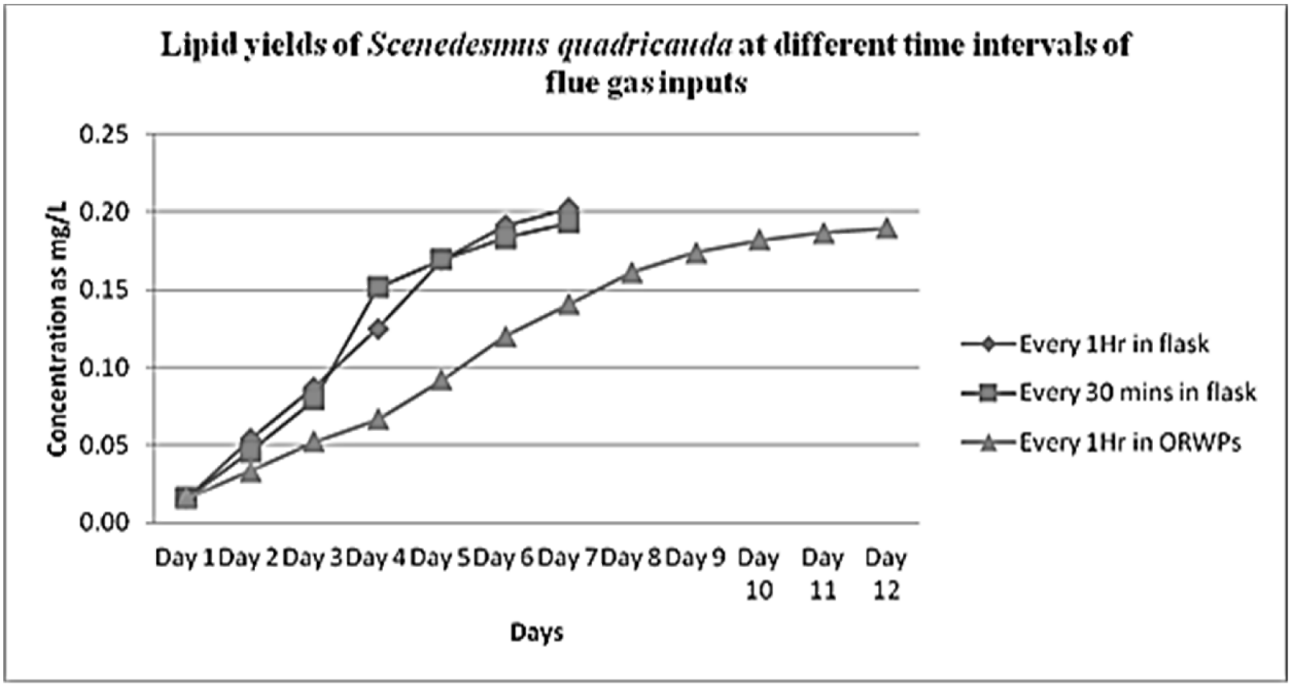


Figure 4: Graph representing the lipid yields of S. quadricauda at different time intervals of flue gas inputs

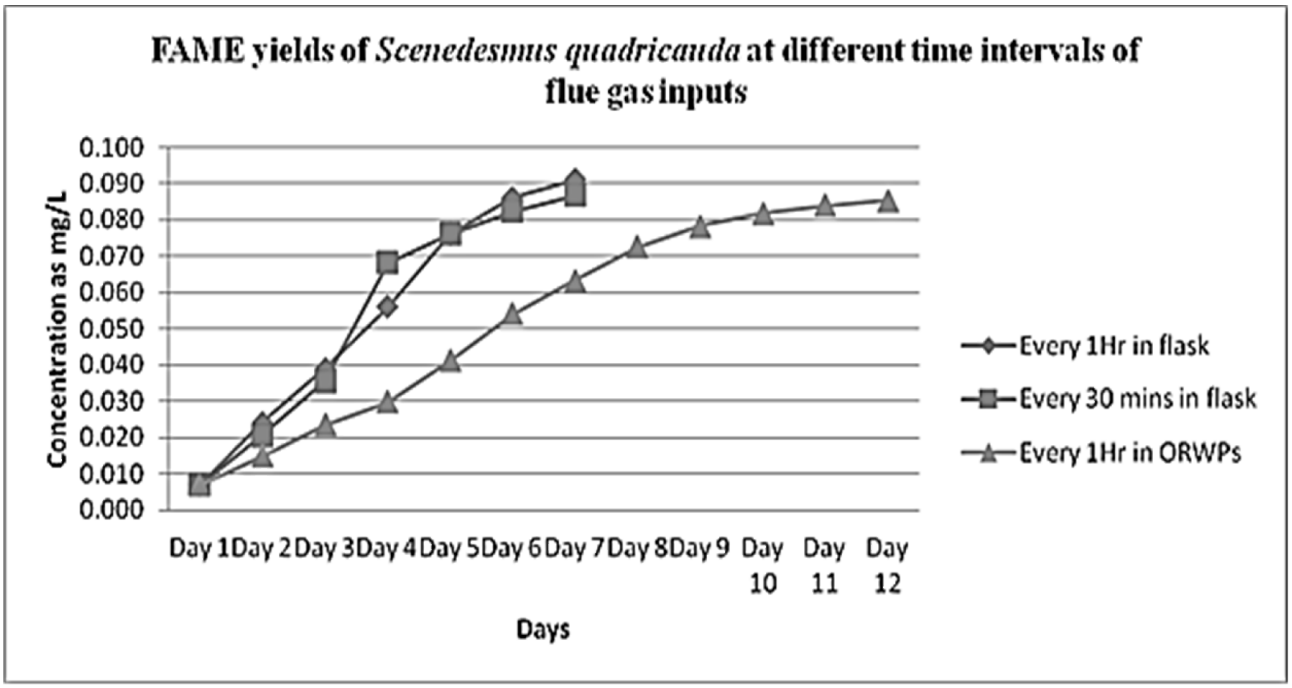


Figure 5: Graph representing the FAME yields of S. quadricauda at different time intervals of flue gas inputs

Initial and final concentrations of SOx (Figure 6) and NOx (Figure 7) present in the flue gas were analyzed and it was observed that the concentrations were reduced up to 50% in all the three experiments. The nitrate and sulphate concentrations were monitored daily relating to the sulphur and nitrogen dissolved in the culture medium which was also reduced up to 65% in all the three experiments.

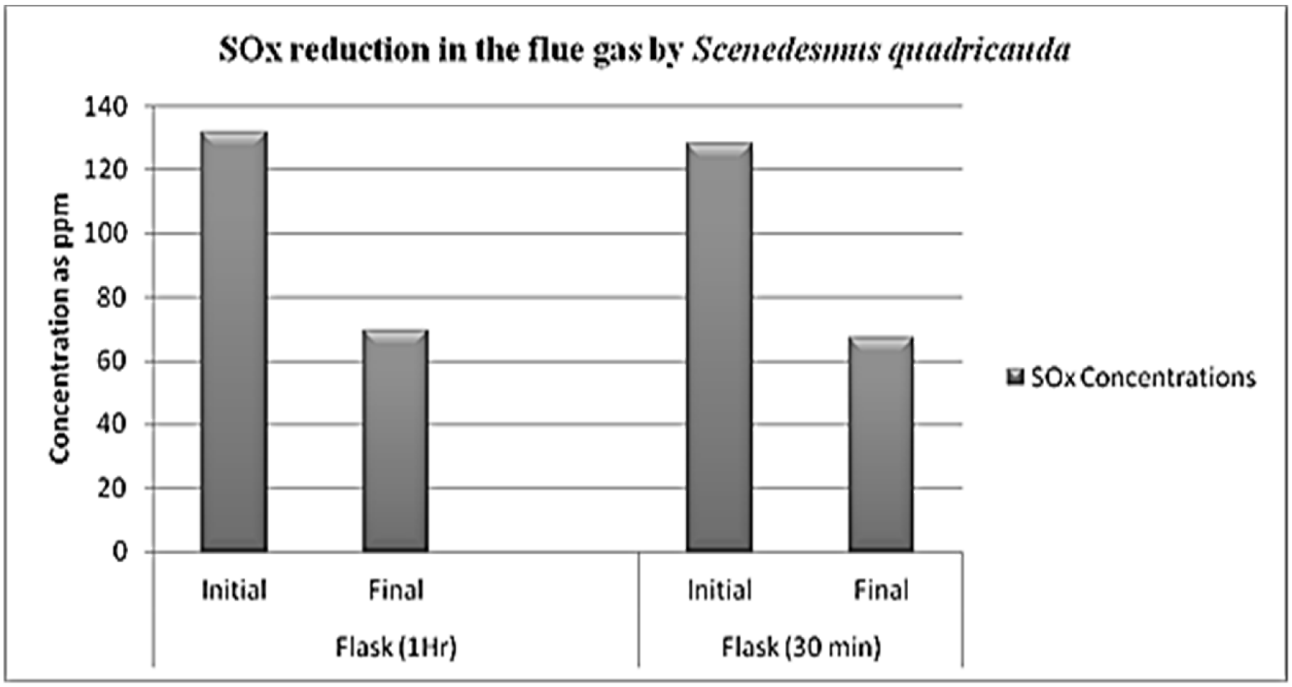


Figure 6: Graph representing the SOx reduction in the flue gas by S. quadricauda

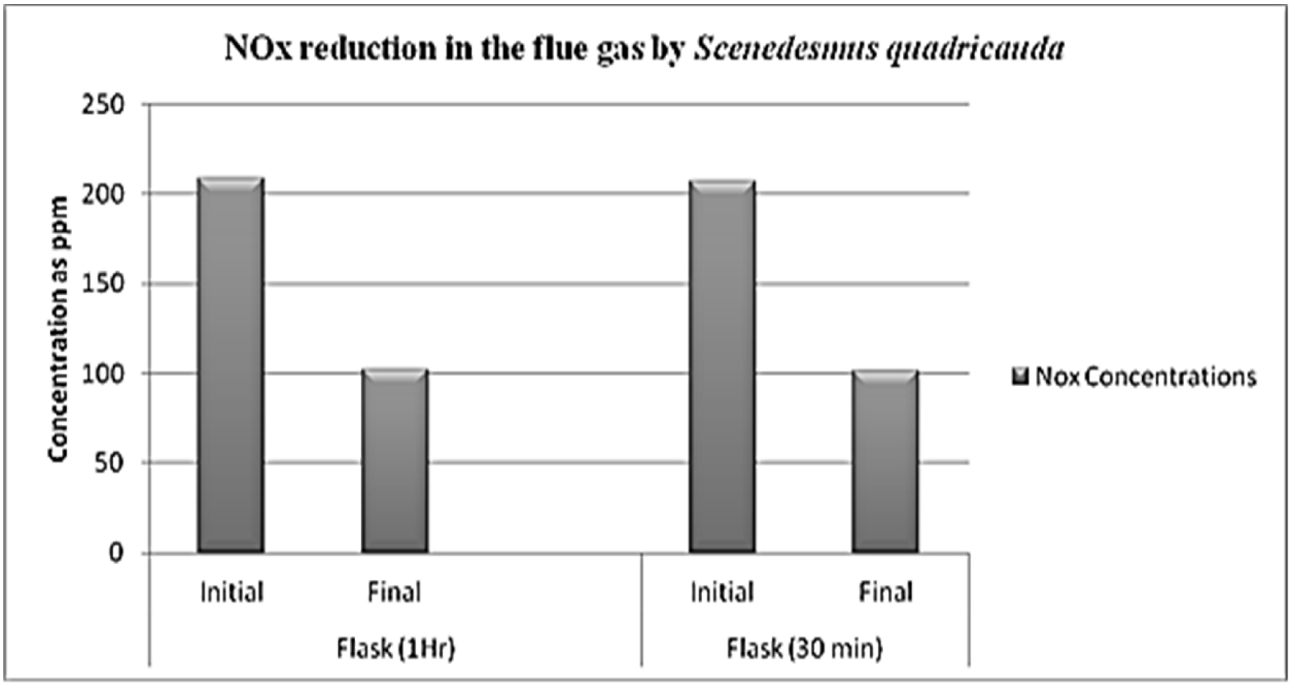


Figure 7: Graph representing the NOx reduction in the flue gas by S. quadricauda

In all the three experiments various parameters like alkalinity, carbonates, bicarbonates and aqueous CO_2 were analyzed. These parameters concentration varied from day 1 to day 7 in flasks (Figures 8 and 9) and day 1 to day 12 in open raceway pond (Figure 10).

Alkalinity and carbonate ions concentration gradually increased with the increasing growth of *S. quadricauda* during the exponential phase. Bicarbonate ions concentration gradually decreased due to the rapid uptake of CO_2 by the fast growing micro algae (Figures 8, 9 and 10).

In all the three experiments, the concentrations of nitrates and sulphates (Figures 8, 9 and 10) were reduced upto 65% from initial day to final day due to their utilization by *S. quadricauda* for its growth and lipid generation. On the other hand the concentration of CO_2 in aqueous state reduced up to 70% from initial day to final day due to the utilization of carbon dioxide by the micro algae *S. quadricauda.*

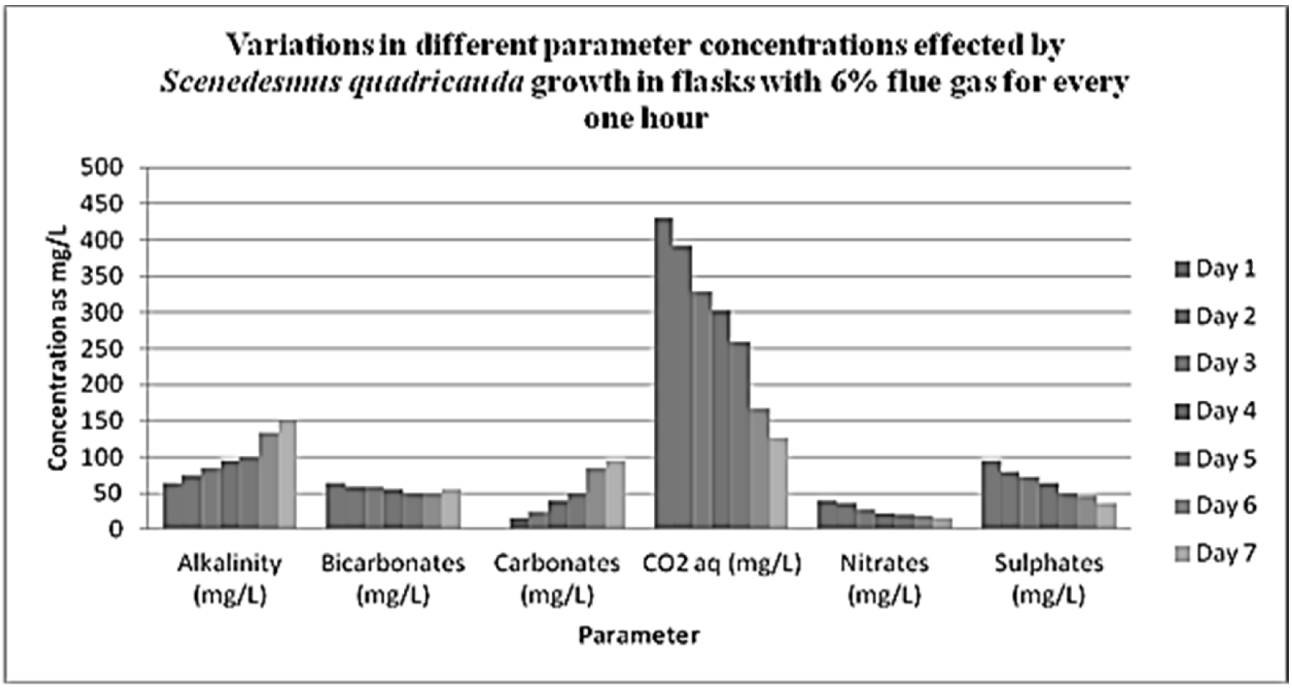


Figure 8: Graph representing the variations in different parameter concentrations effected by S. quadricauda growth in flasks with 6% flue gas for every one hour

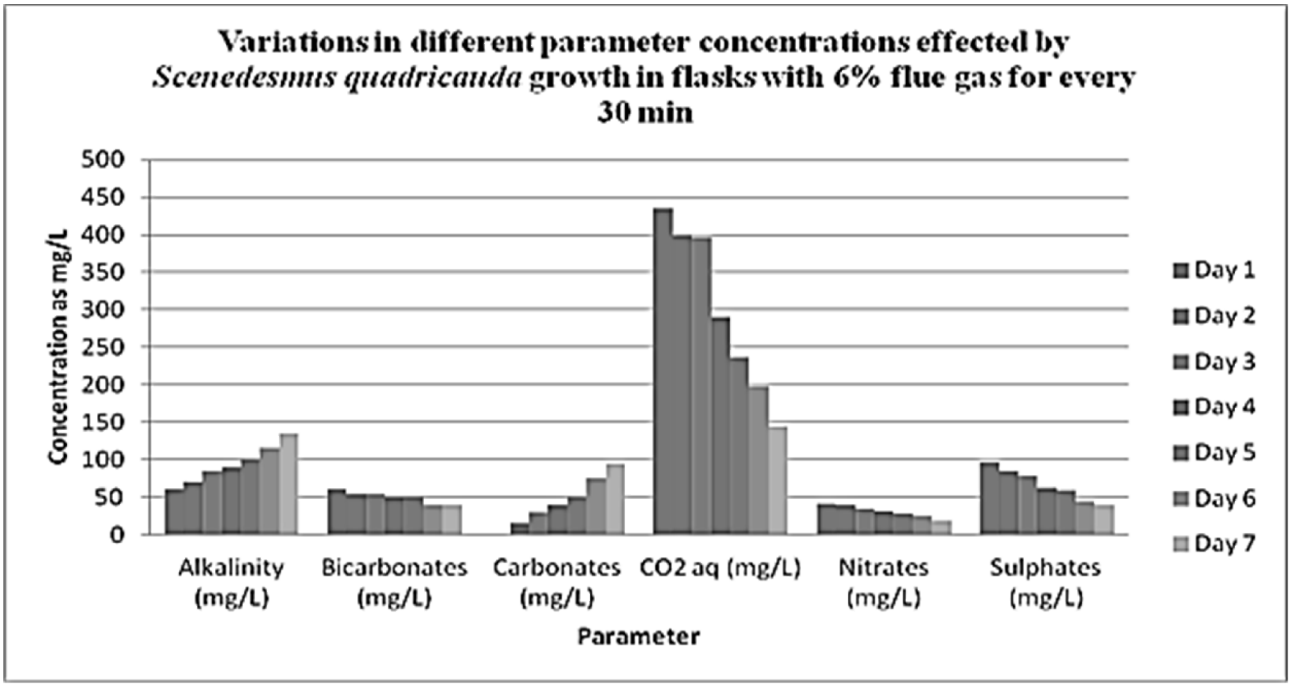


Figure 9: Graph representing the variations in different parameter concentrations effected by S. quadricauda growth in flasks with 6% flue gas for every 30 min

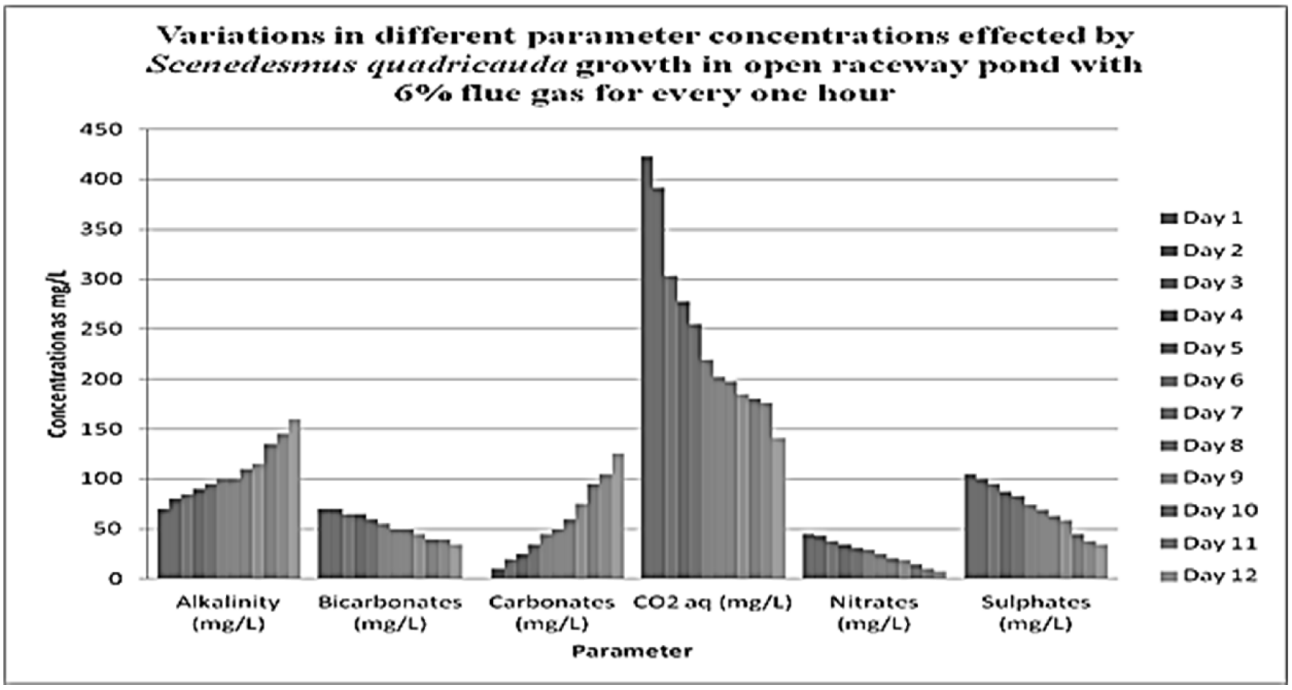


Figure 10: Graph representing the variations in different parameter concentrations effected by S. quadricauda growth in open raceway pond with 6% flue gas for every one hour

The outlet flue gas-CO_2 percentages in the flasks (1 Hr and 30 min) were analyzed by using Gas Chromatography (Figures 11 and 12) showed slight reduction from initial day to final day in the two experiments. This is due to the utilization of the CO_2 from the flue gas by *Scenedesmus quadricauda* for its growth.

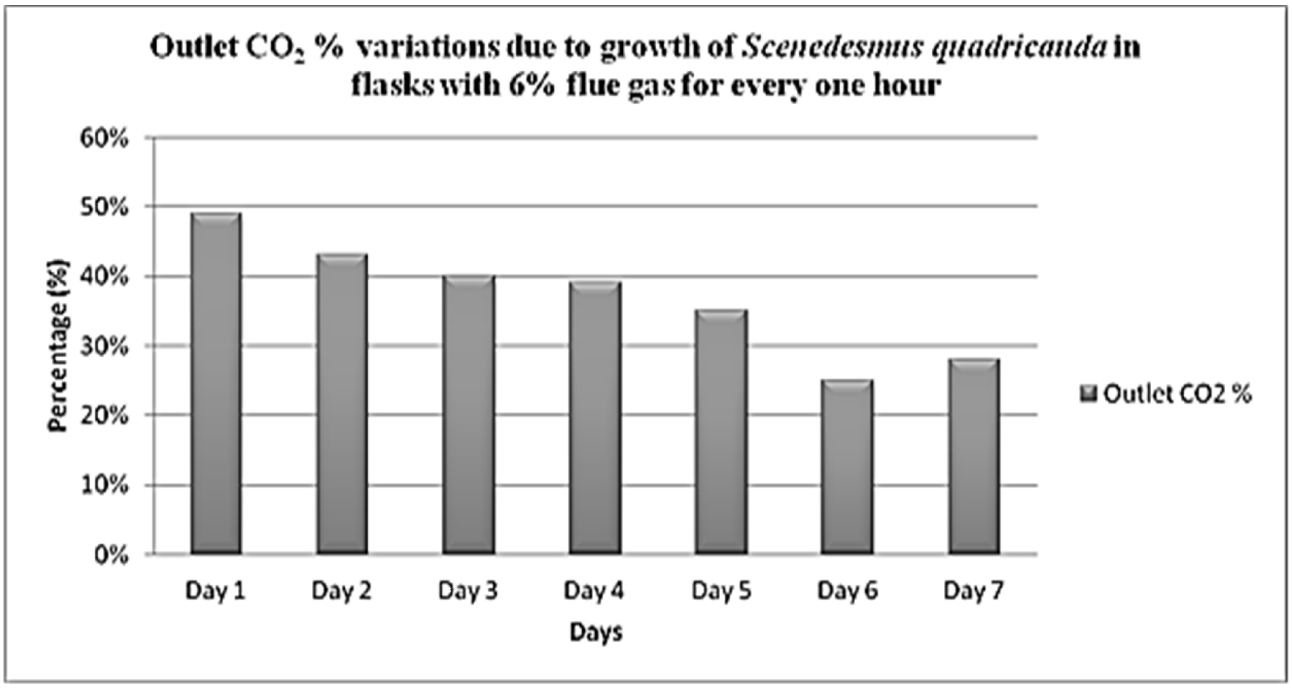


Figure 11: Graph representing the outlet flue gas CO_2 % variations due to growth of S.quadricauda in flasks with 6% flue gas for every one hour

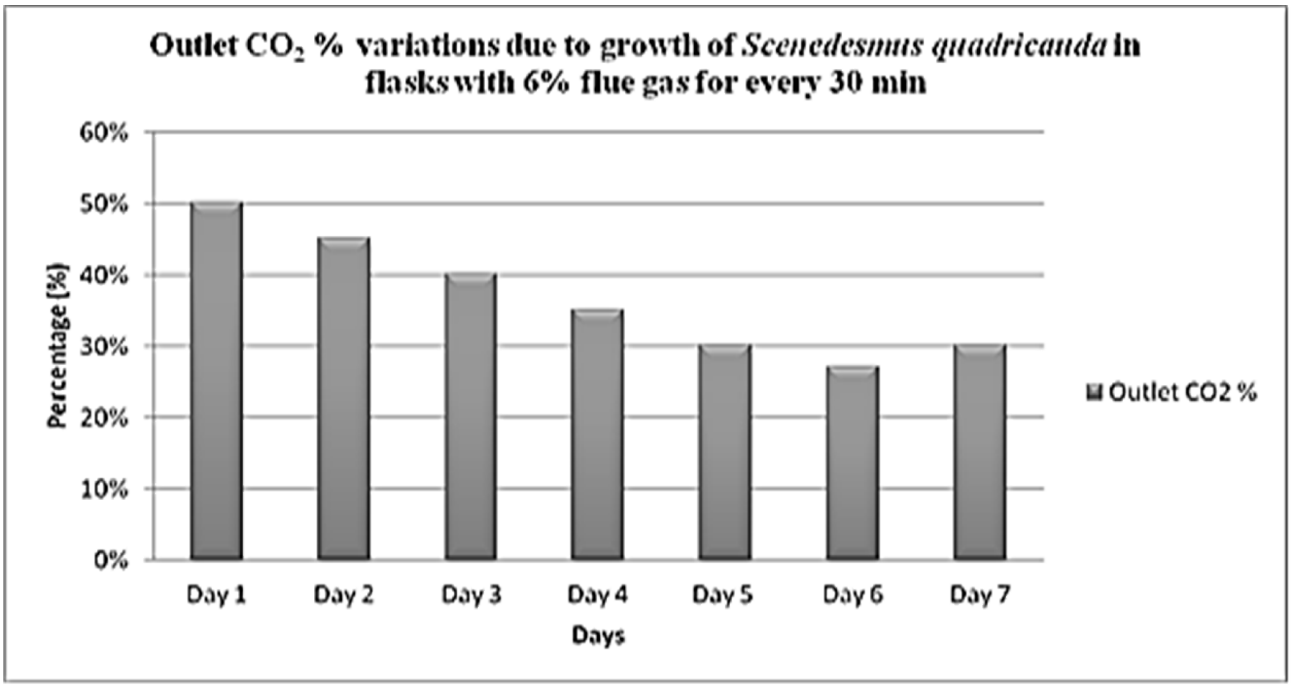


Figure 12: Graph representing the outlet CO_2 % variations due to growth of S. quadricauda in flasks with 6% flue gas for every 30 min

In all the three experiments, pH variations (Figures 13, 14 and 15) were observed from initial day to final day. The pH scale varied from slight acidic from initial day to slight alkaline on the final day due to the accumulation of carbonate ions.

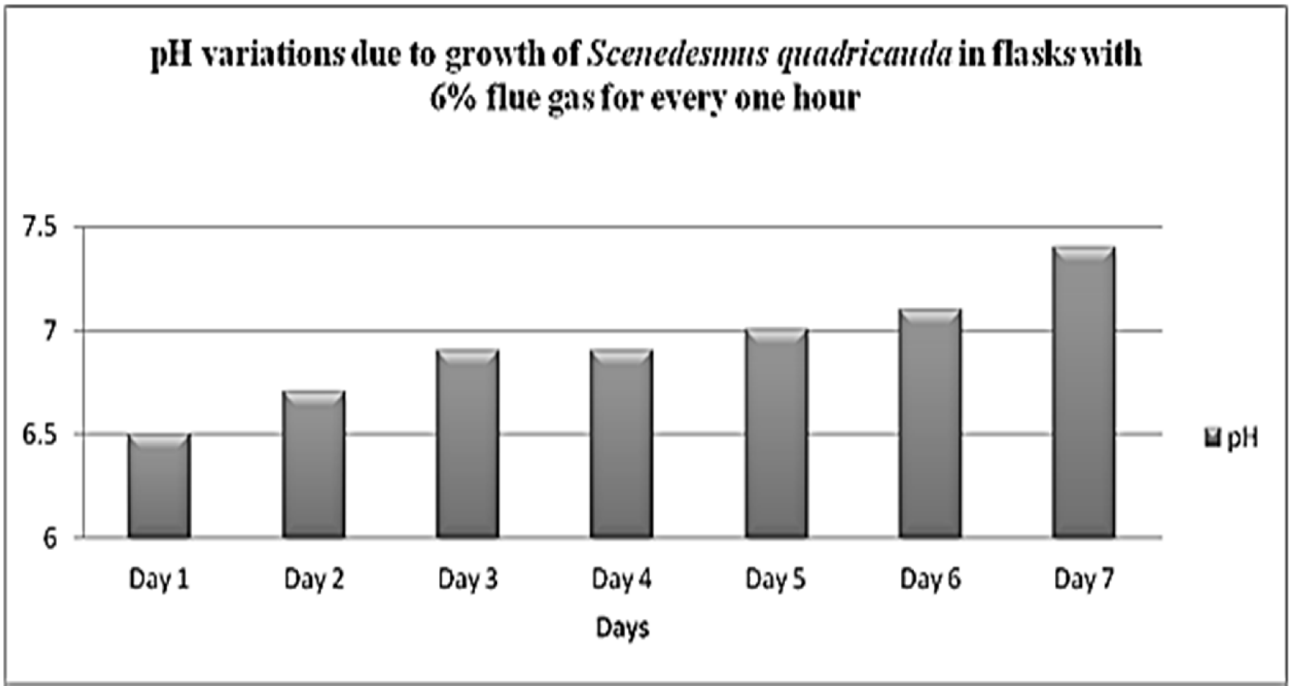


Figure 13: Graph representing the pH variations due to growth of S. quadricauda in flasks with 6% flue gas for every one hour

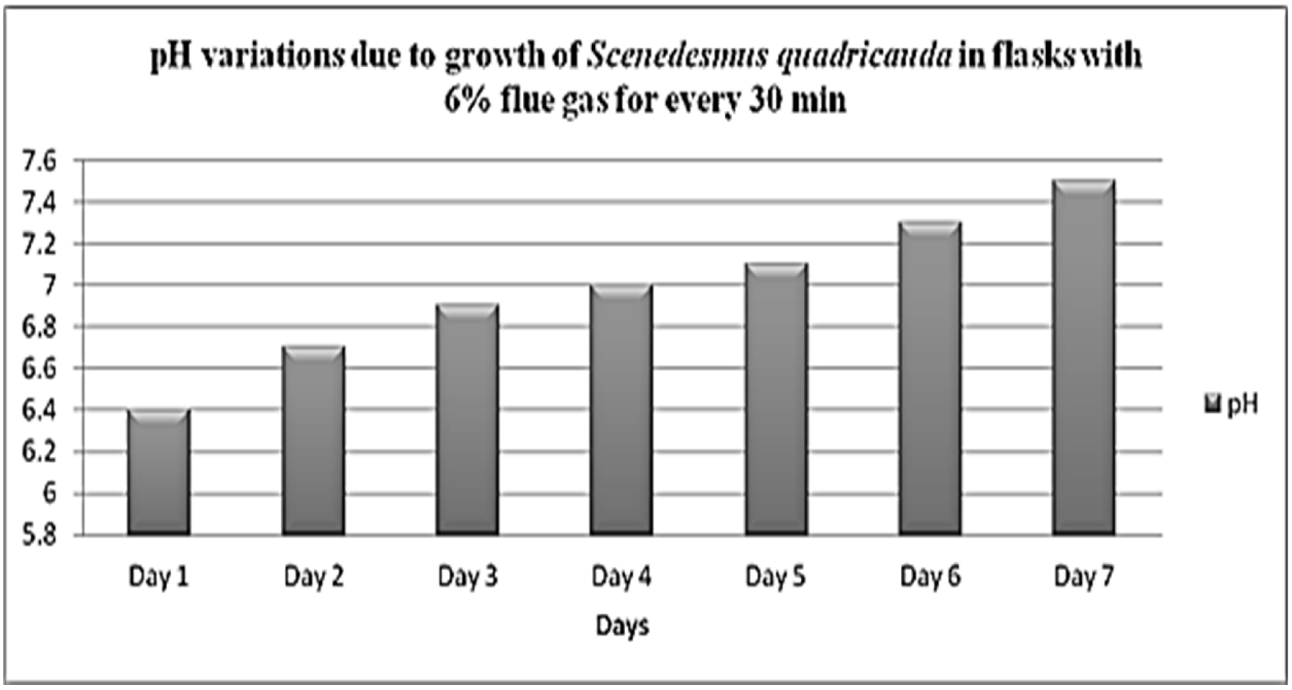


Figure 14: Graph representing the pH variations due to growth of S. quadricauda in flasks with 6% flue gas for every 30 min

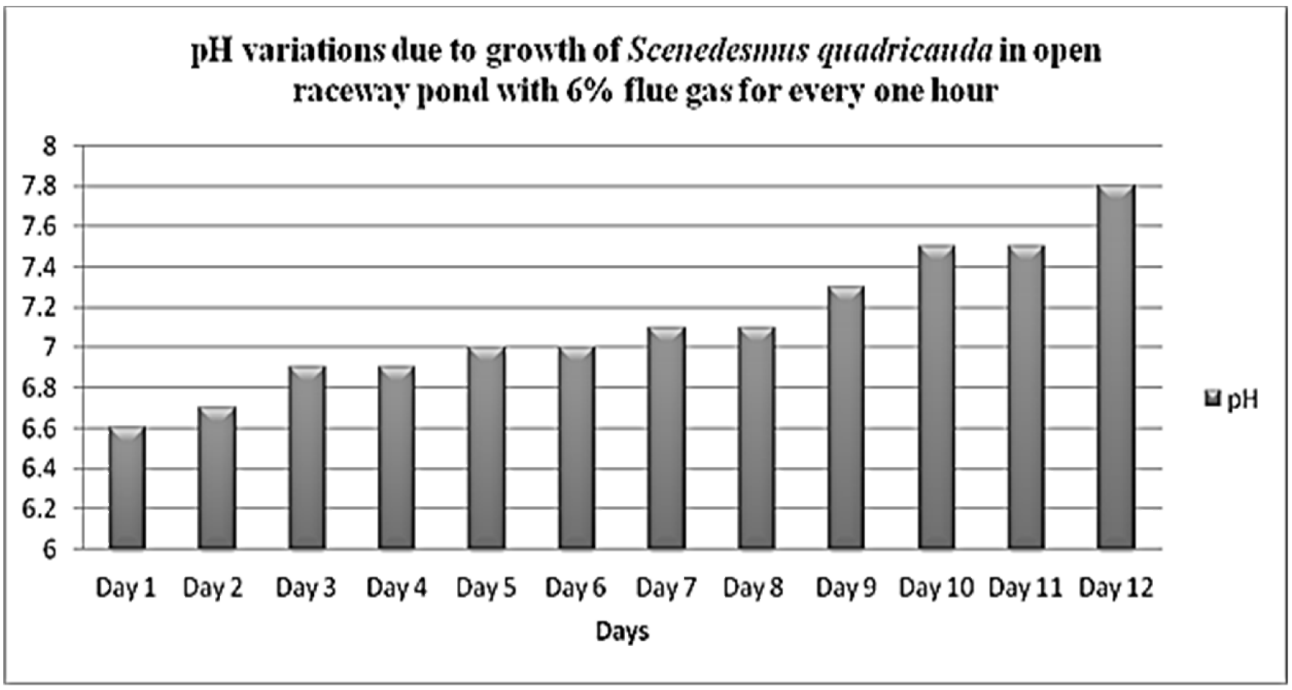


Figure 15: Graph representing the pH variations due to growth of S. quadricauda in open raceway pond with 6% flue gas for every one hour

In the present study, 6% flue gas air mixture was used for the cultivation of micro alga *S. quadricauda* which showed efficient growth in accordance with the previous studies by De Morais et al., [16] who observed that *Chlorella kessleri, Scenedesmus obliquus*, *Spirulina* sp., *Chlorella vulgaris*, and *Chlorella sorokiniana* grew best under 6% CO_2 concentration.

The present results observed indicates that micro alga *S. quadricauda* can efficiently utilize CO_2 from flue gas which was in accordance with the studies of Yoo et al. [17] who found *Scenedesmus* sp. to be the most suitable for CO_2 reduction due to high rates of biomass production (0.218 g/l per day).

In the present study, the results which were obtained pertaining to biomass growth and lipid yields were closely related to previous study done by Guruvaiah et al., [15] who studied on utilization of flue gas from coal burning power plant for microalgae cultivation for biofuel production and they obtained the maximum biomass growth of 1.20 mg/L at 2% flue gas CO_2 concentrations and lipid productivity more than 15%.

The present results obtained pertaining to the parameters like pH variation, increase in carbonate ions, decrease in bicarbonate ions and decrease in aqueous CO_2 were in accordance with Palanisami et al., [18].

In the present study, it was observed that the presence of NOx in flue gas did not inhibit the growth of microalgae, in accordance with the findings of Hauck et al., [19] and Matsumoto et al., [12].

3.1 GC-MS ANALYSES

The GC-MS analysis reports showed that In the lipid samples the presence of Palmetic acid, Stearic acid, oleic acid and linolenic acid were noted (Figure. 16). Whereas in the FAME sample the presence of long chain methylated fatty acid esters were seen such as: Palmetic acid phenyl methyl ester, Stearic acid phenyl methyl ester, oleic acid phenyl methyl ester and linolenic acid phenyl methyl ester (Figure. 17).

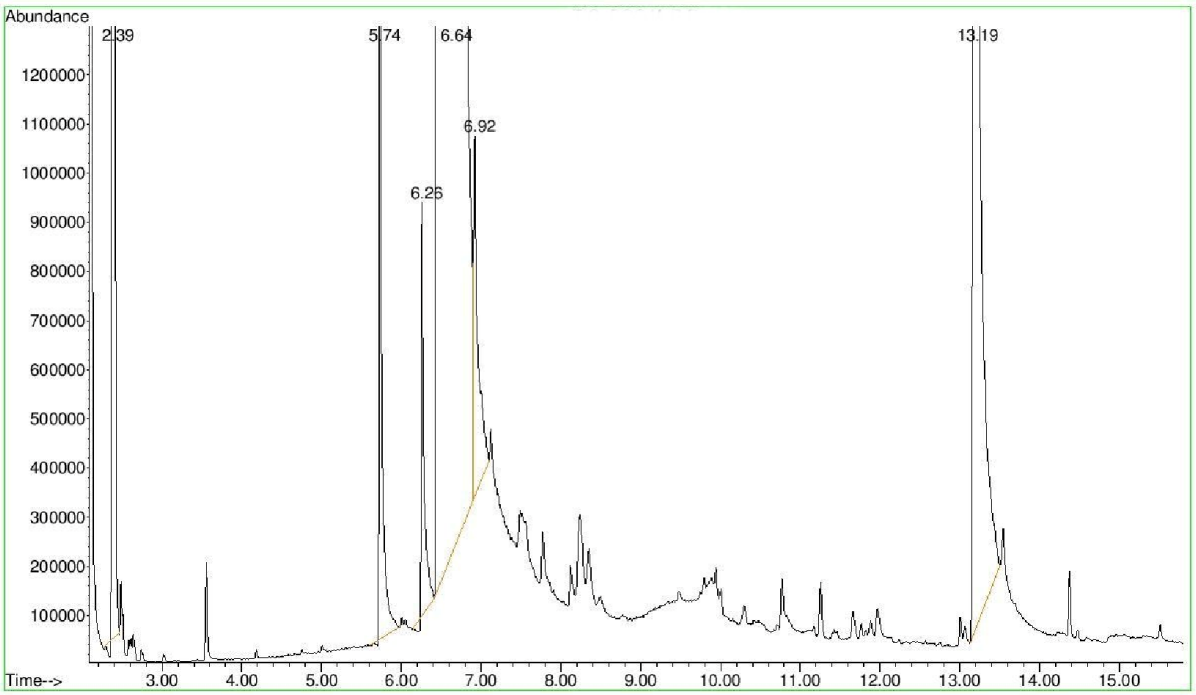


Figure 16: GC-MS graph of lipid components derived from S. quadricauda

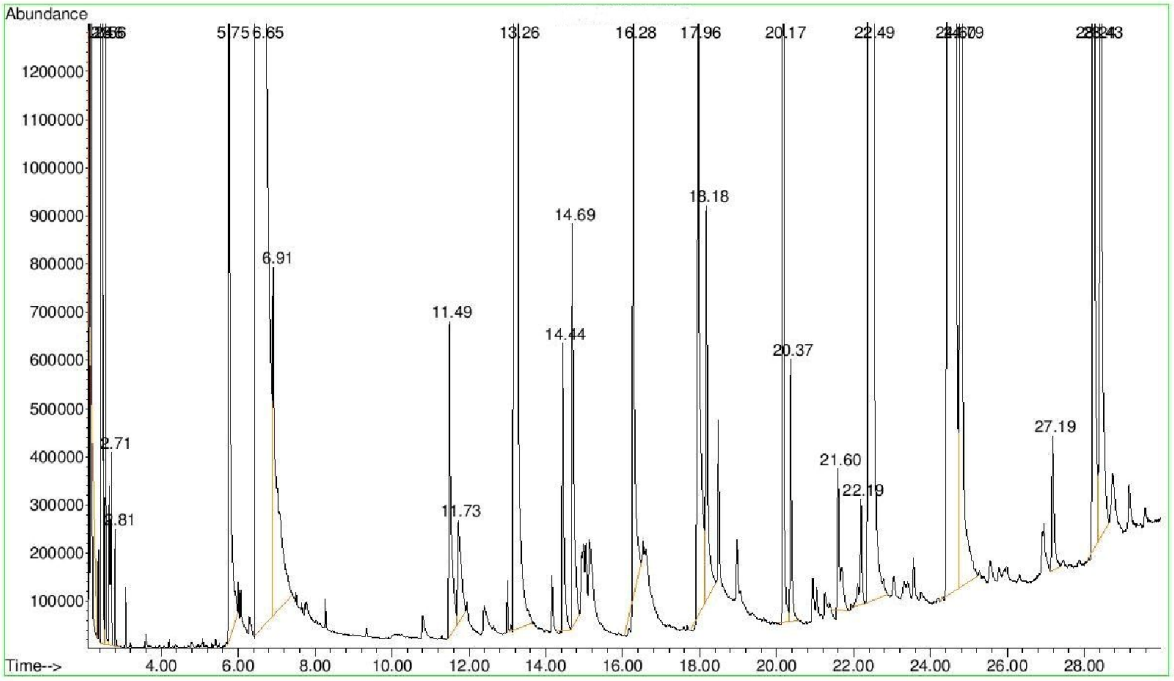


Figure 17: GC-MS graph of FAME components derived from S. quadricauda

4 CONCLUSION

The present study results revealed that *Scenedesmus quadricauda* was efficiently grown in the presence of flue gas obtained from the coal-burning industrial plant. It was also observed that the microalga *S. quadricauda* efficiently utilized the CO_2 from the flue gas for its biomass growth and in turn with the production of lipids and fatty acid methyl esters (FAME). It was also recorded that the microalga *S. quadricauda* had a potential for the reduction of carbon dioxide from the flue gas up to 75%. Hence these experiments are recommended to be carried out at industrial scale for the dual purpose of remediation and energy production followed by commercialization.

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Notice of Retraction

The authors of the following article have requested that it be retracted from publication in the *International Journal of Innovation and Applied Studies*:

Richard Atimniraye Nyéladé, "Social representation of climate change in the farming communities of the Northern-Cameroon," *International Journal of Innovation and Applied Studies*, vol. 9, no. 1, pp. 202–208, November 2014.

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La mixité sociale une facette de la politique de la ville

[Social mixing a facet of urban policy]

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ABSTRACT: The mix is proper to a mixture of heterogeneous elements or different character. Social diversity as the co or cohabitation in the same place people or groups socially, culturally or even of different nationalities. This leads us to consider the social mix as the co or cohabitation in the same place people or groups socially, culturally or even of different nationalities. The mix would be a cure for the ills of modern city, see generated by it. Taking the usual comments, whether from the press or urban studies and without prejudging their reality or can mention the contrast between rich areas and poor areas, difficult areas that go adrift, "ghettos" problems also raised by what would be a crisis of social bond, "divide", which would result in the increase in crime, the development of anonymity, individualism, exclusion. The urban sprawl, museification center are also discussed. Mainly mixed should ensure mixing of different social categories, brewing itself being a guarantor of social cohesion. In this way, the mix would be the guarantee of harmony in difference.
So gather the diversity of social groups in the city is a concern that does not start today or even yesterday. This dream has lived the great utopian thought from Plato to Thomas More. The pioneers of modern urbanism designed projects for some forms of social diversity. That said, the theme of social diversity is mobilized as a central objective of urban policy. These policies are designed to cope with the rise of urban poverty analyzed in terms of social and urban exclusion. They are based on the model of a "balanced" society seamlessly blending social classes, ethnic groups and generations to ward crystallization pockets of poverty that would be problematic because at the basis of a culture of poverty, development insecurity or the establishment of an "underclass".

KEYWORDS: Segregation, urban policy, Integration, Aggregation, Exclusion, Urban Renewal.

RÉSUMÉ: La mixité est le caractère propre à un mélange d'éléments hétérogène ou différents.
La mixité sociale comme la coprésence ou la cohabitation en un même lieu de personnes ou de groupes différents socialement, culturellement ou encore de nationalités différentes.
Ce qui amène à considérer la mixité sociale comme la coprésence ou la cohabitation en un même lieu de personnes ou de groupes différents socialement, culturellement ou encore de nationalités différentes.
La mixité serait un remède aux maux de la ville actuelle, voir engendrés par elle. En prenant les commentaires habituels, qu'ils émanent de la presse ou d'études urbaines et sans préjuger de leur réalité on peut mentionner le contraste entre zones riches et zones pauvres, les quartiers difficiles qui partent à la dérive, les « ghettos ». Problèmes aussi posés par ce qui serait une crise du lien social, la « fracture », qui se traduiraient par l'augmentation de la délinquance, par le développement de l'anonymat, de l'individualisme, de l'exclusion….
L'étalement de la ville, la muséification du centre sont également évoqués. Principalement la mixité devrait assurer un brassage des différentes catégories sociales, ce brassage étant quant à lui un garant de la cohésion sociale. De la sorte, la mixité serait le gage d'une harmonie dans la différence.
Ainsi, rassembler la diversité des groupes sociaux dans la ville est un souci qui ne date pas d'aujourd'hui ni même d'hier. Ce rêve a habité les grandes pensées utopiques, de Platon à Thomas More. Les pionniers de l'urbanisme moderne ont conçu des

projets visant certaines formes de diversité sociale. Ceci dit, le thème de mixité sociale est mobilisé comme objectif central des politiques publiques urbaines.
Ces politiques ont pour objectif de faire face à la montée de la pauvreté urbaine analysée en termes de processus d'exclusion sociale et urbaine. Elles s'appuient sur le modèle d'une société « équilibrée » mélangeant harmonieusement classes sociales, groupes ethniques et générations pour conjurer la cristallisation des poches de pauvretés qui seraient problématiques parce qu'à la base d'une culture de la pauvreté, du développement de l'insécurité ou de la constitution d'une « underclass »

MOTS-CLEFS: Ségrégation, politique de la ville, Intégration, Agrégation, Exclusion, Rénovation urbaine.

INTRODUCTION

Le terme mixité est ambigu car il est polysémique. Il vient du latin miscere, qui veut dire mélanger, renvoyant à l'idée de mixage entre plusieurs éléments différents. Son caractère relativement indéterminé résulte du fait qu'on peut parler indifféremment de mixité des formes d'habitat, de mixité des générations, de mixité des catégorie professionnelles, des nationalités, des sexes, etc…..

Il pose également un problème de mesure car l'état de mixité ne sera pas identique selon le critère retenu et l'échelle considérée.

Ainsi la diversité sociale apparente d'un quartier peut elle très bien juxtaposer plusieurs cités nettement plus homogènes, tout comme l'hétérogénéité globale d'un établissement scolaire peut dissimuler une ségrégation interne par classe.

Mais à une évaluation statique de la mixité dans le domaine de l'habitat convient il encore d'adopter une approche dynamique, intégrant les déplacements des individus dans les lieux publics et l'accessibilité aux potentiels urbains. En effet, il est utile de modifier le regard en fonction de la mobilité des populations dans la structure d'ensemble de la ville et des stratégies d'accès aux différents espaces urbains qui ne renvoient pas aux mêmes échelles de mixité et d'intégration pour les individus.

En définitive, la mixité n'est pas à proprement parler un concept scientifique mais renvoie à un mythe, au sens de valeurs et de représentations collectives qui structurent la société. Elle définit moins une situation objective qu'elle ne se réfère à un idéal. On pense à l'image d'une ville caractérisée par la diversité sociale et culturelle. Par extension, on accorde à la mixité sociale les vertus comme l'échange et la tolérance, l'enrichissement mutuel et l'harmonie sociale. Fortement connotée idéologiquement, la mixité est considérée, comme une valeur évidente que l'on oppose aux ghettos et aux communautarismes. En claire, il s'agit avant tout d'une notion politique légitimant l'intervention de l'Etat.

Ainsi la mixité est analysée dans le cadre des politiques de la ville apparaissant alors comme valeur synonyme et de justice sociale, à l'opposé de l'idée de ghetto.

Or, les populations pauvres ne sont pas forcément gagnantes, en raison d'une politique de mixité qui peut également les priver de ressources sociales et culturelles.

Les politique urbaines ont tenté de mettre en œuvre le « brassage sociale » au cœur des grands ensembles, puis le rééquilibrage « sociale » en mettant l'accent sur les procédures d'attribution de logements. Avec la mixité sociale promue, peut on faire sortir les quartiers pauvres de l'enferment ?

Peut-on réduire l'écart entre les quartiers les plus aisés et les quartiers ou s'agglomèrent les laissés pour compte, tout en sachant que d'une zone d'habitat à une autre, la hiérarchie spatiale coupe assez bien la hiérarchie sociale ?

1 LA MIXITÉ INSTRUMENT POLITIQUE

La question de la mixité sociale haute les sciences de l'urbain depuis déjà quatre décennies, avec la parution d'un célèbre article de Jean Claude Chamboredon et modelaine le maire (1970), qui doit être parmi les plus cités dans le domaine. A l'époque les peuplements des grands ensembles de logements sociaux de construction récente réalisait une certaine mixité sociale, imposant aux classes moyennes et populaires de cohabiter, en s'inspirant de Nober Elias, ces auteurs rappelaient que proximité physique n'impliquait pas échange social.

Si la question de la mixité sociale dans la ville s'impose aujourd'hui si fortement dans la société, c'est tout autant parce qu'elle incarne la dimension spatiale des inégalités sociales que parce qu'elle évoque l'inscription des modes de vie et des identités culturelles sur le territoire urbain et qu'elle interroge le principe d'égalité des populations

Les études en ce sens révèlent tout particulièrement des logiques de séparation qui se construisent sur des stratégies de distinction et d'évitement entre les ménages selon leurs revenus et leurs trajectoires résidentielles. Cette attitude de mise à

distance ne concerne pas seulement les classes supérieurs mais caractérise également les classes moyennes ayant peur du déclassement et sensibles aux enjeux liés à la scolarisation des enfants.

Dans ce conteste, la notion de mixité est devenue un des principaux instruments de l'action publique ou le nouveau label des politique urbaines. L'idée générale est qu'il faut rééquilibrer la composition du peuplement urbain en introduisant la mixité de façon contrainte tant sur les lieux de résidence qu'au sein du système scolaire.

Il existe en effet, dans la société un décalage criant entre les catégories théoriques d'un modèle d'intégration fondé sur les bienfaits de l'égalité et de la mixité, auxquels la majorité de la population est profondément attachée et les catégories de la pratique souvent dominées par la ségrégation et par la logique des « appariements sélectifs ». Dans des études classiques sur la formation des villes, la sociologie a pu monter une dimension essentielle : la ségrégation et l'agrégation sont les deux faces d'une même réalité. La misse à distance de l'autre a pour contrepartie la recherche de « l'entre soi ».

1.1 LA MIXITE COMME ACTION PUBLIQUE

Le terme de mixité sociale est à la mode. En France comme à l'étranger, il émaille le discours et propositions de « décideurs » urbains locaux et nationaux. c'est une notion vide de sens pour les uns, car elle peut désigner tout et son contraire, pour les autres, elle est un outil pour lutter contre les ghettos urbains.

Plus qu'un état, la mixité désigne ainsi un processus ou une action. Et cette action est sous tendue par des postulats d'organisation de la ville et de la société. Le premier postulat est que la mixité crée les conditions d'une plus grande égalité. En effet la concentration spatiale des populations pauvres peut engendrer, en elle-même, un renforcement des inégalités sociales. Les travaux américains sur le ghetto contemporain ont montré de multiples façons les effets sociaux destructeurs d'une telle concentration. L'action en faveur de la mixité est donc bien une politique d'égalité et de justice sociale

Le deuxième postulat est que la mixité favorise l'urbanité ou la cohésion sociale. De ce point de vue, la mixité comme catégorie de l'action publique s'appuie sur le diagnostic généralement partagé d'une « crise » de la ville et du lieu social. La vision la plus répandue consiste en effet à souligner la montée en puissance des conduites individualistes, qui viendraient saper les fondements de tout ordre social. La ville étant le lieu par excellence de cette situation, elle tendrait à perdre ce qui faisait son unité et son urbanité ; c'est-à-dire la relation qui lie, d'une part, un lieu bâti et sa configuration spatial et de l'autre, l'aptitude du groupe qui l'occupe à gérer les lieux sociaux et conviviaux.

D'un côté, la ville et le lieu de la mobilité et d'une individualisation croissante des modes de vie. Mais de l'autre coté, cette ville donnant à chacun la possibilité de développer son autonomie recèle également les germes d'une ville de l'entre soi porteuse d'un refus de l'altérité qui appose à la ségrégation volontaire des beaux quartiers et la ségrégation vécue par les Individus commune violence ; une assignation à résidence dans les quartiers pauvre. La promotion de la mixité puise alors sa force dans la volonté de contrebalancer cette double logique de ghettoïsation de la société par la haut et par le bas. La puissance publique réaffirme ainsi son rôle ontologique de constructeur de la société et du lien social.

1.2 LA MIXITE PIERRE ANGULAIRE DES POLITIQUES URBAINES

Les problèmes des banlieues appelé par euphémisme « quartiers sensibles » ont été à l'origine de politiques publiques nouvelles : habitat et vie sociale en 1977, puis la politique de la ville sous ses divers déclinions (Blan 2007). Il s'agissait d'améliorer les conditions de vie dans les quartiers dégradés à travers des approches spécifiques à la fois du bâti et des populations.

La question de la mixité sociale Jalonne toute l'histoire du peuplement des quartiers d'habitat social. Les quartiers aujourd'hui qualifiées « de sensible » sont pour la plupart, le produit des transformations des cités de grand ensembles crées par « l'urbanisme fonctionnel » des années cinquante à soixante dix. Pendant cette période, la croissance économique et l'expansion démographique se concentrent dans les villes. il est alors indispensable de construire une grande quantité, dans l'urgence des logements à bon marché, visant à offrir l'accès au confort moderne, mais aussi à promouvoir le « brassage » des populations. La mixité est ainsi au fondement du grand ensemble. En rapprochant sur un même lieu des catégories autrefois séparées (les populations pauvres, les classe populaires et les nouvelles couches moyennes), il est censé fonctionner comme un ascenseur social et favoriser une « moyennisation » de la société.

1.3 LE LOGEMENT SOCIAL : LA GESTION DU PEUPLEMENT :

La politique du logement social passe d'une logique quantitative de la population de masse à une logique qualitative de gestion du peuplement. Il s'agit en effet d'arrêter la construction des HLM et de mieux équilibrer l'habitat à l'échelle des agglomérations.

En France avec la loi barre de 1977 instaurant l'aide personnalisé au logement (APL), cette politique favorise tant l'accession à la à la propriété pour les ménages aux revenus moyens que l'accès au logement social locatif pour ceux qui en étaient exclus.

Ainsi durant cette période les franges supérieures de la classe ouvrière et les catégories de classe moyennes utilisent le parc HLM comme une étape dans un parcours de mobilité. Ces familles vont s'orienter vers le modèle de l'habitat pavillonnaire, laissant la place à une population fragilisée par la crise économique et aux travailleurs immigrés, certains experts attirent alors l'attention sur le « malaise » des banlieues et sur « les problèmes de la ségrégation ».

Ainsi avec les émeutes que connaient les villes, on parle « d'enclaves » et de «délinquance juvénile » déjà associé au milieu urbain des grands ensembles.

Avec la montée du problème de l'exclusion et l'apparition des « quartiers sensibles », la question de la mixité sociale va prendre une connotation très différente de celle qui prévalait dans les années soixante. La concentration spatiale des pauvres devient synonyme de dangerosité et de peur.

Dès le début des années quatre-vingt apparaît alors dans ces quarter une obsession du « rééquilibrage social » la maîtrise de la nature du peuplement devient objectif prioritaire des acteurs de la politique de la ville.

Les procédures d'attribution des logements constituent dès lors un enjeu essentiel Les organismes HLM sont les « grands acteurs du tri urbain ». Ils deviennent de véritables gestionnaires sociaux du peuplement à l'échelle décentralisée sur site, tant du point de vue de la morphologie des quartiers que du problème des relations de voisinage

2 LES AXES D'INTERVENTION DE LA MIXITE

L'objectif de mixité oriente deux grands types d'intervention volontariste il s'agit d'une part de lutter contre le ghetto qui menace toujours quand sont réunies les conditions de concentration des populations fragiles, et d'autre part de repartir le logement social de façon plus équilibrée dans des agglomérations, en introduisant des quotas dans les communes riches.

En France, cette question à déboucher sur 4 lois importantes :

La loi besson (1990) puis la loi de dotation de solidarité urbaine et la loi d'orientation pour la ville (LOV), votées en 1991 qui adoptent un ensemble de mesures d'urbanisme visant la mise en œuvre de la mixité sociale enfin la loi SRU, relative à la solidarité et au renouvellement urbains, du 13 DEC- 2000, positionne encore plus fermement cette dimension centrale des politiques urbaines. De nos jours le 12 plan (2000-2006) définit la politique de la ville comme faisant partie intégrante d'une lutte globale contre les exclusions et s'inscrivant dans un vaste projet de développement des territoires et de rééquilibrage urbain, conduite à l'échelle des agglomérations.

Mais avec la loi de programmation de cohésion sociale du 18 jours 2005, l'action en faveur de la mixité vise à franchir un pas décisif. En effet il n'est plus seulement question de gérer le peuplement de l'habitat social & de rééquilibrer la structure du parc HLM sur le territoire. Avec la notion de rénovation (centrée sur les quartiers) et celles du renouvellement urbain (à l'échelle de la ville), il s'agit bien plus de mettre en œuvre une nouvelle politique de peuplement et de produire une mutation urbaine en profondeur, à l'aide d'une action physique de revitalisation des quartiers.

2.1 LA MIXITE FAVORISE T'ELLE LA COHESION SOCIALE : PROXIMITE SPATIALE ET DISTANCE SOCIALE

Les recherches Scientifiques conduisent à dresser un constat mitigé à l'égard des vertus attachées à cet impératif de mixité. En effet, comme elles peuvent le montrer, la proximité entre les différents classes sociales renforce moins la convivialité et les échanges qu'elle n'exacerbe les différences et les conflits. Ainsi de sa construction, le grand ensemble est voué à constituer une mixte de proximité spatiale et de distance sociale. Il rassemble momentanément des catégories hétérogènes de population inscrites dans des trajectoires multiples, ce qui, loin de produire l'image d'une société nouvelle en voie de « moyennisation » renforce au contraire les clivages de classe. Par ailleurs, non seulement le grand ensemble engendre une cohabitation difficile, mais encore porte t-il en lui la nostalgie du quartier populaire .En effet, même si le parc HLM, par apport aux bidonvilles, représente un réel progrès matériel, il incarne pour les plus pauvres tout le poids de distraction de l'ancienne vie communautaire. A l'aube des années quatre-vingt on peut décrire l'univers relationnel du grand ensemble comme « un groupement artificiel et contraint.

Cette analyse conduit à interroger l'idée selon laquelle les populations pauvres seraient toujours gagnantes à une politique de mixité.

En fait, le lien entre rénovation urbaine, mixité et lien social n'est guère évident. Ainsi une opération de rénovation peut insérer fonctionnellement l'habitat dégradé dans la grande ville mais dissoudre en même temps l'ancienne communauté de quartier. Dans un autre contexte, celui de la société américaine, le repli sur la communauté est analysé comme une transition

dans le cycle des relations raciales, assurant pour la population immigrée une fonction d'accueil et de refuge, avant une mobilité sociale et spatiale.

Certes le regroupement des populations, quand il est subi, peut se transformer en espace clos et enfermant. Mais il y a aussi des bénéfices à l'existence d'un « entre soi » des quartiers pauvres, comme le montre, par exemple, la réussite de certains commerçants étrangers.

Paradoxalement, les actions en faveur de la mixité peuvent alors tout aussi bien priver les individus de ressources sociales et culturelles issues d'un milieu d'entraide et de solidarité. On est donc conduit à poser un regard ambivalent sur la recherche de mixité dans les quartiers pauvres. Si ces derniers sont des lieux de ségrégation et de stigmatisation, ils sont également des espaces de ressources et de solidarités. Mais autant on pouvait valoriser l'homogénéité des communautés ouvrières et des distances de classe, autant aujourd'hui l'appel à la mixité comme instrument de lutte contre le ghetto manifeste, d'une certaine façon, la peur de l'immigré et des communautés ethniques. Dans une large mesure, la question de la mixité soulève implicitement un début concernant l'intégration des immigrés et la place des quartiers multiculturels dans la société.

2.2 LES EFFETS DE LA MIXITE DANS LES QUARTIERS PAUVRES

Lorsqu'on parle de mixité dans les quartiers pauvres, il est moins question de métissage que du fait d'y attirer durablement les couches moyennes, celles-ci étant considérées comme vecteur d'un modèle de normes et de valeurs auquel les populations «exclues » pourront se conformer. Cet objectif s'appuie sur l'idée d'un basculement des quartiers pauvres dans la déviance et dans la destruction sociale, rappelant d'une certaine manière la vieille peur des classes dangereuses du XIX siècle.

De ce point de vue, l'appel au rétablissement de la mixité sociale n'est pas une nouveauté de la politique de la ville. Il réactualise au contraire une vieille histoire de moralisation des catégories populaires dans des quartiers définis par le regard de classe supérieures.

Hier comme aujourd'hui, la Banlieue pauvre est une menace pour la ville riche. En somme il s'agit, certes de façon atténuée, de « civiliser » les classes populaires exclues, et de faire en sorte que les « autres » deviennent comme « nous » par la pédagogie, au sens scolaire du terme, du « vivre ensemble ».

Cette analyse ne vise pas à mettre en cause le principe de régulation par les pouvoirs publics des processus ségrégatifs et de l'inégalité profonde qu'ils engendrent. Elle invite à interroger le principe de mixité sociale à l'aune des résultats escomptés par cette politique. En effet celle-ci est loin d'atteindre ses objectifs et elle engendre souvent des effets paradoxaux pouvant même aboutir à des résultats inverses aux buts poursuivis.

Sur un autre plan, si cette politique de mixité a évité la constitution de ghettos, elle imprègne en partie négativement les modes de vie et le lien social. En effet, la dispensions des problèmes rapproche les ménages de manière contrainte et met en présence une diversité de comportements qui se distinguent quant à la manière d'organiser son espace et son temps. Le rapprochement contraint crée en lui-même une humer ségrégative, dés lors que les petites différences finissent par occuper tout l'espace.

C'est ainsi que l'objectif de la mixité de la population peut se transformer en son contraire en renforçant la segmentation « ethnique » des rapports sociaux et donc la volonté de mixité se heurte-t-elle sans cesse eux stratégie de misse à distance entre les habitants eux-mêmes.

CONCLUSION

De quoi parle-t-on au juste quand on parle de mixité sociale ? Ce mot peut simultanément être consensuel et partisan, mais aussi moralisateur, accusateur et réconciliateur. le discours sur la mixité sociale se fonde sur des constats statistiques, ce qui lui donne une apparence trompeuse de scientificité : il renvoie les inégalités sociales et leur traitement à la répartition des populations dans l'espace, ce qui revient à mettre l'essentiel entre parenthèse, l'inégale répartition des richesses.

Ce discours exprime aussi un idéal d'égalité de justice et d'harmonie sociale. Il est un mot d'ordre lorsqu'il cherche à provoquer une mobilisation politique, mais il devient un vieux pieux si cet idéal est affirmé, tout en étant considéré comme une mission impossible, car les Hommes sont ce qu'ils sont comme disait le Général de Gaulle. Enfin, il s'agit d'un simple argument quand le « vocable » (la mixité sociale) n'est pas engagé dans un discours vertueux mais duplice. C'est le cas par exemple lorsque le ghetto sert de prétexte pour interdire l'accès d'un territoire aux pauvres et aux étrangers, en prétendant que c'est dans leur intérêt bien compris. Il s'agit bien entendu de distinction analytique et un même discours peut utiliser tous ces registres.

Il faut reconnaître que la frontière entre le mot d'ordre et le vieux pieux est difficile à tracer, tenant peut être à une plus au moins grande dose de désabusement. Mais ces distinctions permettent de clarifier les enjeux implicites du discours sur la mixité sociale dans la ville comme à la compagne d'ailleurs car, contrairement à une idée tenace, la mixité sociale n'est pas le remède à un problème spécifiquement urbain.

Cette analyse ne vise pas à faire la promotion des ghettos ! Elle se demande dans quelle mesure la volonté de mixité ne conduit pas au moins partiellement, à développer des effets « désolidarisant » et à noyer les identités collectives et communautaires, installant alors en lieu et place des rapports individualisés de dépendance à l'égard des dispositif d'assistance, là même où on en appelle à la « participations des habitants ».

En effet, toutes les tentatives d'administrer les relations sociales par une distribution « harmonieuse » des populations ont été des échecs.

L'orientation autoritaire des groupes sociaux dans l'espace résidentiel ne parvient jamais à créer les conditions d'un véritable mélange et dans bien des cas renforce les stratégies de distinction pour éviter de se voire assimiler aux classes populaires. Loin de réduire les distances sociales, la mixité programmée construit les barrières, attise les antagonismes, généralise les conduites d'évitement aussi bien dans l'espace public (formation de micro territoires socialement ou ethniquement marqués) que dans les écoles (contournement de la carte scolaire). Peut-on imaginer sérieusement que loger des ménages paupérisés dans des quartiers chics produira une quelconque convivialité sociale avec les familles de la grande bourgeoisie qui ont des moyens et des stratégies pour protéger leurs espaces sociale ? Et finalement n'est-ce pas l'échec d'un projet politique qui reposait déjà sur ces postulats qui conduit à reposer de façon récurrente cette question de la mixité ?

Il faut donc considérer un autre mode de «Gouvernance » des populations dans l'espace urbain celui-ci passe par l'attribution de moyens largement supérieur pour les quartiers ou les ressources des habitants limitent l'accès au savoir, à l'activité économique et sociale et en général, à la ville. L'allocation préférentielle de ressources en équipement, en services et en biens ne préjuge pas des modèles d'expression sociale qui seront investis par les populations, ce qui évite ainsi l'axe central de l'idéologie de la mixité sociale. La promotion du mode de vie des classes moyennes comme modèle de référence pour les classes « inadaptées ». Son mode opératoire privilégie, celui de la diffusion du modèle par capillarité, c a d par exposition directe dans la fréquentation des même lieux (qui s'assemble se ressemble), perdrait alors sa puissance de domination et par voie de conséquence, ses effets d'exclusions.

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Notice of Retraction

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Ampleur des disparités scolaires entre les communes de la ville de Goma au niveau de l'enseignement secondaire année scolaire 2012-2013

[Extent of schooling disparities between the communes of Goma city in level of secondary schools during 2012-2013]

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ABSTRACT: Education has aways been essential because it has contributed to the socio-economic development of society. The education of women and young girls in particular, given its impact on the mastery of fertility, the amelioration of health, the access to an employment of good quality is perceived as one of the keys of development. Education is thus at the centre of concerns of all nations. A sound example is the many international consultations about the issue in 2000 with the adoption of eight Objectives of the Millennium for Development (OMD) among which two are related to education.

Of all those conferences, the one which has left a mark and which has made people become aware is the one of Jomtien in Thailand in 1990 on education for all for the year 2011. According to PONSER, (1994), Jamtien has raised much hope because from its recommendations, the great number of African states should adopt educational politics. In fact, this conference considered education as one of the main priorities for development and states were required to make primary education universal in 2000.

In the first congress of the Mouvement Populaire de la Révolution (MPR), (1972), a resolution was adopted recommending with insistence the fair geographical distribution of education supply in the regions of the country. Despite the different declarations made in the conferences organised by UNESCO, very important disparities still persist between rural and urban areas, between sexes, between continents, between states, between provinces and even between territories or communes in the same country.

That is why this scientific study aims at establishing the existence of disparities related to schooling between communes of Goma town. This study will also allow appropriate authorities create schools in a well balanced way in the different communes of Goma.

KEYWORDS: schooling disparities, communes, Goma city, secondary schools.

ABSTRACT: L'éducation a toujours été considérée comme primordiale, car participant au développement socio-économique des sociétés. L'éducation des filles et des femmes en particulier, par son impact sur la maitrise de la fécondité, l'amélioration de la santé, l'accès à un emploi qualifié, est perçue comme une des clés du développement. L'éducation est ainsi au cœur des préoccupations de tous les pays. En témoignent les nombreuses concertations internationales sur la question culminant en 2000 avec l'adoption des huit objectifs du millénaire pour le développement (OMD) dont deux sont relatifs à la scolarisation.

De toutes ces conférences, celle qui aura le plus marqué les esprits et suscité une plus grande prise de conscience est celle de Jomtien en Thaïlande en 1990 sur l'éducation pour tout l'an 2000. Selon PONSER, (1994), Jomtien a suscité autant d'espoir parcequ'à partir de ses recommandations, la plupart des États Africains allaient mettre en place des politiques éducatives en effets, cette conférence avait fait de l'éducation de base une des grandes priorités du développement et les États ce sont engagés à rendre l'éducation primaire Univers aire en l'an 2000.

Dans le premier congrès du mouvement populaire de la révolution /MPR/ 1972 /on avait adopté une révolution recommandant avec instance la répartition géographique équilibrée de l'offre de l'éducation dans les régions du pays.

Malgré, les différentes déclarations annoncées les conférences organisées par l'UNESCO, des inégalités souvent très importantes subsistent entre notamment les zones rurales et urbaines entre les sexes, entre les continents, entre les pays, les provinces, voire entre les territoires en communes au sein d'un même pays, etc.
C'est ainsi que dans cette recherche scientifique, nous avons voulu constater l'existence des disparités scolaires entre les communes de la ville de Goma. Aussi, cette étude permettra aux autorités compétentes de créer les écoles secondaires dans les différentes communes de la ville de Goma.

KEYWORDS: disparités scolaires, communes, ville de Goma, enseignement secondaire.

1 INTRODUCTION

Dans tous les pays, l'éducation est au centre des préoccupations parce que l'école forme et prépare ceux qui sont appelés à gérer les entreprises productrices des richesses et créatrices d'emplois, à effectuer des recherches nucléaires ou spatiales, agronomiques ou génétiques indispensables à l'amélioration de la vie et à la meilleure connaissance de l'environnement. Ces activités s'apprennent à l'école [3]

C'est ainsi que G. MOKONZ,[6], ajoute en disant que l'éducation apparait pour la communauté internationale comme un bien si désiré que l'ONU l'a placée au rang des droits fondamentaux de l'homme. En effet, l'article 26, alinéa 2 de la déclaration universelle de droit de l'homme stipule que « toute personne à droit à l'éducation. L'éducation doit être gratuite au moins en ce qui concerne l'enseignement élémentaire est obligatoire, l'enseignement technique et professionnel doit être généralisé, l'accès aux études supérieures doit être ouvert en pleine égalité à tous en fonction de leur mérite. Tout gouvernement a le devoir de tout mettre en œuvre pour assurer l'alphabétisation de ceux qui ne peuvent pas encore trouver des places dans les écoles ou qui n'ont pas pu en bénéficier dans leur jeunesse ».

L'adhésion à la charte de l'ONU impose aux États des obligations en matière de l'enseignement des jeunes et des adultes. C'est ainsi que l'instruction a connu dans le monde un développement spectaculaire sur le plan quantitatif, surtout au cours des années qui ont suivi les grandes conférences sur l'éducation, conférences organisées par l'UNESCO après la seconde guerre mondiale (1955-1966) en Amérique Latine, en Asie, dans les États Arabes, en Europe, en Amérique du Nord et enfin en Afrique.

Toutes ces conférences ont mis l'accent sur le développement quantitatif des systèmes d'enseignement. Elles ont arrêté des plans de scolarisation à court et à long terme pour un développement harmonieux de l'enseignement dans le monde en général et dans les pays sous-développés en particulier. Plus récemment encore, la communauté internationale a décrété la dernière décennie du 20^{e} siècle (1990-1999) « la décennie de l'éducation pour tous » ceci a de nouveau été rappelé au cours du forum mondial sur l'éducation organisé à Dakar du 26 au 28 avril 2000. Pour ce dernier forum, l'objectif de l'éducation pour tous devrait être atteint d'ici 2015. (G. MOKONZI, [6].

L. François, [1], dit que dans les pays développés, la démocratisation de l'enseignement entraine la prolongation de la scolarité, la multiplication par cinq ou par dix des effectifs secondaires, la transformation des universités, des séminaires en véritables villes scientifiques, dans les pays en voie de développement, on a reconnu l'éducation comme l'attribut de la réelle indépendance, le ferment de l'unification politique, le moyen de création de la conscience nationale. Dit-on que l'œuvre de l'éducation devrait s'étendre à la nation entière. L'éducation devient alors partie intégrante du développement économique et social ; particulièrement précieux parce que capable d'enrichir un pays ; de tous les capitaux, l'homme est le plus difficile à former, mais par la suite le plus productif. Cependant, pour tous les pays, sans distinction, un grand effort est encore nécessaire pour éliminer toute discrimination volontaire ou involontaire : entre garçon et fille, entre groupes sociaux et religieux différents, entre populations rurales et urbaines, entre classes sociales.

Pour G. RICHARD [11], l'enseignement est la clef du progrès en Afrique, qu'il est l'un des moteurs essentiels d'un développement rapide dans tous les domaines. De ceci nous comprenons que l'éducation n'est pas seulement un droit que le Jeune Africain partage avec tous les autres enfants du monde, mais également un investissement dont tous les États Africains tireront profit. Dans le premier congrès du MPR (1972) on avait adopté une résolution recommandant avec insistance la répartition géographique équilibrée de l'offre d'éducation dans les régions du pays. En effet, dans chaque pays, tout retard de développement scolaire est ressenti par la communauté régionale, comme une expression d'un manque d'intérêt de la part des instances nationales et ce retard risque de développer des sentiments régionalistes qui peuvent être un risque pour la cohésion nationale. Aussi l'objectif d'une réduction des disparités peut-il se justifier pour des raisons éthiques de justice sociale. Cet objectif peut s'imposer dans la pratique comme une nécessité politique.

Cependant, en dépit des belles paroles contenues dans les différentes déclarations et malgré une augmentation considérables des effectifs globaux enregistrés particulièrement dans les pays du tiers monde, après les conférences organisées par l'UNESCO de 1966, des inégalités souvent très importantes subsistent entre notamment les zones rurales et urbaines, entre les sexes, entre les continents, les pays, voire entre les provinces, territoires au sein d'un même pays, etc. ces disparités tendent à s'aggraver au niveau de l'accès scolaire ainsi qu'au passage d'un niveau d'un enseignement à un autre. Les conditions de scolarisation sont ainsi loin d'être les mêmes, elles sont inégalement distribuées aux masses désireuses d'accéder à l'enseignement. G. MOKONZI cité par BAHATI KABUYUNGU [2]

C'est ainsi que dans cette recherche scientifique notre attention est plus focalisée sur toutes les écoles secondaires opérationnelles et agréées par le gouvernement congolais dans la ville de Goma. De ce fait, nous nous sommes posé les questions suivantes : quelle est l'ampleur des disparités entre les communes de la ville de Goma au niveau de l'enseignement secondaire ? Ces disparités sont-elles faibles ou prononcées ? Quelle est la cause des disparités entre les communes de la ville de Goma au niveau de l'enseignement secondaire ?

Considérant, l'ampleur de disparités constatées dans les écoles secondaires de la ville de Goma nous partons des hypothèses selon lesquelles, il existerait des disparités scolaires entre les différentes communes de la ville de Goma. Les disparités scolaires entre les différentes communes de la ville de Goma seraient dues a la création déséquilibrée et non planifiée des écoles dans les quartiers de la ville de Goma.

L'objectif poursuivi dans cette recherche est de faire constater l'existence des disparités scolaires entre les communes de le la ville de Goma.

Cette étude permettra aux planificateurs de l'enseignement de tenir compte de la carte scolaire dans les communes de Goma en essayant de favoriser la démocratisation de l'enseignement dans cette ville et équilibrer l'offre et la demande en matière de l'éducation. Aussi elle permettra aux autorités compétentes, la création équilibrée des écoles secondaire dans ces différentes communes.

2 CONSIDERATIONS TERMINOLGIQUES

2.1 QUELQUES IDEES SUR LES DISPARITES SCOLAIRES

2.1.1 DISPARITÉ

Pour G. MIALARET [5], les disparités signifient défauts de parité, contrastes, différences. Selon G. MOKONZI [6] le terme disparité désigne le défaut d'égalité, le contraste, les différences, les inégalités. De ceci, nous pouvons définir que la disparité scolaire est le manque d'équilibre lié à la scolarisation entre les entités. G. MOKONZI, [8], distingue deux sortes de disparités à savoir : les disparités spatiales qui sont celle observées entre les entités à un moment donné, et les disparités temporelles qui consistent à comparer la situation au début et à la fin d'une période de référence donnée. La disparité spatiale va attirer notre attention.

2.1.2 POPULATION SCOLARISABLE ET POPULATION SCOLARISEE

La population scolarisable est l'ensemble de toutes les personnes à l'âge d'être à l'école. R. DONTTRENS cité par BAHATI KABUYUNGU [2]. Pour l'UNESCO [12] la population scolarisable comprend le nombre de tous les enfants en âge scolaire. Quant à la population scolarisée est l'ensemble de tous les effectifs inscrits à un niveau donné de l'enseignement quelque soit leur âge. Donc, tous les élèves qui sont inscrits dans toutes les écoles secondaires opérationnelles de la ville de Goma constituent notre population scolarisée.

2.2 LES METHODES DANS L'ETUDE DE DISPARITE

L'écart-type et le coefficient de variation, le coefficient de GINI et la courbe de Lorenz sont les méthodes utilisées dans l'étude des disparités spatiales.

2.2.1 L'ECART-TYPE ET LE COEFFICIENT DE VARIATION

La dispersion des entités autour de la moyenne globale peut être considérée comme une mesure de l'ampleur des disparités. L'écart-type et le coefficient de variation servent à mesurer cette dispersion.

Plus l'écart-type est grand, plus les disparités sont élevées. Néanmoins, il faut noter que l'interprétation de l'écart-type n'est pas aisée car elle n'est pas basée sur un critère précis. Aussi recourt-on le plus généralement à l'écart-type dans l'approche comparative des disparités. Par contre, pour le coefficient de variation le schéma d'interprétation est bien précis.

Ce coefficient s'obtient par la formule suivante :

$CV = \frac{SD}{\overline{X}}$ Où CV= coefficient de variation

SD= écart-type

$\overline{X}$= moyenne

2.2.2 LE COEFFICIENT DE GINI ET LA COURBE DE LORENZ

Le coefficient de Gini est une mesure de dispersion qui nous permet de voir dans quelle mesure une caractéristique particulière est distribuée entre les différentes unités d'analyse. Pour pouvoir calculer ce coefficient, il faut comparer la distribution de la variable à analyse, à celle d'une autre variable qui sert de variable critère

Une autre mesure des disparités parallèles au coefficient de Gini est la courbe de Lorenz. La construction de celle-ci se fait en fonction des proportions cumulées de la variable à analyser (pi) placées en ordonnée et de la variable critère (qi) placée en abscisse. S'il n'y a pas de disparités entre les unités d'analyse, les points représentants ces dernières vont se situer sur la diagonale qui, pour cette raison, est appelée ligne d'égalité. La surface comprise entre la courbe de Lorenz et la diagonale constitue donc une mesure de l'ampleur des disparités. Plus cette surface est grande, plus les inégalités sont importantes.

3 MILIEU ET METHODES

Dans cette partie, nous allons parler de la population d'étude, des techniques de récolte des données et de traitement de données, de méthode du travail.

3.1 POPULATION D'ÉTUDE

R.QUIVY et al, [10], définissent le terme population comme un ensemble d'éléments constituant un tout.

Quant à nous, une population est un ensemble d'individus sur lesquels s'applique une étude et ces individus ont les mêmes caractéristiques.

Notre population est fini parce qu'elle est constituée de toutes les écoles opérationnelles se trouvant dans les deux communes de la ville de Goma pour l'année scolaire 2012-2013.

3.2 TECHNIQUES DE COLLECTE DES DONNÉES

Nous nous sommes servis de la technique documentaire

Selon M. GRAWITZ [9], la technique documentaire est une technique qui consiste en la consultation des documents écrits, documents chiffrés, documents officiels et des documents privés. Dans cette technique le chercheur n'exerce aucun contrôle sur la façon dont les documents ont été établis, mais doit sélectionner ce qui l'intéresse, l'interpréter ou comparer des matériaux pour les rendre utilisables.

En ce qui concerne notre travail, la collecte des données a consisté à consulter les registres d'appel dans les différents bureaux des établissements secondaires de la ville de Goma. Dans ces registres, nous avons trouvé les effectifs des élèves de différents quartiers dont l'âge varie entre 12 à 18 ans et plus.

Nous avons également consulté les archives au bureau de l'État Civil de différents quartiers de Karisimbi et de Goma où nous avons collecté les effectifs des enfants en âge scolaire se trouvant entre 12 et 18 ans pour le niveau secondaire. Nous y avons aussi récolté la population totale que renferme chaque quartier.

3.3 TECHNIQUES DE TRAITEMENT DES DONNEES

Pour analyser et traiter les données quantitatives de notre investigation, nous avions fait usage aux taux de scolarisation, à l'indice de sélectivité (IS) ou (I. R.R), au coefficient de variation, au coefficient de Gini et à la courbe de Lorenz.

3.3.1 LE TAUX DE SCOLARISATION

Le taux de scolarisation est la proportion exprimée en pourcentage des élèves inscrits à un niveau scolaire donné par rapport à l'ensemble de la population des classes d'âges correspondant. Pour calculer les taux bruts de scolarisation, nous avons appliqué la formule ci-dessous.

$$T.B.SC = \frac{population - scolarisée}{population - scolarisable}$$

Où

T.B.SC= Taux brut de scolarisation

3.3.2 L'INDICE DE SELECTIVITE (IS) OU (IRR)

Cet indice nous a permis d'étudier l'ampleur des disparités entre les différents quartiers de deux communes de la ville de Goma en matière de scolarisation au niveau de l'enseignement secondaire. Pour calculer IRR, nous avons recouru à la formule selon laquelle :

$$IR \quad \frac{Pourcentage \quad de \quad la \quad population}{Pourcentage\ de\ la\ population\ scolarisable}$$

Si IRR est supérieur à 1 cela signifie qu'il n'y a. (MALALA NTAMBUE, 2005)

3.3.3 LE COEFFICIENT DE VARIATION

Il s'obtient par la formule :

$CV = \frac{SD}{X}$ Où CV= coefficient de variation

SD= écart-type

X= moyenne

3.3.4 LE COEFFICIENT DE GINI SE CALCUL PAR LA FORMULE SUIVANTE :

$$G = \sum_{i=k}^{n} (p_i q_{i-1} - p_{i-1} q_i)$$

Où

G= coefficient de Gini
p_i= proportion cumulée de la variable à analyser
q_i= proportion cumulée de la variable critère

Et enfin, la courbe de Lorenz

3.4 PRESENTATION, ANALYSE ET INTERPRETATION DES RESULTATS

Dans cette partie, nous présentons les résultats de notre recherche, nous analysons et traitons les données de différents quartiers de différentes communes de la ville de Goma.

Ainsi, nous avons procédé commune par commune. La ville de Goma a deux communes dont leur situation se présente dans les tableaux ci-dessous.

La population totale, la population scolarisable, la population scolarisée de différents quartiers de la commune de Karisimbi se présente dans le tableau ci-après :

Tableau N°I : Répartition des effectifs nombre d'écoles secondaires, population scolarisable, population totale dans la commune de Karisimbi

N°	Indicateurs / Quartiers	Population totale	Population scolarisable	%	Population scolarisée	%	TBSC	N^{bre} d'écoles	IRR
1	MABANGA SUD	81988	13704	13.84	1784	5.61	19.99	4	0.40
2	KATOYI	60843	13443	13.58	58.37	18.4	43.42	16	1.35
3	NDOSHO	52659	12047	12.17	5236	16.51	43.46	15	1.36
4	KASIKA	45366	10867	11	2404	7.58	22.12	8	0.69
5	MAJENGO	39923	7841	7.92	834	2.63	10.63	3	0.33
6	MABANGA NORD	38739	8558	8.64	2353	16.42	27.49	6	0.86
7	MURARA	31601	19707	19.91	11496	36.25	58.33	16	1.82
8	KAHEMBE	28358	3703	3.74	1034	3.26	27.92	1	0.87
9	VIRUNGA	14576	3168	3.2	537	1.79	16.95	3	0.53
10	MUGUNGA	14315	2309	2.33	159	0.5	6.88	2	0.21
11	BUJOVU	10162	3631	3.66	37	0.01	1.02	1	0.030
	KARISIMBI	423030	98978	100	31708	100	32.03	75	

Au regard de ce tableau, nous constatons que la commune de Karisimbi compte 75 écoles secondaires avec un effectif de 31708 sur 98978 enfants scolarisable soit 32.03%. Le quartier Katoyi a une population scolarisable de 13443 et organise 16 écoles dont 5837 scolarisées soit 43.42% avec 7606 non scolarisées. Le quartier Murara a une population scolarisable de 19707 et organise 16 écoles avec un effectif de 11496 scolarisées soit 58.33%. Le quartier Ndosho organise 15 écoles avec un effectif de 5236 scolarisées soit 43.46% et un effectif de 12047 enfants scolarisable. Le quartier Kasika dispose 8 écoles secondaires avec un effectif de 2404 soit 22.12% d'enfants scolarisés et une population scolarisable de 10867. Le quartier Mabanga Nord compte 6 écoles secondaire avec un effectif de 2353 soit 27.4% d'enfants scolarisés et une population scolarisable de 8558 dont 6205 non scolarisés. Le quartier Mabanga Sud dispose 4 écoles secondaire avec un effectif de 1781 soit 19.99% d'enfants scolarisés et une population scolarisable de 13704. Le quartier Virunga compte 3 écoles secondaire avec un effectif de 537 soit 16.95% d'enfants scolarisés et une population de 3168 scolarisable. Le quartier Majengo organise 3 écoles secondaire avec un effectif de 834 élèves soit 10.63% et une population scolarisable de 7841. Le quartier Mugunga dispose 2 écoles secondaire seulement avec 159 élèves soit 6.88% et 2309 enfants non scolarisables. Enfin, le quartier Bujovu organise une seule école avec un effectif de 37 élèves soit 1.02% et 3631 enfants scolarisable. De ce qui précède nous constatons que le quartier Murara occupe le premier rang avec un pourcentage de 58.33% et le quartier Bujovu est le dernier avec un pourcentage de 1.02% en matière de scolarisation.

Pour analyser l'étude de disparités entre les communes et les quartiers de la ville de Goma nous avons recouru aux méthodes suivantes :

Les calculs de l'indice de sélectivité ou de représentation relative, le coefficient de variation, le coefficient de Gini et la courbe de Lorenz ;

Le tableau ci-dessous représente les indices de représentation relative (IRR) à partir de la population scolarisable et la population scolarisée.

3.4.1 CALCUL DES INDICES DE REPRESENTATION RELATIVE (IRR)

Tableau N°II : Analyse des disparités à partir de l'indice de représentation relative.

N°	Indicateurs / Quartiers	Population scolarisable		Population scolarisée		IRR
		Fréquence	Pourcentage	Fréquence	Pourcentage	
1	MURARA	19707	19.91	11496	36.25	1.82
2	MABANGA SUD	13704	13.84	1781	5.62	0.40
3	KATOYI	13443	13.58	5837	18.4	1.35
4	NDOSHO	12047	12.17	5236	16.51	1.36
5	KASIKA	10867	11	2404	7.6	0.69
6	MABANGA NORD	8558	8.64	2353	7.42	0.86
7	MAJENGO	7841	7.92	834	2.63	0.33
8	KAHEMBE	3703	3.74	1034	3.26	0.87
9	BUJOVU	3631	3.67	37	0.11	0.030
10	VIRUNGA	3168	3.2	537	1.7	0.53
11	MUGUNGA	2309	2.33	1.59	0.5	0.21
	KARISIMBI	98978		31708	100	

Ce tableau montre que les quartiers MURARA (1.82) Ndosho (1.36) et Katoyi (1.35), les indices de représentation relative sont supérieurs à 1 ce qui signifie qu'ils sont favorisés en matière de scolarisation à l'école secondaire par rapport aux autres quartiers. Les indices de représentation relative des quartiers suivants : Kahembe (0.87), Mabanga Nord (0.86), Kasika (0.69), Virunga 0.53, Mabanga Sud 0.40, Mugunga 0.21, Majengo 0.33 et Bujovu 0.030. Montrent que ces quartiers sont défavorisés en matière de scolarisation des enfants à l'école secondaire par rapport à l'ensemble de la commune. De ce résultats, nous pouvons confirmés selon la quelle, il existerait des disparités spatiales entre les différents quartiers de la commune de Karisimbi.

Cependant pour se rendre compte si ces disparités sont faibles ou prononcées, nous avons recouru au coefficient de variation. Ci-après nous présentons le tableau de données et le calcul de cet indice.

3.4.2 CALCUL DES DISPARITES A PARTIR DE COEFFICIENT DE VARIATION

En calculant les deux indices de dispersion on obtient pour l'année scolaire 2012-2013 les résultats suivants :

Indices	2012-2013
Moyenne de la commune	25,29%
Minimum	1,02%
Maximum	58,33%
Écart-type	16,55
Coefficient de variation	0,65

De ces résultats, nous constatons que le coefficient de variation est supérieur à 0.30 ; 0.65>0.30 ; ce qui signifie que les disparités entre les quartiers en matière de scolarisation sont très prononcées. Ce qui nous permet de confirmer l'hypothèse selon laquelle les disparités entre les quartiers de la commune de Karisimbi seraient très prononcées.

Pour voir si dans quelle mesure une caractéristique particulière est distribuée entre les différents quartiers, les calculs de coefficient de Gini nous a permis d'aboutir aux résultats fiables.

En comparant la distribution de la variable à analyser c'est-à-dire en considérant la population scolarisée à celle de la variable critère c'est-à-dire la population scolarisable au cours de l'année scolaire 2012-2013, nous avons examiné les disparités entre les quartiers de différentes communes de la ville de Goma en calculant le coefficient de Gini suivant les étapes ci-après.

Tout d'abord nous avons classé des unités d'analyse dans l'ordre croissant suivant les indices de représentation relative. Le tableau suivant nous les présente.

Tableau N°III .Pourcentages cumulés pour la variable à analyser et la variable critère.

N°	Indicateurs / Quartiers	IRR	Population scolarisée			
			Pourcentage	Pourcentage cumulés	Pourcentage	Pourcentage cumulés
1	BUJOVU	0.030	0.11	0.11	3.67	3.67
2	MUGUNGA	0.21	0.5	0.61	2.33	6
3	MAJENGO	0.33	2.63	3.24	7.92	13.92
4	MABANGA SUD	0.40	5.62	8.86	13.84	27.76
5	VIRUNGA	0.53	1.7	10.56	3.2	30.96
6	KASIKA	0.69	7.6	18.16	11	41.96
7	MABANGA NORD	0.86	7.42	25.58	8.64	50.6
8	KAHEMBE	0.87	3.26	28.84	3.74	54.34
9	KATOYI	1.35	18.4	47.24	13.58	67.92
10	NDOSHO	1.36	16.51	63.75	12.17	80.09
11	MURARA	1.82	36.25	100	19.91	100

Il ressort de ce tableau que selon l'ordre croissant en tenant compte de l'indice de représentation relative que les quartiers de la commune de Karisimbi sont ordonnés en commençant par le quartier Bujovu qui se place au premier rang et le quartier Murara au dernier rang.

Les pourcentages cumulés de la population scolarisée et de la population scolarisable ont été calculés en suivant cet ordre croissant. Cependant nous avons procédé au calcul du coefficient de Gini.

G= [(0.0011x0)-(0x0.0367)]=0

+ [(0.0061x0.0367)-(0.0011x0.06)]=0.00015787

+ [(0.0324x0.06)-(0.0061x0.1392)]=0.00109488

+ [(0.0886x0.1392)-(0.0324x0.2776)]=0.00333888

+ [(0.1056x0.2776)-(0.0886x0.3096)]=0.001884

+ [(0.1816x0.3096)-(0.1056x0.4196)]=0.0119136

+ [(0.2558x0.4196)-(0.1816x0.506)]=0.01544408

+ [(0.2884x0.506)-(0.2558x0.5434)]=0.00692868

+ [(0.4724x0.5434)-(0.2884x0.6792)]=0.06082088

+ [(0.6375x0.6792)-(0.4724x0.8009)]=0.054464484

+ [(1x0.8009)-(0.6375x1)] =0.1634

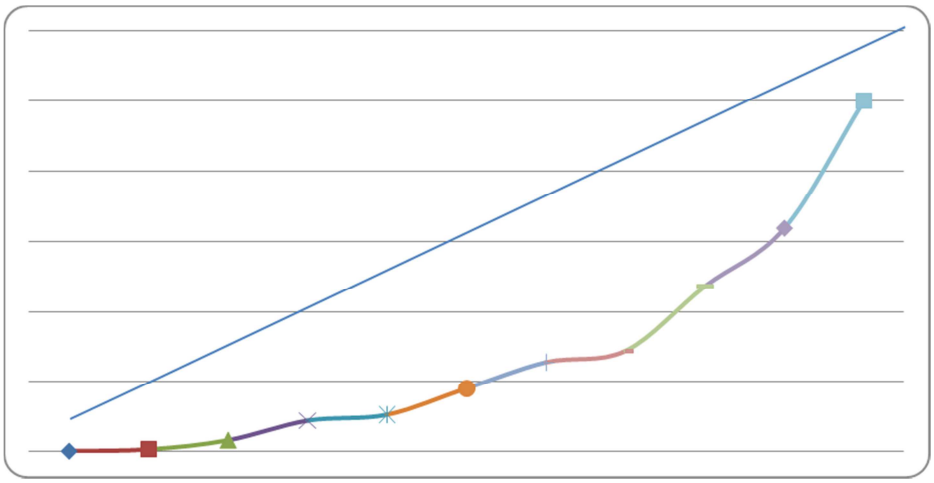
G= 0+0.00015787 +0.00109488 +0.00333888 +0.001884 +0.0119136 +0.01544408 +0.00692868 +0.06082088 +0.054464484 +0.1634 =0.319447354$\cong$0.32

Étant donné que G= 0.32 est supérieur à 0.30, il existe des disparités très prononcées entre les quartiers de la commune de Karisimbi du point de vue de la population scolarisée par rapport à la population scolarisable.

A part l'indice de représentation relative, le coefficient de variation, le coefficient de Gini, la représentation de la courbe de Lorenz a été tracée pour nous renseigner sur l'ampleur des disparités dans les quartiers de la commune de Karisimbi.

A partir de propositions cumulées de la variable critère (qi) en abscisse, on peut construire la courbe de Lorenz de la manière suivante :

COURBE DE LORENZ



Étant donné que la courbe s'écoute de la droite d'égalité, il y a des disparités entre les quartiers de la commune de Karisimbi lorsqu'on considère la population scolarisée en fonction de la population scolarisable. Pour se rendre compte de la situation en matière de scolarisation à l'école secondaire dans la commune de Goma, les données ce présentent dans le tableau ci-dessous

Tableau N°IV : Répartition des effectifs, nombre d'écoles secondaires, population scolarisable, population Totale dans la commune de Goma.

N°	Indicateurs / Quartiers	Population totale	Population scolarisable	%	Population scolarisée	%	TBSC	Nbre d'écoles	IRR
1	KESHERO	49273	10297	25.40	7014	41.41	68.11	20	1.63
2	MAPENDO	44593	9767	24.1	1399	8.26	14.32	3	0.34
3	HIMBI	40704	6201	15.30	3858	22.78	62.21	6	1.48
4	MIKENO	33214	4767	11.76	1250	7.38	26.22	4	0.62
5	KATINDO	29095	6426	15.86	1196	7.06	18.61	3	0.44
6	LES VOLCANS	10010	1890	4.66	1575	9.30	8.33	5	1.99
7	LAC VERT	6851	1182	2.92	646	3.81	54.65	4	1.30
	COMMUNE DE GOMA	213740	40530	100	16938	100	41.79	45	

De ce tableau, nous constatons que la commune de Goma compte 45 écoles secondaires avec un effectif de 16938 sur 40530 enfants scolarisables soit 41.79%. Le quartier Keshero a une population scolarisable de 10297 et organise 20 écoles dont 7014 soit 68.11% d'enfants scolarisés et 3265 enfants nos scolarisés. Le quartier Himbi a une population scolarisable de 6201 et organise 6 écoles secondaires dont 3858 soit 62.21% d'enfants scolarisés. Le quartier Mikeno compte 4 écoles secondaires avec un effectif de 1250 soit 26.22% d'enfants scolarisés et 4767 enfants scolarisables. Le quartier Lac Vert compte 4 écoles secondaires avec un effectif de 646 soit 54.65% d'enfants scolarisés et une population scolarisable de 6426 dont 5230 enfants non scolarisés. Le quartier Mapendo compte 3 écoles secondaires avec un effectif de 1399 soit 14.32% d'enfants scolarisés et une population scolarisable de 9767 dont 8368 enfants non scolarisés. Enfin, le quartier les Volcans a une population scolarisable de 1890 et organise 5 écoles secondaires avec un effectif de 1575 enfants scolarisés soit 83.3% d'enfants scolarisés. De ces résultats, nous constatons que la commune de Goma compte un grand nombre d'enfants scolarisables qui s'élève à 40530 dont 16938 seulement sont scolarisés à l'école secondaire.

Pour analyser l'étude des disparités entre les quartiers de la commune de Goma nous avons recouru aux méthodes suivantes : les calculs de l'indice de représentation relative, le coefficient de variation, le coefficient de Gini et tracer la courbe de Lorenz. Le tableau ci-dessous nous présente les indices de représentation relative de différents quartiers de la ville de Goma.

Tableau N°V : Analyse des disparités à partir de l'indice de représentation relative (IRR)

N°	Indicateurs / Quartiers	Population scolarisable		Population scolarisée		IRR
		Fréquence	Pourcentage	Fréquence	Pourcentage	
1	KESHERO	10297	25.40	7014	41.41	1.63
2	MAPENDO	9767	24.1	1399	8.26	0.34
3	HIMBI	6201	15.30	3858	22.78	1.48
4	MIKENO	4767	11.76	1250	7.38	0.62
5	KATINDO	6426	15.86	1196	7.06	0.44
6	LES VOLCANS	1890	4.66	1575	9.30	1.99
7	LAC VERT	1182	2.92	646	3.81	1.30
	COMMUNE DE GOMA	40530	100	16938	100	

Ce tableau nous montre que dans les quartiers Les Volcans, Kyeshero, Himbi et Lac Vert les indices de représentation relative s'élèvent respectivement à 1.99 ; 1.63 ; 1.48 et 1.30 supérieurs à 1. Ce qui signifie qu'ils sont favorisés en matière de scolarisation à l'école secondaire par rapport à d'autres quartiers. Les indices de représentation relative et Katindo (0.44) sont inférieurs à 1. D'où ces quartiers sont défavorisés en matière de scolarisation des enfants à l'école secondaire ;

Ces résultats montrent réellement que les disparités existent entre les différents quartiers de la commune de Goma. Cependant pour se rendre compte si les disparités sont faibles ou prononcées, nous avons recouru au calcul du coefficient de variation. Ces résultats se présentent comme suit :

3.4.3 CALCUL DES DISPARITES A PARTIR DE COEFFICIENT DE VARIATION

Indices	2012-2013
Moyenne de la commune	46,77%
Minimum	14,32%
Maximum	83,33%
Écart-type	24,95
Coefficient de variation	0,53

De ces résultats, nous constatons que le coefficient de variation (0.53) est supérieur à 0.30 ; ce qui signifie que les disparités entre les quartiers de la commune de Goma en matière de scolarisation sont très prononcés.

En comparant la distribution de la variable à analyser c'est-à-dire en considérant la population scolarisée à celle de la variable critère c'est-à-dire la population scolarisable au cours de l'année scolaire 2012-2013, nous avons aussi examiné les disparités entre les quartiers de la commune de Goma en calculant le coefficient de Gini suivant les étapes ci-après. Tout d'abord, nous avons classé les unités d'analyse dans l'ordre croissant suivant les indices de représentation relative. En suite les proportions cumulées de la variable critère et de la variable à analyser ont été calculées.

Tableau N°VI : Pourcentage cumulés pour la variable à analyser et la variable critère

N°	Indicateurs / Quartiers	Population scolarisée		Population scolarisable	
		Pourcentage	Pourcentage cumulés	Pourcentage	Pourcentage cumulés
1	MAPENDO	8.26	8.26	24.1	24.1
2	KATINDO	7.06	15.32	15.86	39.96
3	MIKENO	7.38	22.7	11.76	51.72
4	LAC VERT	3.81	26.51	2.92	54.64
5	HIMBI	22.78	49.29	15.30	69.94
6	KESHERO	41.41	90.7	25.40	95.34
7	LES VOLCANS	9.30	100	4.66	100

Au regard de ce tableau, nous constatons que selon l'ordre croissant des indices de représentation relative de différents quartiers ; le quartier Mapendo (0.34) se place au premier rang et le quartier Les Volcans (1.99) au dernier rang. Aussi les pourcentages cumulés de la variable critère et de la variable critère et de la variable à analyser ont été calculés en suivant cet

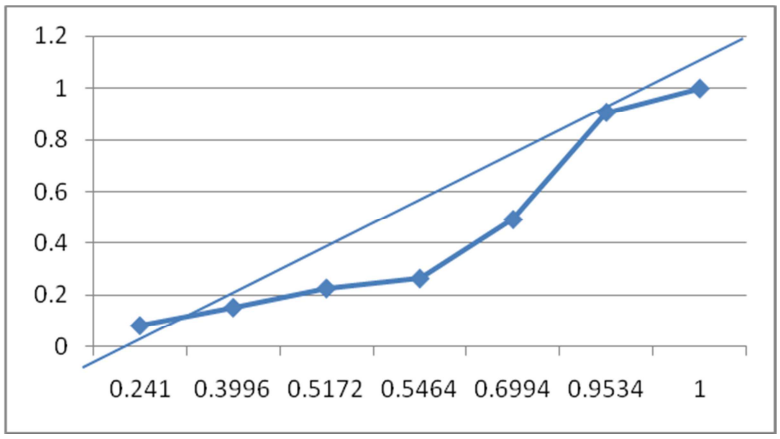
ordre. Ces pourcentages ont été transformés en propositions cumulées avant de calculer le coefficient de Gini. Les calculs se présentent comme suit :

G= [(0.0826x0)-(0x0.241)]=0
+ [(0.1532x0.241)-(0.0826x0.3996)]=0.00391424
+ [(0.227x0.3996)-(0.1532x0.5172)]=0.01147416
+ [(0.2651x0.5172)-(0227X0.5464)]=0.01307692
+ [(04929x0.5464)-(02651x06994)]=0. 08390962
+ [(0.907x0.6994)-(04929x0.9534)]=0.16442494
+ [(1x0.9534)-(0.907x1)]=0.0464

G=0+0.00391424+0.01147416+0.01307692+0.08390962+0.16442494+0.0464=0.3239988≅0.32

Étant donné que G=0.32 est supérieur à 0.30 ; il existe des disparités entre les quartiers de la commune de Goma du point de vue de la population scolarisée par rapport à la population scolarisable. En outre la courbe de Lorenz a été tracée pour nous renseigner sur l'ampleur des disparités scolaires entre les quartiers de la commune de Goma à l'école secondaire.

A partir des propositions cumulées de la variable à analyser (pi) en ordonnée et de la variable critère (qi) en abscisse, la courbe de Lorenz a été tracée de la manière suivante :



Etant donné que la courbe s'écarte de la droite d'égalité, il y a des disparités entre les quartiers de la commune de Goma lorsqu'on considère la population scolarisée et la population scolarisable.Ainsi pour se rendre compte des disparités scolaires entre les deux communes de la ville de Goma, les données ont été présentées dans le tableau synthèse ci-après.

Tableau N°VII : Repartition des effectifs, nombre d'écoles secondaires, population scolarisable, population Totale dans la ville de Goma

N°	Indicateurs / Communes	Population totale	Population scolarisable	%	Population scolarisée	%	TBSC	N^{bre} d'écoles	IRR
1	Commune de Goma	213740	40530	29.05	16938	34.82	41.79	45	1.19
2	Commune de Karisimbi	423030	98978	70.95	31708	65.18	32.03	75	0.91
3	Ville de Goma	636770	139508	100	48646	100	34.86	120	

De ce tableau, nous constatons que la commune de Goma a un indice de représentation relative de 1.19 supérieur à 1 et la commune de Karisimbi a un indice de représentation relative de 0.91 inférieur à 1. De ces résultats, nous confirmons que la commune de Goma est favorisée en matière de scolarisation à l'école secondaire par rapport à la commune de Karisimbi.

3.4.4 LA CARTE DE PROSPECTION

Pour analyser les causes des disparités scolaires entre les quartiers de la ville de Goma, nous nous sommes servis de la carte de prospection selon G. MOKONZI, (2005),

- La projection des écoles à créer ou à reconvertir pendant toute la période du plan.

Il continue en disant que : « la réalisation de la prospection exige des conditions de la carte de prospection se fonde sur deux démarches à savoir :

- La critique de la carte scolaire actuelle

Standardisation des situations observées dans toutes les entités. C'est ainsi qu'en tenant compte des situations observées et de la législation nous pouvons opter pour les critères suivants :

- Le taux de scolarisation 100%
- Le taux d'occupation des locaux de 55 élèves par classe
- La taille d'école de 12 classes par écoles (le minimum fixé par l'arrêté départemental n° DEPS/AS/834/BCE/001/0389/78 du 20/11/1978.

Pour notre exemple, en tenant compte de ces critères, la carte de prospection dela ville de Goma se présente comme suit :

Tableau N°VIII : Carte de prospection de la ville de Goma

					situation existante						amélioration des conditions existantes				école à créer pour équilibre			BILLAN		
N°	Indicateurs / Quartiers	1 Population scolarisable	2 Population scolarisée	3 TBS	4 Nombre d'écoles	5 Nombre de classe	6 Classe par école	7 Élève par classe	8 Effectif à scolariser	9 Differ à scolarise	10 Élève par classe	11 classes par école	12 Nombre de classe	13 nombre d'école	14 Élève par classe	15 Classe par école	16 Nombre de classe	17 Nombre d'école	18 École pour l'ensemble du système	19 École à créer
1	KESHERO	10297	7014	68,11	20	199	10	35	10297	3283	55	12	128	11	55	12	60	5	16	-4
2	MAPENDO	2967	1999	14,32	3	40	13	35	9767	8368	55	12	25	2	55	12	152	13	15	12
3	HIMBI	6201	3858	62,21	6	86	14	49	6201	2343	55	12	70	6	55	12	43	4	10	4
4	MIKENO	4767	1250	26,22	4	35	9	36	4767	3517	55	12	23	2	55	12	64	5	7	3
5	KATINDO	6426	1196	18,61	3	23	8	52	6426	5230	55	12	22	2	55	12	95	8	10	7
6	LES VOLCANTS	1890	1575	83,3	5	57	15	20	1890	315	55	12	29	2	55	12	6	1	3	-2
7	LAC VERT	1182	646	54,65	4	27	7	24	1182	536	55	12	12	1	55	12	10	1	2	-2
8	MABANGA SUD	13704	1781	18,99	4	48	12	37	13704	11923	55	12	32	3	55	12	217	2	5	1
9	KATOYI	13443	5837	43,42	16	148	9	39	13443	7606	55	12	106	9	55	12	138	12	21	5
10	NDOSHO	12047	5236	43,46	15	146	10	36	12047	6811	55	12	95	8	55	12	124	10	18	3
11	KASIKA	10167	2404	22,12	8	48	6	50	10867	8463	55	12	44	4	55	12	154	13	117	9
12	MAJENGO	7841	834	10,63	3	30	10	28	7841	7007	55	12	15	1	55	12	127	11	12	9
13	MURARA	19707	11496	58,33	16	264	7	44	19707	8211	55	12	209	17	55	12	149	12	29	13
14	KAHEMBE	3703	1034	27,92	1	19	19	54	3703	2669	55	12	19	2	55	12	49	4	6	5
15	VIRUNGA	3168	537	16,95	3	17	6	32	3168	2631	55	12	10	1	55	12	48	4	5	2
16	MUGUNGA	2309	159	6,88	2	9	5	18	2309	2150	55	12	3	0	55	12	39	3	3	1
17	BUJOVU	3631	37	1,02	1	3	3	12	3631	3594	55	12	1	0	55	12	65	5	5	4
18	MABANGA NORD	8568	2353	27,49	6	71	12	33	8558	6205	55	12	43	4	55	12	113	9	13	7

De ce tableau, il ressort les résultats selon lesquels le quartier Les Volcans pour l'ensemble du système, il faudrait 3 écoles, donc 2 écoles sont à supprimer. Le quartier Mikeno pour la situation existante, à 4 écoles, 35 classes, en moyenne 9 classes faudrait 7 écoles, donc 3 écoles à créer. Le quartier Katindo, pour l'ensemble du système a besoin de 10 écoles d'où 7 écoles à créer le Quartier Mapendo à besoin de 15 écoles pour encadrer toute la population scolarisable, donc 12 écoles sont à créer. Le quartier Keshero pour l'ensemble du système il faudrait 16 écoles, donc 4 écoles à supprimer sur les 20 écoles de la situation existante. Le quartier Lac Vert pour la situation existante à 4 écoles, il faudrait 2 écoles à supprimer. Le quartier Mabanga sud à besoin de 5 écoles pour encadrer la population scolarisable de 13704, sur ce, 1 école doit être créée. Le quartier Katoyi pour l'ensemble du système a besoin de 21 écoles, donc 5 écoles à créer. Le quartier Ndosho devrait avoir 18 écoles pour l'ensemble du système, alors 3 écoles sont à créer. Le quartier Kasika à 8 écoles pour la situation existante pour améliorer cette situation, il faudrait 17 écoles pour l'ensemble du système et 9 écoles sont à créer. Le quartier Majengo a besoin de 12 écoles pour l'ensemble du système, donc il faudrait créer encore 9 écoles. Le quartier Murara, organise 16 écoles avec 264 classes. Pour améliorer la situation il a besoin de 29 écoles, d'où la création de 13 classes est indispensable.

Le quartier Kahembe à besoin de 6 écoles pour l'ensemble du système, donc il faut créer 5 écoles pour améliorer la situation existante. Le quartier Virunga à besoin de 5 écoles pour l'ensemble du système, donc 2 écoles sont à créer. Le quartier Mugunga organise 2 écoles seulement alors qu'il a besoin de 3 écoles pour l'ensemble du système, d'où une école mangue. Le quartier Bujovu a besoin de 5 écoles pour encadrer toute la population scolarisable de 3631, donc 4 écoles sont à créer.

Enfin, le quartier Mabanga Nord à besoin de 13 écoles pour l'ensemble du système. Sur ce, 7 écoles manquent pour améliorer la situation existante. De ces résultats, nous confirmons notre deuxième hypothèse

4 CONCLUSION

Au terme de notre travail de recherche qui s'intitule « Ampleur des disparités scolaires entre les communes de la ville de Goma au niveau de l'enseignement secondaire 2012-2013.

Après analyse et traitement des données, nous avons abouti aux résultats suivants :

Pour la commune de Karisimbi, le coefficient de variation est de 0,65>0,30 et le coefficient de Gini est de 0,32>0,30. De ces résultats nous pouvons confirmer que les disparités entre les quartiers de la commune de Karisimbi sont prononcées.

Quant à la commune de Goma, les résultats se présentent comme suit :

Le coefficient de variation est de 0,53> à 0,30 et le coefficient de Gini est de 0,32>0,30. De ces résultats, nous constatons que les disparités entre les quartiers de la commune de Goma sont prononcées.

En outre, dans l'ensemble, la commune de Goma avec IRR=1,19 est très favorisée en matière de scolarisation par rapport à la commune de Karisimbi avec IRR=0,91 à l'école secondaire. Ainsi notre première hypothèse a été confirmée.

En ce qui concerne la cause des disparités entre les quartiers de différentes communes de la ville de Goma, les résultats montrent que respectivement les écoles à supprimer sont au nombre de 4,2 et 2 pour qu'il y ait équilibre sur la carte de prospection. Aussi les quartiers Mapendo, Himbi, Mikeno, Katindo, Mabanga sud, Katoyi, Ndosho, Kasika, Majengo, Murara, Kahembe, Virunga, Mugunga, Bujovu, Mabanga nord ont besoin de créer respectivement les écoles qui sont au nombre de 12,4,3,7,1,5,3,9,9,13,5,2,1,4,7 pur que toute la population scolarisable de ces quartiers puisses être scolarisée. Ce qui nous pousse à confirmer notre deuxième hypothèse.

De ce qui précède, nous suggérons ce qui suit :

- Aux planificateurs de l'éducation de créer d'une manière équilibrée les écoles en tenant compte de la population scolarisable.
- A l'État : de favoriser la démocratisation de l'enseignement à l'école secondaire
- Aux parents : de soutenir l'œuvre éducative de leurs enfants
- Aux jeunes de mettre en tête que l'avenir de ce pays n'est que pour les gens qui ont étudié pour bâtir un Congo développé et prospère.

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World Cup Football in International Relations: The 2009 Algerian-Egyptian football conflict

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ABSTRACT: The intention of this paper is to introduce a number of issues relating to World Cup football and international relations within the context of the 2009 qualifying match between Algeria and Egypt. Many scholars argue that World Cup football games may increase violence and incite nationalistic aggression in no time especially in countries where football as a sport is the most prevalent. By analyzing the complex series of dynamic scenarios and tension ratios that surrounded the Algeria-Egypt 2009 game, the paper sheds the light on the direct negative impact of football can have upon the political relationships of countries. The idea of establishing international football events to encourage peace between countries goes up in smoke when not only overzealous supporters but also both media and political parties get swayed by the game. The problems that occurred in both countries led to a decrease in diplomatic flexibility of both governments by stimulating radical nationalism on both sides. The Egyptian government failed to manage these controversial issues mainly by letting its media fueling Egyptians' anger. However, both governments acknowledge their common interests and are working on a process to establish a strategic partnership of mutual benefit in order to stabilize the relations between the two countries. Despite all the problems caused by the football game, the Algerian-Egyptian convergence is a principal factor in maintaining and forging a strategic partnership of mutual benefit between Algeria and Egypt in the future.

KEYWORDS: Football diplomacy, Foreign policy, International relations, Power of Media, Football for Peace, Politicized Conflicts, Interstate violence, Nationalism.

1 INTRODUCTION

At first sight, it could seem a bit strange to write a paper on football in an international geopolitical context. However, the link between football and international research runs deeper than my personal sporting interests. The World Cup Football is not just a leisure activity, it is not a simple game played between two different teams, but is, in fact, one of the most powerful components in international relations for its impact on World politics. A world Cup football match is the biggest event in the world and the most universal phenomenon, even more universal than democracy or the market economy (Boniface, 1998). I chose to analyze the 2009 Algeria-Egypt football game when many partitions tried to attach themselves to it because they were sponsoring or hosting the football teams and there was a tremendous demand on prestige of the hosting country and a high level of tensions too. In a game which ended with the defeat of Egypt and the qualification of Algeria, the political and economic implications were tremendous.

2 THE GROWING IMPORTANCE OF FOOTBALL IN HISTORY

"Sport is probably the most effective means of communication in the modern world, bypassing both verbal and written communication and reaching directly out to billions of people world-wide. There is no doubt that sport is a viable and legitimate way of building friendship between nations." Nelson Mandela (Maguire 2005: 1).

The football game has long been a wide-spread sport in the world and an important element in human societies since centuries, but it has been neglected by historians until the early 1980s (Hamelin, 2009). By then, it was realized that sport can affect economic, political and social aspects of a society. We can find traces of the football game in different civilizations, using diverse ball forms, in different ways and for different reasons.

A bas-relief dating from the 5th century BC. shows a ballplayer accompanied by his slave, playing what could be called an ancestor of football (Hamelin, *op.cit*). Whether it is among the Egyptians, the Greeks (Episkyros) or the Romans (Harpastum), evidence of a game which involved the use of the feet and a ball exists. There are a number of references to traditional, ancient or prehistoric ball games, played by indigenous peoples in many different parts of the world. But it was the Chinese competitive game *cuju (*literally "kick ball"*)* which is considered as the earliest form of football because it was standardized and rules were established. Cuju was an exercise in a military manual from the third and second centuries BC. In medieval and modern Europe, people have continued to play ball games. They played in accordance with the tradition, without any written rules. In the 16th century, the birth of a game can be observed in Italy inspired by the rules of the Roman Harpastum. However, it was not until the middle of 19th that the modern football codes have been characterized in England. The game was initially reserved for an elite, but then it spread to the entire population. Today, football is one of the most popular sports on the planet. Football is far from being a simple object of leisure and entertainment; the introduction of mass media allowed it to achieve unprecedented audience and the popularity of the sport has made it a potential policy tool "[...] *used by governments domestically to promote national identity, public health, and social values, and diplomacy, to support foreign-policy goals*" (Keys, 2006: 7). Harvey (2010: 189) also points out that: "*The high visibility of international sports events has fostered a favorable climate for state intervention. Nations have increasingly forged direct propaganda links between sport triumphs and the viability of their political-economic systems".* This new vision to football lead to the development of new concepts such as: "sports diplomacy", "soccer diplomacy‟ (or football diplomacy) and "diplomats in sweat suits" (in reference to athletes).

The leaders of Soviet Russia have always regarded sports to be a matter of primary importance to the state considering both the utilitarian and socio-political aspects of sport. This can be even seen in their definition of the term *'*physical culture' (1925): "*Physical culture must be considered not only from the standpoint of physical education and health and as an aspect of the cultural, economic and military training of youth* [...]*, but also as one of the methods of educating the masses* [...]*, and in addition, as a means of rallying the broad masses of workers and peasants around the various Party, soviet, and trade union organizations, through which the masses of workers and peasants are to be drawn into social and political activity*" (quoted in Washburn, 1956). Actually, the interrelationship between political ideology and sport is common for many countries. In today's world, sports mega-events, especially the FIFA Football World Cup, have become a major political, economic, social and cultural force.

A number of concrete examples of football diplomacy can be found in history to show how football can have a myriad of functions within international relations. Its role can be positive improving international relations of states with difficult histories, or the way around worsening the relations as is the case with the 2009 Egypt/Algerian football conflict. In the case study of this paper, there was both a negative impact in the relations between Algeria and Egypt, but a positive impact between Algeria and Sudan.

3 ALGERIA-EGYPT INTERNATIONAL RELATIONS

I decided to divide International relations between Algeria and Egypt into two phases: before 1978 and after 1978. This is the date when the Egyptian president Anwar Sadat decided to collaborate with Israel and agreed on signing the Camp David Accords to conclude a Peace Treaty between the two countries. The same year the Egyptian president received a Nobel Peace Prize under the big discontent of the Arab world, especially Algeria, who all considered this as a stab in the back.

Algeria and Egypt have been generally very friendly throughout their history especially before 1978. Egypt was a strong material and political support for the Algerian war of independence. The president of Egypt Gamal Abdel Nasser maintained his support to Algerian leaders even though the British attempted to seize the Suez Canal. The relationships between the two countries were excellent at many levels. The Palestinian cause was a common denominator as to the political approach of the two countries as their views on the reform of the Security Council of the United Nations were substantially similar. Moreover, the continuing solidarity between Algeria and Egypt during the Six-Day War in Egypt 1967 and later during the October 1973 war against Israel reinforced this political rapprochement.

However, the relationships after 1978 have seen an unprecedented level of tensions following the Egyptian president Anwar Sadat's decision to negotiate with the Israelis. Gradually, Egypt started building economic relations with Israel; it

stopped the boycott laws, inaugurated airline flights between the two countries and even began to supply Israel with crude oil.

Tensions between Egypt and Algeria remained intense for decades since then until November 1988 when Algeria decided to re-establish relations with Egypt (Lea and Rowe, 2001: 155-156). Nevertheless, both countries were drawn to play in the same Group for the qualifying competition first in 1989 and again for the 2010 FIFA World Cup. The tensions noted in the football games were quickly turned into political conflicts.

4 ALGERIA-EGYPT 2009 POLITICIZED FOOTBALL CONFLICTS

This is obviously a negative example of how football can lead to more hostility at a diplomatic level. The World Cup 2009 hate match between Algeria and Egypt kept busy many parties: Fifa's disciplinary experts, the police, the governments and presidents, not only in Algeria and Egypt but also Sudan, who hosted the game between the two international teams, and France, where live a high number of French Algerians and Algerian immigrants. The diplomatic tensions between Algeria and Egypt occurred in the past as well over a football game in 1989. While in the past, the primary fault was on Algerian supporters, the 2009 incident was all caused by Egyptians, especially the hostility of the Egyptian media who massively fueled both its population and its government.

It all started by the home match which took place in Algeria in June 2009. Upon the defeat of the Egyptian team, insults spread on many internet sites, Egyptian hackers crashed some Algerian national websites and so did Algerian hackers in response to them. The tensions were kept alive for six months, to the point that upon their arrival to Cairo, the 11 Algerian players were subjected to harm. They were attacked by stone-throwing youths, who smashed their bus windows and injured three of them consequently. The incident was later covered by the Egyptian media who accused the Algerians of fabricating the claim; while the players and a representative of the FIFA witnessed the Egyptian security guards standing back and allowing the attack to happen (Montague, 2009). The Algerian players were not even able to have some rest at their hotel prior to the game as the Egyptian fans kept making loud drumming noise the whole night. Again, the absence of the police was noted during this incident. Because both the Egyptian media and the government tried to push all the blame on the Algerians, the situation was made worse and uncontrollable: violence, recriminations, diplomatic conspiracy and a trail of broken glass and burned-out cars and boats from Egypt, Algeria to France as well. Algerian, or Egyptian fans, they were all calling for cutting political and economic ties between the countries and caused millions of dollars of losses. The football agitated fans, whether Egyptians or Algerians, expressed their anger in diverse violent forms. The football match between the two teams soon transformed into a declaration of war (Jailan, 2009). The Algerians were unhappy by the pacific attitude of their media calling for peacetime or their government trying to quiet the incident, Algerians started responding to the Egyptian media attacks via youtube videos, followed by furious exchanges in newspapers and sports websites, and this led to an electronic war of words which further soured the relationship between the countries.

The verbal sparring on the Internet revived decades old political issues like the defeat of Egypt in the Six-Day War (1967) which saw the loss of Arab territories most of which are still unrecovered, and the controversial Egypt peace treaty with the Jewish State. Algerian supporters posted song videos with photos of Sunni Muslim authority Sheikh Mohammed Tantawi shaking hands with Israeli President Shimon Peres, accusing Egyptians as traitors. While Egyptian fans hit back with a song referring to Egypt's support to the Algerian independence.

The football match took place in Khartoum's Al Merreikh stadium on the 18th November 2009, with over over 35,000 Algerian and Egyptian supporters and 15,000 extra police and heavily armed security forces keeping tight control over them. Algerian supporters threatened to end Djezzy GSM, which is the main mobile network operator owned by Egypt and worth a value of $7 billion. Both Algerian and Egyptians companies were alarmed. Several calls were made between the Algerian, Egyptian and Sudanese presidents. The Lebanese Al-Khazen, worrying about the political implications, commented that "If an Arab president calls another, the conversation should be about the issues concerning the [Arab] nation and not about a football match" (quoted by Black, 2009).

In this volatile political atmosphere, the president Abdelaziz Bouteflika gave away 15.000 free tickets and deployed the Algerian Armed Forces planes at the service of the football supporters when all the flights were fully booked. This move was the first of its kind in history and resulted in fans cheering their president in the streets. He wanted, first, to encourage the team by all means and second, to reverse the situation and control it in an attempt to calm down the angry fans. But for the Egyptian media, the Algerian president was openly declaring war by sending the fans in the army planes and is, for them, encouraging violence to happen in Sudan.

Algeria won over Egypt and was qualified for the World Cup 2010 but the relationships between Egypt and Algeria continued to heat up for a few months after the football game. Having lived all these incidents myself, I came to the

conclusion that the source of the problem was the Egyptian media who have a strong impact on both the population and the government. For example, the Egyptian TV received a hoax phone call from weeping fans pretending to be under attack from knife-wielding Algerians in Khartoum. The TV quickly staged Algerians as criminals, accused the president Bouteflika for sending thousands of 'criminals' (quoting their words) in army planes, and blamed Sudan for taking sides with Algeria. The events in Sudan evolved into a diplomatic row with Egypt after officials in Cairo accused authorities of failing to protect its citizens. The Egyptian president Mubarak in a blunt TV talk said he would send the army to Sudan if necessary because "Egypt does not tolerate those who hurt the dignity of its sons". Further, Anas el-Feqqy, Egypt's Minister of Information, influenced by the prank call, stated on Egypt's most popular television show that Algerians bought the knives and daggers from the streets of Khartoum and were planning on revenge with a massive slaughter. The Sudanese government later tried to explain that media reports in Egypt exaggerated the state of facts, but it was of no use, the media already fueled the Egyptians' anger and convinced them of the twisted events.

The inflammatory Egyptian media reports were indeed the major problem in the conflict. On 25 November 2009, 200 Egyptian intellectuals signed a statement condemning the media hype and political manipulation of the dispute.

During the football game period, many Egyptian politicians and high ranking officials saw in this tumult phase an opportunity to divert people's attention and to improve their image so they gave televised statements saying exactly what the angry audience wanted to hear. On this occasion, Hossam el-Hamalawy, a well-known Egyptian blogger said: "You cannot keep fooling people with football. People at the end of the day - even after trashing the Algerian embassy - are still going to go home on empty stomachs". Additionally, Egyptians among actors, singers, writers, journalists demonstrated great creativity swearing, cursing, insulting and describing in the worst way all Algeria, its people, and its government. For that reason, the Arab League proposed that, in the future, celebrities and political leaders should not attend such sensitive matches or expose their opinions on TV for the risk of influencing negatively public passions and the countries' international relations.

The tensions continued for a few months in both countries even after respective Presidents ordered the media to stop their negative reports on the events, especially from the side of Egypt. The events described above serve as an illustration on how football clearly plays a significant role in international relations; it has a direct impact on politics and can lead to detrimental actions to the concerned countries. In the Algeria-Egypt case, both governments understand the need to construct stable and cooperative relations.

With the election of Egyptian president Abdel Fattah El-Sisi, ties with Algeria started to get closer. The two countries will not be completely absorbed only in the management of the Algeria-Egypt relationship in the narrow sense. Instead, they plan to extend their field of vision to include the stability and development of all North Africa. In July 2014, both governments decided to be the two arms of a pincer on the Libyan desert to preserve the dominance of the security establishment in North Africa, they both share concerns about the instability of Libya, and they are both looking forward to more business opportunities and prospects for cooperation.

5 CONCLUSION

Overall this paper illustrates how football can be utilized as a strong tool in foreign policy and politics. If well applied, it can enhance the relationships between countries leading to improved international cooperation. It also contributes to the image and the popularity of a country in the same way as cultural factors do. However, the contrary also applies.

In the Algeria-Egypt case, the football matches go beyond the shared enjoyment of a game; football in both countries is really a big issue that directly touches their mutual patriotism. That is why along with tensions, nationalistic ambitions are always expressed. Consequently, the claim that football constitutes a peace movement is discredited by reporters, academics, and policymakers (United Nations, 2003; Hoberman, 2011).

The enormous energy that sprung during the football game, the enthusiasm and the synchronized national union around "one" issue, are all most vivid during football matches. Foreign observers gaped at a level of nationalist fervor and mass mobilization rarely seen before in either Algeria or Egypt. For both Algerians and Egyptians, football opens a window where they can finally express their unsatisfied oppositions and aspirations. It is indeed the result of failures in the political and economic development of both countries. Both Egypt and Algeria were going through economic disorder and political crises due to the corrupted governments.

Even though both countries are filled with people with hatred feelings, the diplomatic crisis was sorted out and did not lead to cutting off ties between the two countries. The source of the problem was identified to be the Egyptian media igniting the national tensions. I think that beyond its role as an international barometer, football between Algeria and Egypt will

continue to be a politicized football, and will always raise the zeal of each country's supporters. Thus, it is important for both countries to work on their relations and political systems in order to avoid any retaliation between the two peoples in the future football games. Currently, both sides are already working to suitably handle any issues, differences of opinion and disputes which may arise in the future. It is vital that both countries actively improve their relations to each other through different mechanisms other than football games, as these proved to be precarious to the foreign policy. I think other variety programs ranging from volleyball, basketball, martial arts, swimming, athletics, and boxing, to music, arts, theatre, and film making, will be more useful as means to foster peaceful relations. It is evident that Algeria and Egypt are now two geopolitical entities whose future football matches will be closely watched and analyzed.

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Environmental planning and management (EPM) as a strategry for solving environmental problems in Niger delta region: A study of Bonny Island, Rivers State, Nigeria

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ABSTRACT: Environmental issues are meant to be operationalized through the formulation of actor-specific environmental actions plans, which define priority action that will convert strategy into practice. The Environmental Planning and Management (EPM) process which is an increasingly popularized strategy of solving the myriads of problems affecting the environment in contemporary world. The study examines the use of Environmental Planning and Management (EPM) process as a strategy of solving environmental problems in Bonny Island, Rivers State, Nigeria by investigating the perception of the general public on the state of the environment in the area, level of participation of people in compliance to existing environmental strategies, causes of ineffective environmental management in the area and assessing community satisfaction with existing environmental management approach using well structured questionnaires administered to sampled households. Questions were related to socio-economic characteristics of households, willingness to participate by the community in the EPM process, perceived level of environmental degradation in the area, level of compliance of oil and gas companies to environmental laws and the role of Government environment protection agencies in protecting the environment of the study area.

The results confirm that the level of damage from oil exploration, gas activities, pollution and pipeline vandalizations is chronic and cumulative, which has resulted to the degradation of the environment, routine of facilities and compliancy to environmental management approaches are not regular, facilities and equipment were found be grossly inadequate therefore proper inspection can not be well carried out, the community expressed dissatisfaction with the existing environment approach which they attributed to the inability of fully implementing the environmental approach, the community indicated that given the opportunity they are willing to participate in evolving an effective environmental management approach. Recommendations were made for the effective and efficient application of the EPM process in the study area.

KEYWORDS: Environmental Planning and Management, Degradation, Environment, Bonny Island.

INTRODUCTION

The Niger-Delta region is located in the southern part of Nigeria, it is known for rich natural resources such as oil, abundant flora and fauna, hydrocarbon deposits in its oil, clay for burnt brick silica sand for glass manufacturing industries, its

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rich mangrove forest was considered the third largest in the world. Oil fields in Niger-Delta are not large but are plentiful in the region and cuts across farms, waterways and fishing grounds.

For nearly four decades, the Nigeria economy is completely dependent on petroleum extraction, generating 25% of its GDP (which has risen to 40% as of 2000) NDDC 2005. Even though oil has become the centre of current industrial development and economic activities, the links between oil exploration and exploitation process and the increasing environmental, health and social problems in oil process and the increasing environmental, health and social problems in oil producing communities which has led to environmental pollution, oil spillage, land degradation, pipeline vandalization and biodiversity depletion.

The rate at which immediate environment of this rich region, that defines wealth and poverty simultaneously is being affected is quite alarming. The environment is bad that the inhabitants are used to witnessing first degree environmental degradation. As in the case of most oil producing regions of less developed countries, the economic and political benefits are given more weight than the resulting damage of the environment which is important.

The environmental challenges in Bonny results from the continual exploration and exploitation of natural resources which has gradually degraded the ecosystem primarily from economic motives. This has become an important issue of growing concern, considering that serious environmental degradation, increased activities in the oil industries leading to discharge of toxin of increased volume of effluents which have exacerbated the incidences of pollution and contamination both surface and ground water by harmful gas, contamination of soil by oil spills and leaks, increased deforestation as well as environmental degradation stemming from gas flaring. Considering the effects of land degradation will not reel out inadequate waste management, bush burning, urban industrial pollution, erosion and inappropriate agricultural activities resulting to acid rain, biodiversity depletion, air pollutant deforestation, population pressure and over exploration.

The Niger Delta has celebrated and Nigerian's lack of coherent pollution control policy. Until recently, three was little incentive for power plants to implement pollution abatement strategies or for oil companies to undertaken environment remediation efforts, only recently no longer willing to tolerate oil company's absolving themselves of their responsibility to reducing pollution.

However, this could be attributed to lack of community involvement in environmental management approach in the study area.

Therefore, this study is set out to address the problem of environmental degradation in Bonny Island.

AIM AND OBJECTIVES

This research is aimed at investigating the environmental characteristics and problems of the study area and plan proposals for environmental planning and management. The specific objectives are to:

i. review the concepts, principles, relevance of EPM strategy
ii. examine the spatial environmental characteristics of Bonny
iii. identify the environmental problems in Bonny
iv. make proposals for environmental management using the EPM strategy.

CONCEPTUAL FRAMEWORK

CONCEPT OF EPM PROCESS

The EPM concept entered the planning dictionary or can be said to have originated in the 1960's with the social movement and revolution, which changed the concept and discipline of physical planning. The movement originated in U.S. with the integration of social planning with physical planning. Alschuler, Brooks, Peter Marris, Howard Odum and others are among the earlier planners who propagated the concept of EPM.

UNCHS defines environmental planning and management approach as the process in which it allows for interactive, participation of stakeholders in reaching a consensus an environmental issues which needs to be planned and managed.

Wahab (1998:17) defines EPM as a bottom-up participatory interactive and collaborative approach to physical planning and management in which public technocrats work in concert with the organized to jointly address environmental and socio-economic issues affecting people and their environment.

The UNCH/UNEP (1987) defines EPM as a continuing and dynamically evolving process whose purpose is to make development policy formulation and implementation progressively more responsive to environmental consideration.

Environmental Planning and Management is according to UNCHS (1995), " a new way of looking of and understanding development a new way of organizing our thoughts about how to mobilize resources and take action in respect of developmental issues". The EPM process is a holistic, dynamic flexible and interactive approach to sustainable physical planning and management capable of addressing all environmental problems confronting physical planning while strengthening the local capability for better planning and management.

The EPM process is adopted as a means of solve specific environmental problems it becomes imperative to integrate the procedure into the normal or routing activities of all stakeholders involved. The EPM process is also a fall not of the Agenda 21 of the united Nation to mobilize support form local actors or stakeholders in the public organized private and the popular sectors concluding the indigenous people in their guest for solving environmental issues.

THE STUDY AREA

Bonny is a town in River state in South east Nigeria, on the sight of Biafra. A small island located just offshore. It is located between longitude 4^0N5^0N and between latitude 6^0E8^0E. Bonny Island constitute of several settlements, squatter settlements and migrant communities of interest are Agalanga, Jacob-Ama (Mango village) Akusu I and II including Nembekiri (Monkey villages), while the settlements include Bonny town which is the largest settlement which is located on the South-West edge f the island, the labour camp (a.k.a workers camp), and the oil and construction complexes and their residential areas.

According to the 1991 census, the population of Bonny was about 156, 760. Bonny now has about 215,358, this increase is as a result of the source: National Population Commission.

Table1: Population Distribution in the Study Area

Settlements	**Population distribution**
Abalamabie	9,325
Agalanga	22,535
Akiama	10,769
Akusu	20,506
Bonny	64,607
Finna	53,071
Jacob Ama	7,019
Nemekiri (Monkey Village)	21,501
Workers camp	6,023
Total	**215,358**

Source: NPC (2006)

Bonny Island experiences a seasonal climate (dry season and (net season) with high humidity all year and high annual average rainfall of about 4000mm, with mean annual maximum temperature of about 31.3 ^0C and mean minimum temperature of about 22.5^0C.

Air quality on Bonny Island is generally good, although industrial activity and different forms of road and river traffic have increased in recent years. Air quality monitoring data from Nigeria Liquidified and Natural Gas Corporation (NLNG, 2001), indicated that all potential pollutants, cabonmonoxide, nitrogenoxide, sulphur oxide, hydrogen sulphide, methane and non methane, volatile hydro carbons at present is average compared to Nigeria and internationally accepted standards.

Bonny Island is relatively flat and consists of series of shallow sand ridges that indicates past regular seaward accretion. Hydro geological study has revealed that rain water percolation through sand has created a bulb of fresh water resource that supplies borehole water for the Bonny populace.

Bonny Island's river system has the highest volume of all the river systems in the Delta an the proportion of fresh water flow down the river is low. Therefore is generally a net flux of tidal water up the river, which disperse into various creeks and channels.

The Island supports three main types of natural vegetation; Mangrove, Fresh water swamps and dry land rain forest. The fresh water swamp forest includes area of "Galloping swamp", which has dry land rain forest on the drier ridges and swamp forest in between. In addition there are areas of open coast sand beaches, inter tidal flats and creeks.

Agriculture on Bonny Island is very limited and only takes place on the relatively poor sandy soil of the dry land ridges of the galloping swamp forest, therefore fishing which is traditionally a very important economic activity on Bonny Island. About 55% of the population are engaged in fishing or fish farming. While about 45% of the population are oil workers, construction workers, unskilled low income workers, artisans etc.

At Bonny, the road network consists of single two-long, two wary carriage way road that inter connects Bonny town with the other settlements. The primary roads are essentially single two lane carriage ways that act as major distributors for all categories of traffic movement between Bonny and the rest of the Island. Usage of the major roads by cars, motor bikes and pedestrians heavy.

ENVIRONMENTAL PROBLEMS FACING THE STUDY AREA

Bonny is now experiencing series of environmental damage, this is because the area is known for productive wetlands and oil deposits. The terrestrial and marine environment has being badly damaged and one of the primary cause is the oil industry and other associated industries.

OIL EXPLORATION

Oil exploration began in 1958, little did one know that the environment would be adversely affected by its activities. Oil exploration has being a major uncontrollable source of environmental and social degradation, because of the massive oil exploration in the area which has led to a range of environmental issues such as contamination of both surface and ground water by harmful gases like Benzene, Ethyl benzene, Toluene (O'Rourke and Connolly 2003).

GAS FLARING

Gas and oil activities have caused damage to the environment, thousands of tons of waste all disposed untreated directly into the ecosystem. There has being considerable amount of gas flared which is as a result of oil and natural gas that is mixed in every oil deposit, the natural gas called "associated gas" must be removed from oil before refining (Ashton et al 1999). Gas flaring is simply the burning of this associated gas. Gas flaring is simply the burning of most countries of the world where gas may only occur in certain circumstances such as emergency shut downs. Due to the lack of utilized infrastructure, approximately 76% of associated gas is flared (Africa News Service 2003). Not only is the flaring damaging the environment and human health, it is also wasting huge amounts of the country's second most valuable natural resource.

Table 2: Gas flaring (billion cubic metres) in sub sahara Africa

Countries/Year	1995	2000	2005	2010
Angola	4.51	5.94	4.72	4.08
Cameroun	1.15	1.19	0.97	0.92
Chad	0.00	0.00	0.09	0.05
Congo	1.08	2.02	1.79	1.88
Cote d'Ivoire	0.06	0.09	0.04	0.09
DRC	0.53	0.43	0.44	0.39
Eq. Guinea	0.61	1.21	1.36	0.39
Ghana	0.00	0.00	0.01	0.20
Gabon	2.15	2.54	2.36	1.68
Nigeria	**27.09**	**27.19**	**21.25**	**15.18**
South Africa	0.06	0.13	0.14	0.10
Global	154.97	164.90	171.65	133.90

Source: Baumuller, H. et. Al (2011), The Effects of Oil Companies Activities o the Environmnent, Health and Development in Sub-Saraha Africa. Directorate-General for External Policies of the Union. Directorate B, Policy Department Study. European Parliament. 2011. Retrieved from http://www.europarl.europa.eu/activities/communities/studies.do?language=EN 27/08/2011

POLLUTION

Pollution has gradually eaten into the environment because of series of oil exploration and exploitation, other related gas activities etc, which has corroded the air quality, water and land. There is a considerable amount of dredging and filling of the water ways, siltation, erosion, spills which has led to acidification of water bodies, discharge of huge amounts of production water containing significant quantities of hydrocarbons, leaks from old corroded and poorly maintained pipelines, oil in gas flares, abandoned offshore rigs, refinery effluent and toxic sludge which has in turn damaged forests and agricultural land.

The reason why the inhabitants which depends on the biodiversity for their means for survival have become nuisance to the environment.

Table 3: SOME SEVERELY POLLUTED SITES IN THE STUDY AREA

LOCATION	ENVIRONMENT	IMPACTED AREA (ha)	NATURE OF INCIDENCE
Bonny	Mangrove forest	20	Gas flare and oil spill
New finima	Mangrove forest	10	Gas flare and oil spill
Abalamabie	Mangrove forest		Oil spill
Akiama	Mangrove forest	5	Discharge of refinery wastes

Source: A workshop on pollution and environmental studies. Port Harcourt (May 2006).

PIPELINE VADALISATION

Nigeria has lost over N150.5 billion to pipeline vandalization in the last eight years just as no fewer than 2,550 people have lost their lives due to fire incidents resulting from pipeline vandalism within the same period under review but the petroleum products' pipelines vandalism took the center stage from early nineties in the Niger Delta region but the crescendo has taken an unbearable dimension as the spate Total Network of pipelines running across the length and breadth of the country carry refined and crude products to designated points. There are about 5,001 Kilometers stretch of pipelines, consisting of about 4,315 multi products pipelines to 23 depots (20 inland and 3 Refineries' depots) and 666 Kilometers of crude oil pipelines to the four refineries. The crude pipelines originate from the off-shore terminals to supply the refineries in Warri, Kaduna and Port Harcourt.

The pipes are buried under the ground with about 25 meters wide Nigerian National Petroleum Corporation's (NNPC) right of way (ROW). The maintenance and security of the ROW are carried out by NNPC through the Communities. Environmental degradation was fashionably canvassed as a reason for communities to disrupt activities of the multinationals in order to call attention to the negative effects of their operations on ecology of the area.

Other causes of line breaks and spills are:

- Rupture due to diminished integrity and aging process of the pipes
- Sabotage

Pipelines vandalism is on the upward swing and seems to be continuing unabated. In 2000, the number of vandalized pipelines stood at 137 and 2,237 in 2005. The increase observed in the half year of 2006 was 144.88% higher than what was observed in the same period of 2005. Pipelines vandalism has continued to be more prominent in areas like port-Harcourt, Warri and Mosimi axis. In 1996, there were 33 cases of vandalized pipelines and 16 ruptures as against 1,170 within the first half of 2006. Product losses incurred through vandalism in 2000 was 397,600 Metric Tonnes or 10.121 billion Naira and 647,632 or 42.102 billion naira in 2005. In the first half of 2006, there were 2059 cases of vandalism Degradation of the environment is one of the worst disasters that have befallen the areas where pipelines have been vandalized. Raging fires have destroyed farmlands and forests thereby reducing arable land for farming. Spills into waterways destroy marine and aquatic life, flora, fauna, resort centers, pollution of drinkable water (Badejo and Nwilo). Pipeline vandalism compounds the spate of spillages from other sources and exacerbates the problems of environmental degradation and pollution of waterways

METHODOLOGY

The method of data collection was through the use of applicable sampling techniques. Since the study population is made up of residents in the study area. The authors carried out a stratified sampling to delimit the area of study into settlements.

There are nine settlements. The settlements were then delimited using simple random sampling technique to select respondents for the research work. From these settlements, the study sample was taken.

Information on the population in the nine settlements of the study area was obtained from the National Population Commission (NPC) Rivers State Office Port-Harcourt.

Samples were taken in the nine settlements that makes up Bonny Island. The sampled 200 household heads, the 200 households sampled was chosen for convenience due to the limited time available to carry out the research. Well structured questionnaires was administered to the selected respondents, Three sets of questionnaires were administered: The first were directed at the oil companies for the purpose of determining the existing environmental management, policies, measures as well as the general problems encountered. The second were administered on the residents of the area in which the environmental problems were identified, with a view to determining the general problems encountered. The third were administered on staff of Rivers State Environmental Protection Agency, who are saddle with the responsibility of environmental protection and management, to get the views of respondents on environmental planning and management problems in the study area.

Oral interviews was also adopted along side with questionnaire administration for the three categories of respondents to source vital information that was not captured by the questionnaire.

Similarly, published and un-published literatures were also reviewed which forms the theoretical foundation of the study. The data collected was analyzed using basic statistical tools, such as tables and charts where necessary.

RESULTS AND DISCUSSION

ASSESSMENT OF COMPLIANCE TO EXISTING ENVIRONMENTAL PROTECTION LAWS

In general, the level of compliancy with effluent standards and administration is low, compliance monitoring by FEPA in 1954 revealed that some industries have installed pollution control devices of which the facilities are slightly below full compliancy. There are still polluted sties which are not cleared, abandoned oil facilities which has led to fire accidents and toxic spills, oil companies do not regularly report compliance. The government have also contributed in somewhat in her oversight to the management of the oil industries.

Source: FEPA 2008

ESTIMATION OF THE DEGRADED ENVIRONMENT

For the purpose of this study, it is very important to know the estimate of the level of degraded environment which is gotten from the level of compliance to the environmental management strategies in existence.

- Assessment of community satisfaction with existing environmental management approach.
- Level of participation by the community in compliancy to existing environmental management strategies.
- Opinion of the residents on the cause of ineffective environmental management in the study area.
- Willingness to participation of industries in the area
- Willingness to participate by the residents of the community
- Educational background of respondents and their willingness to participate in the EPM approach in reducing environmental degradation.
- Income of respondents with the study area
- Willingness to contribute resources

Table 4: Estimation of the level of degrading of the environment

Type of degradation	Ratio	Percentage
Pollution	6.5	65
Gas flaring activities	3.5	35
Total	10	100

Source: Field Survey 2013

Table 5: OIL SPILLS

Quantity average per millions of barrels	Year
2 – 5 million barrels	2005
5 – 9 million barrels	2006
9 – 13 million barrels equivalent to 36 – 50 Exxon valdez spills.	2007

However volume estimates of oil spills are usually low as 50% of Nigerian oil is assumed to evaporate within 48 hours and spills are not usually detected in that period. These do not include any marine spills which are some of the worst.

Source (World Bank 2006)

LEVEL OF PARTICIPATION OF PEOPLE IN COMPLIANCE TO EXISTING ENVIRONMENTAL STRATEGIES

INFERENCE

This show that there is little or no participation by members of the community. This is as a result of non-challancy and neglect. This therefore calls for the need of public participation.

Table 6: Opinio of the residents on the causes of ineffective environmental management in the area

Causes	Frequency	Percentage
Effectiveness of environmental laws	50	33
Blames oil industries	46	31
Inadequate equipment	30	20
Lack of cooperation	24	16
Total	150	100

Source: Field Survey 2013

Table 7: Assessment of community satisfaction with existing environmental management approach

Responses	No. of respondents	Percentage
Satisfied	20	10
Dissatisfied	180	90
Total	200	100

Source: Field Survey 2013

In trying to apply the EPM approach in curtailing environmental degradation of the study area a test for willingness of the residents of the community on the study area to participate in the programme was carried out as shown below.

Willingness to participation of industries in the area

Inference

This shows that the oil industries involved are ready to comply and participate in the reduction of environmental degradation in the area.

From the survey, it was deduced that 33% of the respondents agreed to the fact that it is due to the ineffectiveness of environmental laws, 31% blames the oil industry for polluting the environment, 20% says there are no adequate equipments to carry out inspection 16% agree to the fact that no cooperation between the oil industries, government and the community.

Table 8: Willingness to participate by the community

Responses	No. of respondents	Percentage
Respondents willing to participate	150	75
Not willing to participate	50	25
Total	200	100

Educational background of respondents and their environmental willingness to participate in the EPM approach reducing environmental degradation

Table 9: Education Level of Respondents

Background of respondents	Agreed	Percentage	Disagreed	Percentage	Total No. of respondents
Primary	30	20	10	20	40
Secondary	45	30	10	20	55
Post secondary	60	40	5	10	65
Others	15	10	25	50	40
Total	150	100	50	100	200

Table 10: Income of respondents within the study area

Average monthly income	No. of respondents	Percentage
Less than N5,000	40	20
6,000 – 10,000	30	15
11,000 – 16,000	50	25
18,000 – 23,000	30	15
25,000 – 29,000	30	15
30,000 and above	20	10
Total	200	100

Source: Field survey, 2013

From the data collected it is observed that 20% earn from N5,000 and less monthly. There are petty traders and mostly fishermen while 15% are artisans and casual labourers earn between 6,000 – 10,000 while about 30% of the residents earn between 18,000 – 23,000. The remaining 10% earn N30,000 and above this hereby shows that a very good percentage of the population have the ability to contribute to the EPM approach.

Table 11: Test for willingness to contribute resource

Resources	Percentage	Frequency
Technical know how/ skill labour	30	60
Unskilled labour	20	40
Time	25	50
Finds	15	30
Equipments (materials)	10	20
Total	100	200

Source: Field Survey 2013

This shows that 75% i.e. 150 respondents are willing to participate in the programme while 50 respondents i.e. 25% disagree. Thereby given the opportunity the residents of the study area are willing to contribute or plug and development of their environment.

SUMMARY OF FINDINGS

- The level of damage from oil exploration, gas activities, pollution and pipeline vandalizations is chronic and cumulative, which has resulted to the degradation of the environment.
- The routine of facilities and compliancy to environmental management approaches are not regular
- Facilities and equipment were found be grossly inadequate therefore proper inspection can not be well carried out.
- 85% of the respondents showed dissatisfaction with the existing environment approach, this can be attributed to the inability of fully implementing the environmental approach.
- 75% of the respondents indicated that given the opportunity they are willing to participate in evolving an effective environmental management approach.

PROPOSALS FOR ENVIRONMENTAL PLANNING AND MANAGEMENT FOR BONNY ISLAND

From the inferences it was observed that existing environmental management approach in practice has no inbuilt mechanism and proper procedure for actors involvement/participation, therefore the following has been recommended.

a. There is a need to raise public awareness on the importance of their participation in the physical planning and development of their environment. This can be enhanced through media campaigns and necessary legislation.
b. The need for the residents to be educated and empowered to detect, report and monitor oil spills, resource degradation and participation in clean up restoration.
c. There is need to foster partnership and collaboration between RSEPA (Rivers State Environmental Authority) and the residents in evolving an environmental management strategy, through this medium the residents will stop looking at oil spills as a commercial asset and make them realize that the spills create long term damage to the environment.
d. Ministries responsible for the environment should be empowered with adequate funds and means to supervise the industries involved.
e. No new oil license should be issued until companies have rectify and clean up current problems.

PROPOSED EPM STRATEGY FOR ENVIRONMENTAL DEGRADATION IN BONNY ISLAND

The application of the EPM strategy will formulate a realistic and implementable strategies for environmental degradation in Bonny.

PHASE I

a. This phase includes the preparation environmental management profile for the study area. This profile will document necessary information or data and preparation of detailed and intimate short, medium or long term environmental action plan report.
b. Sensitizing and mobilizing stakeholders in environmental management. There residents within the study area who have legitimate interest (state, local government and the general public) will be identified and effectively sensitized about their roles and mobilization through brief sessions, formal and informal meetings.

PHASE II

a. This phase involves the establishment of working groups, where the working groups would be seen as platforms for negotiating environmental issues and suggestions and agreements will be translated into actions.
b. Goal formulation process

The working group will be responsible for goal formulation in environmental management approach. The goal denotes what environmental planning is out to achieve in particular. The working group will have a fairly simple and immediate solution and develop demonstration projects, which will spark people's interest in the process.

PHASE III

This is the final phase of the process. Environmental planning and management strategy /action plan formulated and endorsed by the working groups will be implemented. These strategies will be initiated, institutional improvements solidified, procedures for monitoring and evaluating results will be put in place. The key results are

a. Implementation of action plans with goals to be achieved

b. Setting targets and activities to be carried out to achieve these targets

c. Creating awareness and mobilization from determining a benchmark

d. Estimating capital cost of project and maintenance after completion

e. Identifying sources of finance and agreement on cost recovery.

PROPOSED FRAMEWORK FOR ENVIRONMENTAL PLANNING AND MANAGEMENT

The framework which best fits the conditions above is the bottom up multilevel circular approach. This will include decision making, embrace participation, clarity and agreement on environmental planning issue to be tackled, giving emphasis to resources mobilization and building of consensus and participation. It will also allow for endorsement and support of interest groups, which forms the central mechanism of action.

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Qualité de l'information comptable et coût de capital : cas des entreprises tunisiennes

[The quality of Accounting information and the cost of capital: The case of Tunisian companies]

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ABSTRACT: This study explores the relationship between the cost of capital and the quality of accounting information for a sample of Tunisian firms listed on the stock exchange of Tunis. We chose the determinants of the cost of capital according to previous literature. Our results show the existence of a negative association between the cost of capital and the quality of accounting information. Note also that the cost of capital depends positively on the debt, the return on equity, and volatility. The results of the study provide an important contribution to the understanding of the complex relationship between accounting information quality of Tunisian firms and the cost of capital.

KEYWORDS: Cost of capital, accounting Information quality, Cost of capital determinants, debt, return on equity, volatility.

RESUME: Cette étude explore la relation entre le coût de capital et la qualité de l'information comptable pour un échantillon d'entreprises tunisiennes sur la période qui s'étale entre 2008-2012. En s'inspirant des travaux des précurseurs nous avons choisi les déterminants du coût de capital. Nos résultats montrent l'existence d'une association négative entre le coût de capital et la qualité de l'information comptable. Notons encore que le coût de capital dépend positivement de l'endettement, de la rentabilité des fonds propres, et de la volatilité. Les résultats de notre étude présentent une importante contribution à la littérature comptable en expliquant le lien entre la qualité de l'information comptable et le coût de capital pour un échantillon d'entreprises tunisiennes.

MOTS-CLEFS: Coût de capital, Qualité de l'information comptable, Déterminants du coût de capital, endettement, rentabilité des fonds propres, volatilité.

1 INTRODUCTION

Il y a un consensus entre les chercheurs sur l'importance de la qualité de l'information comptable. Une réduction de l'asymétrie d'information aurait des répercussions favorables sur la bonne allocation des ressources au niveau de l'économie et sur la croissance des marchés financiers. Elle serait de même à l'origine d'un niveau élevé de la liquidité des titres et d'une réduction du coût de capital. Une asymétrie d'information amoindrie pourrait aussi générer des rendements moins volatiles, et engendrer plus de précision au niveau des prévisions des analystes [1].

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La Tunisie est un pays africain faisant parti de la région MENA. La bourse des valeurs mobilière de Tunisie est composée de 57 entreprises cotées dont 25 entreprises financières. Le marché financier tunisien est caractérisé par une faible protection des investisseurs et par une structure de propriété concentrée. Notons aussi que l'information comptable est peu réglementée. En plus la majorité des entreprises tunisiennes ne fournissent pas des états financiers en normes IFRS.

Malgré la faible réglementation, certaines lois ont été établies en vue de fournir des informations comptables de qualité. D'abord, le code des sociétés commerciales oblige les entreprises à fournir des informations détaillées et cela au niveau de l'article 201. Ensuite le conseil du marché financier oblige les entreprises faisant appel publique à la l'épargne à fournir un ensemble d'informations obligatoirement et cela depuis 2010 et il encourage ces entreprises à divulguer volontairement des informations comptables. Le coût de capital est le taux de rendement minimum exigé par les investisseurs. Ce coût joue un rôle fondamental dans le financement des entreprises Tunisiennes. La réduction du coût de capital est le souci de plusieurs entreprises. Plusieurs recherches ont étudié la relation entre le coût de capital et la qualité de l'information comptable [2], [3], [4], [5]. En l'occurrence ces recherches trouvent que l'information comptable de bonne qualité réduit le coût de capital. En effet, il existe une association négative entre le coût de capital et la qualité de l'information comptable [2]. Ils trouvent que la qualité des accruals comme un attribut de la qualité de l'information comptable a l'effet le plus important sur le coût de capital parmi bien d'autres attributs comme la persistance de l'information comptable, la prédictibilité de l'information comptable, le lissage de l'information comptable, le contenu informationnel des données comptables, l'actualité de l'information comptable, et le conservatisme de l'information comptable. La qualité de l'information comptable réduit le coût de capital en aidant les investisseurs à prendre des bonnes décisions d'investissements [3].

Il existe une relation entre le coût de capital et la qualité de l'information comptable [5]. Ce qu'ils ont trouvé comme résultat montre que la qualité de l'information comptable affecte le coût de capital à travers son effet sur les coûts liés à l'asymétrie d'information. La relation négative entre la transparence comptable et le coût de capital trouvée dans l'étude de [4] est plus significative comparée aux études précédentes. L'on essayera de proposer un modèle mettant en évidence la relation entre le coût de capital et la qualité de l'information comptable. Ce travail portera sur un échantillon de 26 entreprises tunisiennes cotées à la BVMT pendant la période de 2008 à 2012. Plusieurs terminologies ont été attribuées à la qualité de l'information comptable. Cependant au niveau de la littérature, on utilise la qualité des résultats, la qualité comptable, et la qualité de l'information comptable ainsi que la qualité de l'information financière. Par souci de simplification, nous avons utilisé l'expression « qualité de l'information comptable » comme synonymes des précédentes.

Au début, de ce travail, l'on discutera l'importance de la qualité de l'information comptable et l'évolution rapide des recherches à ce sujet.

La suite de cet article est agencée comme suit: la deuxième section traite de la revue de la littérature quant à la relation entre le coût de capital et la qualité de l'information comptable.

La troisième section décrit les données utilisées ainsi que la méthodologie. La quatrième section interprète et analyse les résultats empiriques. Enfin, la conclusion fera l'objet de la cinquième section.

2 REVUE DE LITTÉRATURE

2.1 IMPORTANCE DE LA QUALITE DE L'INFORMATION COMPTABLE

L'on trouve une revue détaillée des différentes recherches sur la qualité de l'information comptable au niveau de l'étude de [6]. Leur revue couvre 350 études sur plusieurs années. Cette étude fait la critique des différents proxys de la qualité de l'information comptable. Leur approche est très intéressante et a permis de bien comprendre les différents attributs de l'information comptable.

L'une des causes de l'évolution des recherches sur la qualité de l'information comptable est la gestion du résultat comptable et les différents scandales financiers qui ont semé le doute sur la qualité des états financiers. Les dirigeants cherchent à atteindre des résultats proches des attentes des investisseurs. L'augmentation des scandales financiers a abouti à l'instauration de la loi sarbane-oxley.

Une autre cause de l'évolution des recherches sur la qualité de l'information comptable est l'apparition du modèle de calcul des Accruals de [7]. Ce modèle est d'une grande utilité et il a été considéré par la littérature comme la mesure la plus appropriée de la qualité des Accruals. [6] ont aussi soutenu le travail de [7]. Récemment l'évolution du référentiel comptable international, IASB, a été aussi un catalyseur de l'évolution des recherches sur la qualité de l'information comptable.

Ceci nous permet de dire que la mise en œuvre d'un ensemble de recherche qui donne de l'importance à la qualité de l'information comptable a été a l'origine de la montée des recherches dans ce domaine

Notons de même que l'évolution des recherches sur la qualité de l'information comptable est due à l'introduction des bases de données qui permettent de saisir l'opportunité d'effectuer des recherches sur plusieurs échantillons et de procéder à des comparaisons à travers plusieurs pays à la fois tout en réduisant les coûts liés à la collecte des données

Les mesures de la qualité des Accruals se sont toutes inspirées du modèle de [7] tout en y apportant des modifications. Les critiques à ce modèle ont été guidées par [8], [9], [10], [11].

C'est la raison pour laquelle l'on dispose d'une variété de mesures de la qualité de l'information comptable et par conséquent on peut choisir parmi elle. Ces mesures ont été développées afin de mesurer la gestion de résultat pour devenir in fine une façon de mesurer la qualité de l'information comptable.

[12] annonce que l'évolution des recherches scientifiques sur la qualité de l'information comptable est due au nombre de proxy proposés.

Les recherches sur la gouvernance d'entreprise donnent aussi de l'importance à la qualité de l'information comptable. Nombreuses sont les études qui ont mis l'accent sur l'association entre les facteurs de gouvernance et la qualité de l'information comptable. Ces résultats trouvent souvent que les facteurs de gouvernance liés à la qualité de l'audit, la qualité du contrôle interne et la qualité du reporting financier sont en association avec la qualité de l'information [13], [14].

Les normalisateurs donnent de plus en plus d'importance aux recherches sur la qualité de l'information comptable. Ils citent dans leurs références des travaux sur la qualité de l'information comptable [15], [16].De même le rapport sarbane-oxley cite plusieurs recherches académiques comme références.

La recherche sur la qualité de l'information comptable rencontre plusieurs défis surtout au niveau de la mesure de la qualité des Accruals. Ces lacunes au niveau de la mesure de la qualité de l'information comptable auraient un effet sur les hypothèses des recherches et sur les questions de recherches qui y sont liées.

2.2 LA RELATION ENTRE LE COUT DE CAPITAL ET LA QUALITE DE L'INFORMATION COMPTABLE

La plupart des travaux s'accordent sur la présence d'une relation négative entre le coût de capital et la qualité de l'information comptable. Au niveau de la littérature, la qualité de l'information comptable joue un rôle important dans la détermination du niveau du coût de capital [17], [18], [19], [20], [2], [21], [22]. Les entreprises qui divulguent davantage d'informations auront un coût de capital faible. Par exemple [17] trouve que les entreprises qui pratiquent une politique de divulgation transparente envisagent une réduction de leur coût de capital de l'ordre de 9.7%.

[17] a utilisé l'instrument de [23] pour mesurer l'asymétrie d'information comptable. Au niveau de la littérature [3], [24], [25] et [26] ont étudié la relation entre le coût de capital et l'asymétrie d'information comptable mais les résultats trouvés sont mitigés. [25] et [26] par exemple dans leur étude ont trouvé que l'augmentation du nombre d'investisseurs informés réduit le coût de capital.

[25] trouvent que des valeurs élevés des actions réduit le coût de capital. [27] développent un modèle dans un marché ou la compétition n'est pas parfaite et dans lequel les investisseurs sont différemment informés. Ils trouvent que la publication d'information afin de réduire l'asymétrie d'information entre investisseurs peut aboutir à l'augmentation de la liquidité des titres et à réduire le coût de capital. Cette étude s'est basée sur des données ayant trait au marché et sur des prévisions de résultat par des analystes. [28], [29] annoncent que lorsque les dirigeants ont accès à l'information plus que les investisseurs, l'entreprise peut réduire son coût de capital et ce en réduisant le risque liée à l'information a travers la divulgation de cette information.

Selon le modèle [3], la qualité de l'information comptable réduit le coût de capital en aidant les investisseurs à prendre des décisions d'investissement. Le coût de capital joue un rôle fondamental dans le financement des entreprises. [3] montrent que l'asymétrie d'information comptable entre les investisseurs n'a pas d'effet sur le coût de capital. Selon leurs modèles, La qualité de l'information comptable réduit le coût de capital à travers une meilleure prise de décision. Ils étudient l'effet de l'information privée et de l'information publique sur le coût de capital.

[30] cherchent à comprendre l'effet de l'information comptable sur le coût de capital. Ils utilisent le MEDAF pour le calcul du coût de capital. Les résultats trouvés montrent une association entre le coût de capital et la qualité de l'information comptable. Une norme comptable de qualité réduit le coût de capital. C'est le rôle des normalisateurs comptables de garantir la qualité de l'information comptable. La publication davantage d'information aboutit à plus de confiance de la part des investisseurs. [30] rajoutent que le coût de capital est le rendement escompté des actions d'une entreprise.

Pour [31] l'entreprise crée de la valeur quand il y a réduction du coût de capital. La réduction des coûts de financement est le principal intérêt des entreprises.

[2] trouvent une association négative entre le coût de capital et la qualité de l'information comptable. Il trouvent que la qualité des accruals est l'attribut qui a l'effet le plus marquant sur le coût de capital entre plusieurs autres attributs comme la persistance de l'information comptable, la prédictibilité de l'information comptable, le lissage de l'information comptable, le contenu informationnel des données comptable, l'actualité/ponctualité de l'information comptable, et le conservatisme de l'information comptable, il trouve aussi que la variabilité de l'information comptable a le même effet sur le coût de capital que la qualité des Accruals.

[2] choisissent le résultat comptable car il représente la première source d'information comptable, ce constat a été soutenu par de nombreuses recherches [32], [33], [2] Ces études montrent que les investisseurs font appel souvent au résultat comptable plus qu'a d'autres mesures de la performance tel que les dividendes ou les cash flow, etc pour approximer l'information comptable.

[13] valorisent le rôle des rapports de performance (information comptable) dans l'alignement des intérêts des investisseurs avec ceux de l'entreprise tout en respectant les schémas d'investissement de l'entreprise.

Une information comptable de mauvaise qualité affaiblit la coordination entre les investisseurs et l'entreprise. Cela crée un risque lié à l'information.

[3] affirment que le risque lié à l'information comptable envisagé par les investisseurs non informé n'est pas diversifiable et peut être évalué.

En effet, les rendements escomptés dépendent du risque liée à l'information comptable qui est en relation avec l'ampleur des informations privées, et de la qualité des informations privées et publiques disponibles. Cela aboutit à la demande de rendements élevés par les investisseurs.

Des attributs de résultat comptable de bonne qualité sont désirables vu qu'ils réduisent le risque lié à l'information comptable et cela aboutit à la réduction du coût de capital.

De mauvaises valeurs des attributs de l'information comptable aboutissent à des valeurs élevées du coût de capital. L'étude de la relation entre le coût de capital et les attributs de l'information comptable est très intéressante. Elle nous permet de connaitre quel est l'attribut le plus intéressant pour les investisseurs.

[21] s'intéressent au score de divulgation en se basant sur la quantité d'information au niveau des rapports annuel. [5] examinent la relation entre le niveau du coût de capital par pays et la transparence de l'information comptable.

L'étude de [2] examine l'effet de sept attributs de l'information comptable sur le risque lié à l'information.

Le risque lié à l'information dérive de l'imprécision au niveau des estimations qui y sont le fruit des informations disponibles auprès des investisseurs [3].

Le risque lié à l'information comptable est dû aussi au manque de coordination entre les dirigeants et les investisseurs. Notons par ailleurs que les décisions d'investissement prises par l'entreprise doivent être respectées [34]. [2] ont étudié les attributs de l'information comptable qui sont plus liés au marché et ce parce qu'ils réduisent le coût de capital mieux que les attributs basés sur la comptabilité. Les variables de contrôle utilisées au niveau de l'étude de [35] sont le Beta, Book to market, et la taille de l'entreprise.

Pour tester l'effet des attributs de l'information comptable sur le coût de capital, [2] classent les attributs par années (1 à 10) par décile. Les auteurs estiment l'équation de régression pour chacune des 27 années de l'échantillon. Les résultats de la régression utilisent les variables de contrôles suivantes (bêta, taille, et book to market).

Les variables indépendantes ajoutées au modèle sont le log d'actifs pour mesurer la taille, la variabilité des cash flows, la variabilité des ventes, le cycle d'exploitation, l'intensité de l'investissement en intangible, l'intensité du capital.

Les ensembles d'attributs basés sur le marché et ceux basés sur la comptabilité contribuent de façon significative au coût de capital.

En particulier, les attributs basés sur le marché sont les plus significatifs. Leurs pouvoir explicatif est de l'ordre de 2% à 3%. Le pouvoir explicatif supplémentaire fourni par l'attribut basé sur le marché est de 0.7%.

L'étude de [2] trouve une relation significative entre les attributs de l'information comptable et le coût de capital. Cela n'est pas valable pour les attributs de la prédictibilité de l'information comptable et du conservatisme.

Parmi les sept attributs de l'information comptable, ce sont les variables indépendantes, les variables de contrôles, et les attributs de l'information comptable basés sur la comptabilité qui expliquent le mieux le coût de capital.

Étudiés séparément, la qualité des accruals, la persistance de l'information comptable et le lissage de l'information comptable ont un effet sur le coût de capital, comme c'est le cas pour l'attribut basé sur le marché à savoir la pertinence de l'information comptable. Parmi les sept attributs déjà cités, la qualité des accruals a l'effet le plus important sur le coût de capital. Ni le conservatisme ni la pertinence de l'information comptable n'ont un effet important sur le coût de capital et c'est pour cette raison que les normalisateurs doivent donner de l'importance à d'autres attributs de l'information comptable.

[2] proposent que l'étude de la relation entre les attributs de l'information basés sur la comptabilité et les décisions d'allocution de capital est une nouvelle voie de recherche intéressante.

Ces auteurs trouvent une association négative entre le coût de capital et la qualité de l'information comptable. Il trouvent aussi que la qualité des accruals est l'attribut qui a l'effet le plus marquant sur le coût de capital entre plusieurs autres attributs comme la persistance de l'information comptale, la prédictibilité de l'information comptable, le lissage de l'information comptable, le contenu informationnel des données comptables, l'actualité/ponctualité de l'information comptable, et le conservatisme de l'information comptable, ils trouvent aussi que la variabilité de l'information comptable a le même effet sur le coût de capital que la qualité des Accruals,

Le coût de capital est un concept important qui représente les décisions d'allocation de capital par les investisseurs. Les composantes du risque sont le risque systématique et le risque non systématique.

[21] trouvent que la valeur absolue des Accruals anormaux trouvée à partir du modèle de [7] a le même effet que la qualité des Accruals. L'augmentation du coût de capital est liée à un niveau élevé d'asymétrie d'information et d'incertitude. Les auteurs annoncent que le comportement des investisseurs reflète leurs prises de conscience de l'importance de la qualité des accruals. En outre, la qualité des accruals est un facteur important dans l'explication des rendements excédentaires quand on l'ajoute à la régression du modèle à trois facteurs et au modèle à un facteur.

Leurs résultats sont valables pour les titres (obligations et actions), les procédures d'estimation (régressions groupées et régressions annuelles), la spécification variable (brute et en décile), la conception de la recherche (coupe transversale, par rapport à l'évolution dans le temps), et le proxy de la qualité des accruals (écart type des résidus du modèle de type [36] et des valeurs absolues des accruals anormaux). De même ces résultats sont robustes après l'inclusion de variables de contrôle ayant un effet sur les coûts de capital.

Notons encore que de nombreux dirigeants utilisent les accruals discrétionnaires pour améliorer leurs systèmes de reporting financiers et pour réduire l'incertitude entre les investisseurs. Des recherches antérieures sur la gestion de résultat ont fourni une documentation relative à la manière avec laquelle les dirigeants, dans certaines périodes, font des choix comptables et prennent des décisions qui permettent de réduire la qualité des accruals (augmentation de l'incertitude entre les investisseurs).

Le travail élaboré par [21] ne s'engage pas à étudier les raisons qui poussent les dirigeants à gérer les résultats. Par exemple les dirigeants rémunérés par des options sont incités à augmenter la volatilité durant la période de vente afin de maximiser leurs profits. Le coût de capital peut être considéré comme un indicateur de la volatilité des rendements. L'existence d'une stock-option incite les dirigeants à prendre des mesures qui augmentent le coût de capital, même si ces augmentations génèrent des coûts à l'encontre de l'entreprise. Soulignons aussi le fait que la qualité des accruals a l'effet le plus important sur le coût de capital alors que l'effet des autres variables mentionnées dans la littérature est beaucoup plus moindre.

[22], stipulent que la relation négative entre la divulgation de l'information comptable et le coût de capital est conditionnée par la qualité de l'information comptable. Des résultats similaires sont trouvés si l'on prend d'autres proxys de la qualité de l'information comptable et du coût de capital. Les auteurs trouvent que la qualité des accruals est le proxy de la qualité de l'information qui a l'association la plus importante avec le coût de capital (une faible qualité de l'information comptable aboutit à une augmentation du coût de capital)

[3] examinent la relation entre l'asymétrie d'information entre investisseurs et le coût de capital et trouvent que l'augmentation de l'asymétrie d'information aboutît à la réduction du coût de capital. [5] examinent la relation entre le coût de capital et la qualité de l'information comptable. Ce qu'ils ont trouvé comme résultat montre que la qualité de l'information comptable affecte le coût de capital à travers son effet sur les coûts liés à l'asymétrie d'information. [4] étudient l'effet de la transparence comptable sur le coût de capital. Les résultats qu'ils ont obtenus indiquent que

l'augmentation de la transparence comptable et comptable réduit le coût de capital. La relation négative trouvée dans cette étude est plus significative comparée aux études précédentes.

[37] étudient l'impact des conditions macro-économiques et des cycles de l'entreprise sur le coût de capital et sur la qualité des Accruals. Leurs résultats montrent que les entreprises ayant un faible niveau des Accruals sont d'une condition économique défavorable ce qui rend le coût de capital plus élevé. Le besoin en financements supplémentaires pousse les entreprises à améliorer la qualité de l'information comptable en vue de bénéficier d'un faible coût de capital.

Dans leur étude [38] examinent la relation entre le coût de capital et la qualité de l'information comptable des entreprises cotées à la bourse d'Australie. Ils ont mesuré l'asymétrie d'information en utilisant le bid-ask-spread. Les variables de contrôle utilisées sont la taille de l'entreprise, le book to market, et la dispersion au niveau des prévisions des analystes.

L'étude de [38] estime le coût de capital en se référant à des données du marché et des prévisions des analystes (ex ante). Le modèle à trois facteurs de [35] est utilisé au niveau de la littérature afin d'estimer la valeur du coût de capital. [38] expliquent les difficultés envisagées au niveau de l'estimation du coût de capital par leur méthode à trois facteurs, et montrent que cet estimateur est imprécis au niveau des entreprises appartenant à des secteurs différents. De même le MEDAF comme instrument de mesure du coût de capital a été largement critiqué vu qu'il se base sur l'hypothèse que les investisseurs sont de mêmes avis. Au niveau de l'étude de [38] le premier proxy du coût de capital utilisé est celui de [39], la mesure du coût de capital selon cette approche rencontre des difficultés au niveau de la collecte des données. Le deuxième proxy utilisé dans cette étude est celui de [40]. Alors que le troisième proxy utilisé est celui de [42].

[38] trouvent que le coût de capital augmente à la suite d'une variation au niveau des prévisions des analystes et que ce coût augmente aussi suite à l'augmentation de l'asymétrie d'information. Conséquemment à ces travaux de recherches nous pouvons nous attendre à avoir une relation négative entre la qualité de l'information comptable et le coût de capital.

Ainsi, l'on prévoit dans notre étude que plus les entreprises ont une information comptable de qualité, plus leurs coûts de capital seraient faibles. D'où on se propose qu' :

H : il existe une association négative entre la qualité de l'information comptable fournie par les entreprises tunisiennes cotées et leurs coûts de capital.

3 LA PRESENTATION DE L'ECHANTILLON, DU MODELE ET L'ANALYSE DES RESULTATS

3.1 L'ÉCHANTILLON

Conformément à la revue de la littérature empirique et théorique, les données sur lesquelles notre étude empirique s'est basée ont été collectées à partir des états financiers publiés aux bulletins officiels, des prospectus d'émission et à partir des rapports annuels d'activités des entreprises sélectionnées. Ces rapports sont disponibles dans le site de la bourse des valeurs mobilières et le site du conseil du marché financier tunisien. Les données boursières ont été téléchargées du site de la bourse de valeurs mobilières de Tunis.

L'échantillon de départ a comporté 59 entreprises mais à la suite de quelques travaux de sélection nous n'avons gardé que 26 entreprises. D'abord, nous avons éliminé les entreprises financières puisque ces entreprises ont des informations divulguées très spécifiques, réglementées et contrôlées par la banque centrale. Il a fallu éliminer aussi de l'échantillon les entreprises dont les rapports annuels n'étaient pas disponibles sur Internet. Les entreprises, pour lesquelles certains rapports ou données manquaient ou qui ne clôturent pas leurs comptes au 31 décembre, ont été aussi éliminées de l'échantillon. Nous disposons alors 130 observations représentant 26 entreprises sur la période 2008-2012.

3.2 PRÉSENTATION DU MODÈLE

Puisque nous avons deux mesures de la qualité de l'information comptable à savoir les valeurs absolues des accruals discrétionnaires estimées selon le modèle de [7] et [8], nous aurons dans ce cas deux équations à estimer :

Equation1:

$$COC_{i,t} = \beta_0 + \beta_1 |ACD1|_{i,t} + \beta_2 TAILLE_{i,t} + \beta_3 END_{i,t} + \beta_4 RENT_{i,t} + \beta_5 MB_{i,t} + \beta_6 Vol_{i,t} + \varepsilon_{i,t}$$

Equation2:

$$COC_{i,t} = \beta_0 + \beta_1 |ACD2|_{i,t} + \beta_2 TAILLE_{i,t} + \beta_3 END_{i,t} + \beta_4 RENT_{i,t} + \beta_5 MB_{i,t} + \beta_6 Vol_{i,t} + \varepsilon_{i,t}$$

Avec $|ACD1|$ et $|ACD2|$ les valeurs absloues des accruals discrétionnaires approximées respectivement selon les modèles de [7] et de [8].

$\boldsymbol{COC_{i,t}}$: Le coût de capital de la firme i à l'instant t.

$\boldsymbol{QR_{i,t}}$: Qualité de l'information comptable de la firme i à l'instant t.

$\boldsymbol{TAILLE_{i,t}}$: Taille de la firme i à l'instant t.

$\boldsymbol{END_{i,t}}$: Le ratio d'endettement de la firme i à l'instant t.

$\boldsymbol{RENT_{i,t}}$: La rentabilité de la firme i à l'instant t.

$\boldsymbol{MB_{i,t}}$: Le ratio valeur marchande/valeur comptable (market to book)de la firme i à l'instant t.

$\boldsymbol{Vol_{i,t}}$: La volatilité du titre i pour l'année t.

Les β_i sont les coefficients relatifs aux variables renseignant sur la qualité de l'information comptable et les variables de contrôle.

Tableau 1- La définition des variables :

Variables	Définition	Signe attendu
$\boldsymbol{COC_{i,t}}$	Est mesuré par le modèle d'évaluation des actifs financiers (MEDAF)	
$\boldsymbol{QR_{i,t}}$	Est mesuré par le modèle de [7] et [8]	(-)
$\boldsymbol{TAILLE_{i,t}}$	le logarithme naturel de total des actifs	(-)
$\boldsymbol{END_{i,t}}$	le rapport entre les dettes à long terme (passif non courant) et les capitaux propres.	(+)
$\boldsymbol{RENT_{i,t}}$	Le ratio ROE est mesuré par le rapport entre le bénéfice net et les capitaux propres.	(+)
$\boldsymbol{MB_{i,t}}$	Le Market to Book est mesuré par le rapport entre la valeur marchande et la valeur comptable.	(+)
$\boldsymbol{Vol_{i,t}}$	Le coefficient bêta est mesuré en se basant sur la relation entre le rendement du titre et celui du marché.	(+)

4 ANALYSE ET INTERPRÉTATION DES RÉSULTATS

L'application des modèles de régressions multiples exige l'absence de multicolinéarité entre les variables indépendantes (exogènes). Ce problème conduit à de mauvaises estimations des coefficients αi. Un problème de multicolinéarité bivariée se pose lorsque deux variables indépendantes sont fortement corrélées. Le tableau 2 présente les coefficients de corrélations de Pearson des différentes variables exogènes figurant dans notre modèle.

Tableau 2- La matrice de corrélation de Pearson

	TAILLE	MB	ROE	ROA	END	Vol	ACD1	ACD2
TAILLE	1.0000							
MB	-0.3426***	1.0000						
ROE	0.2229**	0.4501***	1.0000					
ROA	0.2437***	0.3930***	0.7101***	1.0000				
END	-0.0133	0.1432	-0.1097	-0.2142**	1.0000			
Vol	0.0923	-0.0576	-0.1046	-0.1485*	-0.1986**	1.0000		
ACD1	-0.0244	0.0773	-0.2467***	-0.1186	-0.0457	0.1159	1.0000	
ACD2	-0.0166	0.0719	-0.2522***	-0.1193	-0.0514	0.1155	0.9922***	1.0000

*(***), (**) et (*) significativité respectivement à un seuil de 1%, 5% et 10%*

Ce tableau rend compte de la matrice de corrélation de toutes les variables. L'analyse démontre que les mesures de la qualité de l'information comptable sont corrélées significativement et positivement au seuil de 1% (0.9922). Cela nous incite à utiliser qu'une seule mesure au niveau de l'équation de régression. De même, pour le ROE et le ROA où le niveau de corrélation est significatif de l'ordre de 1%. Cela nous pousse à choisir parmi ces deux variables. Autrement dit, l'on doit

utiliser une seule variable au niveau de la régression. Pour les autres variables les corrélations ne sont pas aussi fortes. Ces corrélations indiquent un niveau de multi colinéarité acceptable. L'application de la méthode de données de panel démontre la présence d'un problème d'homogénéité des données. Ce résultat est indiqué par le test de Fisher que soit par la première équation comme par la seconde. Par conséquent, il est impossible d'utiliser cette méthode. La solution consiste à appliquer la méthode de moindre carrée ordinaire.

Tableau -3 Résultat d'estimation de la relation entre le coût de capital et la qualité de l'information comptable.

Variables	Equation 1	Equation 2
Acd1	.0935341***	
	(2.81)	
Acd2		.092231***
		(2.91)
Taille	-.0011489	-.0012527
	(-0.32)	(-0.35)
END	.0224514*	.0228237*
	(1.71)	(1.75)
ROE	.0562381***	.0572504***
	(2.60)	(2.65)
MB	.0004012	.0003881
	(0.25)	(0.24)
Vol	.0131926*	.0132187*
	(1.90)	(1.91)
Cste	-.0027911	-.0011068
	(-0.04)	(-0.02)
R2	0.1353	0.1390
Fisher	3.21	3.31

(***), (**) et (*) significativité respectivement à un seuil de 1%, 5% et 10%. Les valeurs entre parenthèse désignent le t - student

D'après les résultats de la régression multiple, la qualité de l'information comptable, le ratio d'endettement, le ROE et la volatilité sont les facteurs explicatifs et significatifs du coût de capital. Seulement, la variable taille et celle de market to book ne sont pas significatives.

Les résultats démontrent la présence d'une relation positive significative entre la valeur absolue des accruals discrétionnaires et le coût de capital des entreprises tunisiennes cotées. Les accruals discrétionnaires sont des indicateurs d'une information de qualité faible [2], [28]. On peut alors en déduire une relation négative entre le coût de capital et la qualité de l'information comptable. Ainsi la qualité de l'information comptable atténue le problème d'asymétrie d'information et réduit ainsi le coût de capital. Aussi, les investisseurs et les prêteurs donnent-t- ils de l'importance à l'information fournie par les entreprises. Les investisseurs peuvent mieux évaluer ces entreprises. Les prêteurs eux aussi estiment mieux le risque de défaillance des entreprises. Ce résultat est conforme aux conclusions de [27], [43], [6].

[27] montrent aussi comment le risque d'information plus élevé peut augmenter le coût de capital à travers le risque de liquidité. [43] soutiennent que l'effet sur le coût de capital est principalement dû à l'asymétrie dans la distribution de l'information auprès des investisseurs. La plupart de ces études utilisent la qualité des résultats comme un indicateur de l'incertitude de l'information, où la qualité de bénéfice faible est une mesure de grande incertitude de l'information, et vice versa. [2] constatent que plusieurs proxies de qualité de l'information comptable sont statistiquement associées à un coût de capital, ce qui indique que la qualité des résultats est perçue comme un facteur de risque par les investisseurs. Des conclusions similaires sont fournies par [44]. De ce fait, l'hypothèse relative à la qualité de l'information comptable a été validée avec un seuil de significativité de 1%.

Quant à la relation entre le coût de capital et la rentabilité (ROE), notons qu'elle est positive et significative à un seuil de 1%. Une augmentation de la rentabilité des fonds propres est associée à une augmentation du coûts de ces fonds. En effet, les investisseurs demandent un ajustement proportionnel des rémunérations suite à l'augmentation de la rentabilité des fonds propres. Cette relation significative et positive est valable pour le modèle de calcul des accruals(Jones et jones modifié). Ces résultats sont conformes à l'étude de [43], [2], [35].

Les résultats démontrent aussi la présence d'une association positive et significative à un seuil de 10% entre le coût de capital et l'endettement. Cela signifie que les entreprises ayant un niveau d'endettement élevé ont un coût de capital plus élevé. Cette relation entre le coût de capital et l'endettement est expliquée par la qualité de l'information comptable. En effet les entreprises trop endettées fournissent des informations comptables et financières de mauvaise qualité afin de cacher leur niveau d'endettement élevé. Le coût de capital est une fonction croissante du montant de la dette, parce que la dette augmente la volatilité des bénéfices futurs [45]. Plusieurs travaux empiriques comme ceux de [46], [20], [19], [45] et [47] ont confirmé la relation positive.

Enfin, nos résultats montrent que la volatilité a un impact positif sur le coût de capital. Cette relation est significative à un seuil de 10%. En effet la volatilité des cours augmente le risque qu'envisage l'investisseur. Ce dernier demandera une prime plus importante pour faire face au risque, et cela augmente, par conséquent, le coût de capital. Ce résultat est suggéré par le modèle d'évaluation des actifs financiers (MEDAF). Il est similaire à celui de [48], [2], [35] et diffère de celui de [20] et [46].

Concernant les variables taille, et market to book, aucune relation significative avec le coût de capital n'a été trouvée.

5 CONCLUSION

Plusieurs chercheurs ont focalisé l'intérêt sur la relation entre le coût de capital et la qualité de l'information comptable. Ces études montrent l'importance de cette relation pour les entreprises et leurs différentes parties prenantes.

Notre modèle présente la relation entre le coût de capital et la qualité de l'information comptable pour un échantillon d'entreprise tunisienne cotée à la BVMT. Les résultats obtenus démontrent qu'il y a une relation négative et significative entre le coût de capital et la qualité de l'information comptable. Au niveau de notre étude, le coût de capital a été mesuré par le MEDAF. La qualité de l'information comptable est approximée par la qualité des accruals selon le modèle de [7] et [8]. Nos résultats sont conformes à ceux de [4], [48], [5], [39].

En intégrant des variables de contrôle, on a remarqué que le rendement des capitaux propres, la volatilité et l'endettement ont un effet significatif sur le coût de capital.

En effet, une information de bonne qualité réduit l'asymétrie d'information entre l'entreprise et ses différentes parties prenantes. Cela réduit le risque lié à l'information, la volatilité des cours et rétablit la confiance des investisseurs.

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Loss of ignition as a proxy indicator for assessing the lithological composition of the recent sediments accumulated in some freshwater lakes from the Danube Delta, Romania

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ABSTRACT: The paper asserts the percent horizontal and vertical distribution of the main lithological components (the total organic matter, total carbonates and minerogenic clastic fraction) in the grab surface layer and core sediment samples of some fluvial - Danubian lakes. The study is corroborated on the analysis of 144 grab sampling stations and 6 Hydro-Bios sediment cores collected during 2010-2013. Evaluations of the above mentioned parameters considered in surface sediments, and in samples from distinct cores have been defined by *Loss on Ignition* (LOI) method. By using the total organic matter concentration results in the grab sediment, as a proxy, it was tried to be pursued the source of the organic matter input into the lakes during the recent period. Evaluating the mean areal distribution values of the total organic matter, the shallow water depth, and assuming the *autochthonous* input as a main contributing source, it was exhibited that the investigated lakes are over-supplied with organic material, passing through a continuous shallowing environments due to a strong siltation of the canals and streams. The assessment of the vertical distribution results reported a distinctive pattern with infrequent dominantly organic layers interposed with sequences of minerogenic clastic contents. These fluctuations indicate seasonal shifts that have repercussion on the depositional environment conditions on some moments in time. The results obtained by *LOI* method yields excellent, medium or small correlation between the variations in the investigated parameters.

KEYWORDS: core sediment, Danube Delta, surficial sediment, total carbonates, total organic matter

1 INTRODUCTION

Each lake can yield a numerous type of uses, starting from being centers for human settlements with the whole suite of issues associated as habitation, water supply, boating, navigation, commercial and recreational fisheries, as well as provide relevant data about its evolution on different time scales, degradation of water and sediment quality induced by human activities and other environmental changes at the local and regional scale.

The importance of studying aquatic sediments to outline their origin and characteristics for different goals has experienced an accelerated progress in the recent decades. The benefit of it has been widely studied by the means of many researches ([1], [2], [3], [4]), that emphasizes the major role of the interrelations between sediments, water, soluble elements and particulate matter in the aquatic environment. Thus, in these circumstances, any disturbance which is going to take place in sediments, or in water, will be directly reflected in the lacustrine environment.

The lake sediments are generally composed of clastic material (clay, silt and sand), organic detritus, in-situ chemical precipitates, or a mixture of these components. Their proximate distribution is attributable to *allochthonous* sources (upstream inputs, the nature of the local catchment area, aeolian sediment transport, climate, etc.), as well as for

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autochthonous inputs (the age and the geological substrate of the lacustrine depositional environment along with in-lake related biogeochemical processes).

Specifically, lake sediments are very important in assessing the potential environmental impacts of anthropogenic activities and natural inputs on the composition of the lacustrine sediments, as well as the water quality characteristics of lakes.

2 MATERIAL AND METHODS

2.1 GEOMORPHOLOGY AND THE ENVIRONMENTAL SETTING OF THE STUDY AREA

The Danube Delta is considered as one of the most important and well preserved deltas from Europe, after the Volga Delta, being the natural interface between the extents of land through the medium of the Danube River and the western Black Sea coastline ([5]). The Danube Delta was granted UNESCO World Heritage Site Status in 1991, is listed as a Biosphere Reserve nationwide in Romania, as well as IUCN (International Union for Conservation of Nature) National Park, site of global importance.

Evaluated as an international waterway, the Danube River is one of the most important European connection routes, passing through several countries. It is also denominated as the "Amazon" of Europe ([6]), due to the paramount importance of the natural reservation and wildlife areas developed along its course, within Europe. Before discharging into the Black Sea *via* Danube Delta, the Danube River branches out into three main distributaries: Chilia (northerly), Sulina (in the central part) and Sf. Gheorghe (south), (see Fig. 1).

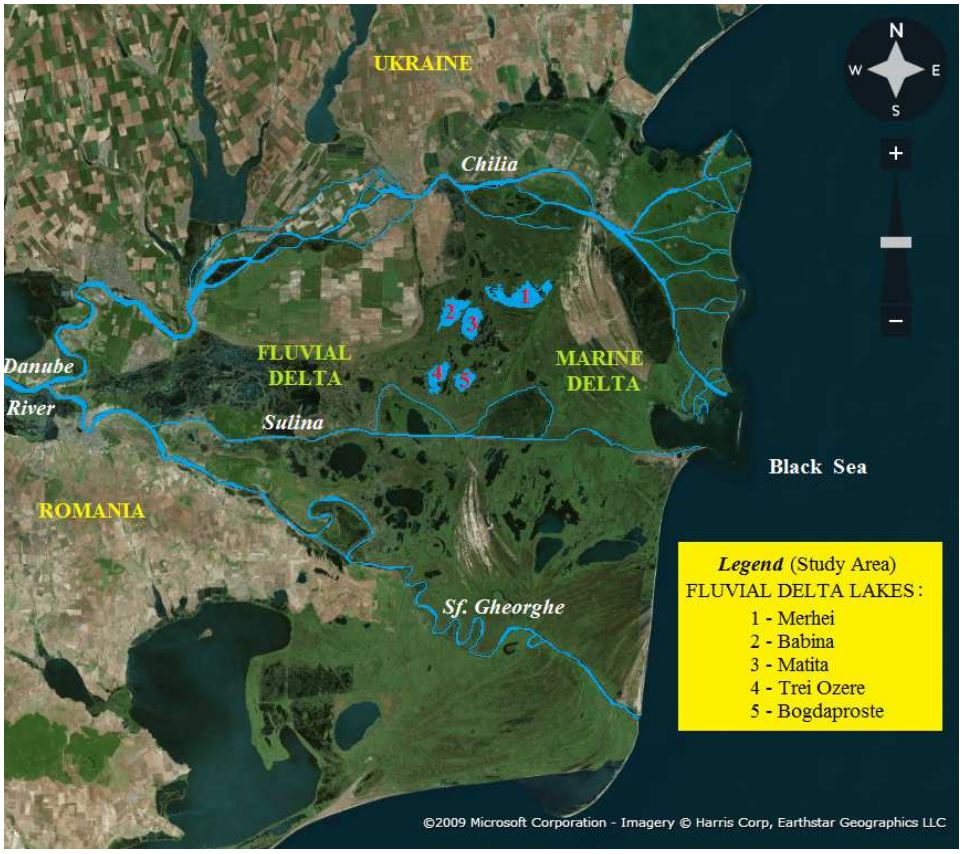


Fig. 1. General view of the Danube Delta and the location of Fluvial Danube Delta lakes where the research was performed. (Satellite image freely available on web services ([7]), Location: Latitude 45°11'7" N, Longitude 28°58'23" E)

The approximate surface of the Danube Delta area is 4152 km2, of which the most part of it (3446 km^2) stretches on the Romanian territory, and a northern smaller part that lies in Ukraine (see Fig. 1). The Danube Delta is a low alluvial plain, predominantly represented by a unique and complex landscape of wetlands, marshes, canals, watercourses and lakes. In terms of geomorphological processes, acts as a very dynamic system, stimulated by strong subsidence and important

sediment accumulation, being the youngest landform of Europe, created by the deposition of sediments (sand, silt) brought by the Danube River. The Danube Delta consists of two principal components – the fluvial delta plain (a more elevated unit located in the western part) and the fluvio-marine delta plain (a subjacent unit positioned between the eastern part and the Black Sea coastline), (see Fig. 1). The initial littoral ridge: Jibrieni-Letea-Răducu-Ceamurlia-Caraorman-Sărăturile-Perișor-Lupilor splits these major units ([8]).

Both in the past and today, the water flow and sediment transport in the lower Danube River represents the driving force that controls and processes the Danube Delta development and evolution, under sedimentological, geomorphological and geoecological aspects ([9]). Several interdistributary depressions characterized by primary or secondary specific hydrographic network have been developed between the Danube branches.

The present paper focuses on the study of lake sediments (grab and core) from the Matița - Merhei - Trei Ozere depression that belongs to the fluvial delta plain.

The Matița - Merhei - Trei Ozere Unit, considered as a weakly clogged lacustrine depression area ([10]), is situated between Chilia (Cernovca Branch and Chiliei Grind), in the northern part, and Sulina distributaries (the big "M" of the Old Danube Branch), in the south (see Fig. 1). This area is placed far enough away from the main arms of the Danube River, thereby the lakes situated in the central-northern part of the unit, are not considerably influenced by the water and sediments provided by the fluvial intake.

The Matița - Merhei - Trei Ozere is one of the dominant lake systems in the Danube Delta, being individualized by the presence of several lakes that cover the entire central part of the fluvial depression. The total water area is about 5701.74 ha (106 lakes). From north to south (see Fig. 2), between the aquatic basins is distinguished: Merhei (1137.47 ha), Matița (641.83 ha), Babina (427.35 ha), Bogdaproste (400.19 ha), Trei Ozere (433.5 ha), ([11]), as well as other lakes, but smaller in size. These lakes are interconnected by the related secondary hydrographic network of inlets and canals (e.g., Eracle, Lopatna, Dovnica, Răducu, Bogdaproste, Sulimanca and Roşca), ([12]).

The system of canals and other small streams present a reversible capacity, aiming to supply (at high water level), and respectively to discharge (at low water level) of the surrounded Danube River distributaries (Chilia and Sulina), ([10]). The main canals that facilitate the inflows and outflows are represented by: Sulimanca, Dovnica, Suez, Lopatna, Rădăcinoasele, Stipoc, Eracle and Bogdaproste (positioned from north to south, see Fig. 2).

2.2 FIELD WORK

During the interval between 2010 and 2013, several sediment samples have been investigated from the Merhei, Babina, Matița, Trei Ozere and Bogdaproste lakes. The sediment samples have been collected in sediment deposition areas, in certain inland lakes from the Matița - Merhei - Trei Ozere Unit. These zones have been chosen depending on the inlet/outlet drainage system that would link with the specific retention basins, as well as their waterways accessibility. The overall aim of this multi-year lake sediment sampling application is to yield a baseline sediment quality characterization.

The sampling expeditions were conducted aboard the R/V "Istros", a fluvial and coastal research vessel, managed by the National Institute for Research and Development of Marine Geology and Geoecology – GeoEcoMar, Romania.

The geographical localization of the sampling points was recorded using the Global Position System (GPS).

To evaluate the surficial bottom type sediments (the top 15 – 20 cm of the recent sediments), one hundred and forty-four samples have been collected by hand, using a Van-Veen grab sampler.

To augment the sediment material information under the water-sediment interface (about a maximum depth of 55 cm), six core samples have been gathered through Hydro-Byos gravity corer. Immediately, after the sampling, in-situ, on the R/V "Istros" board, the grab sediment material was described, sub-sampled, partitioned in single-use plastic containers and stored in cold conditions until their delivery to the laboratories for subsequent analyses. On board, the short cores have been split horizontally; as the sediment core was extruded, slices of 1-3 thickness have been cut and distributed in labelled sample containers.

To be used in the laboratory analyses, an amount of about 100 grams of grab and core sediment was set apart.

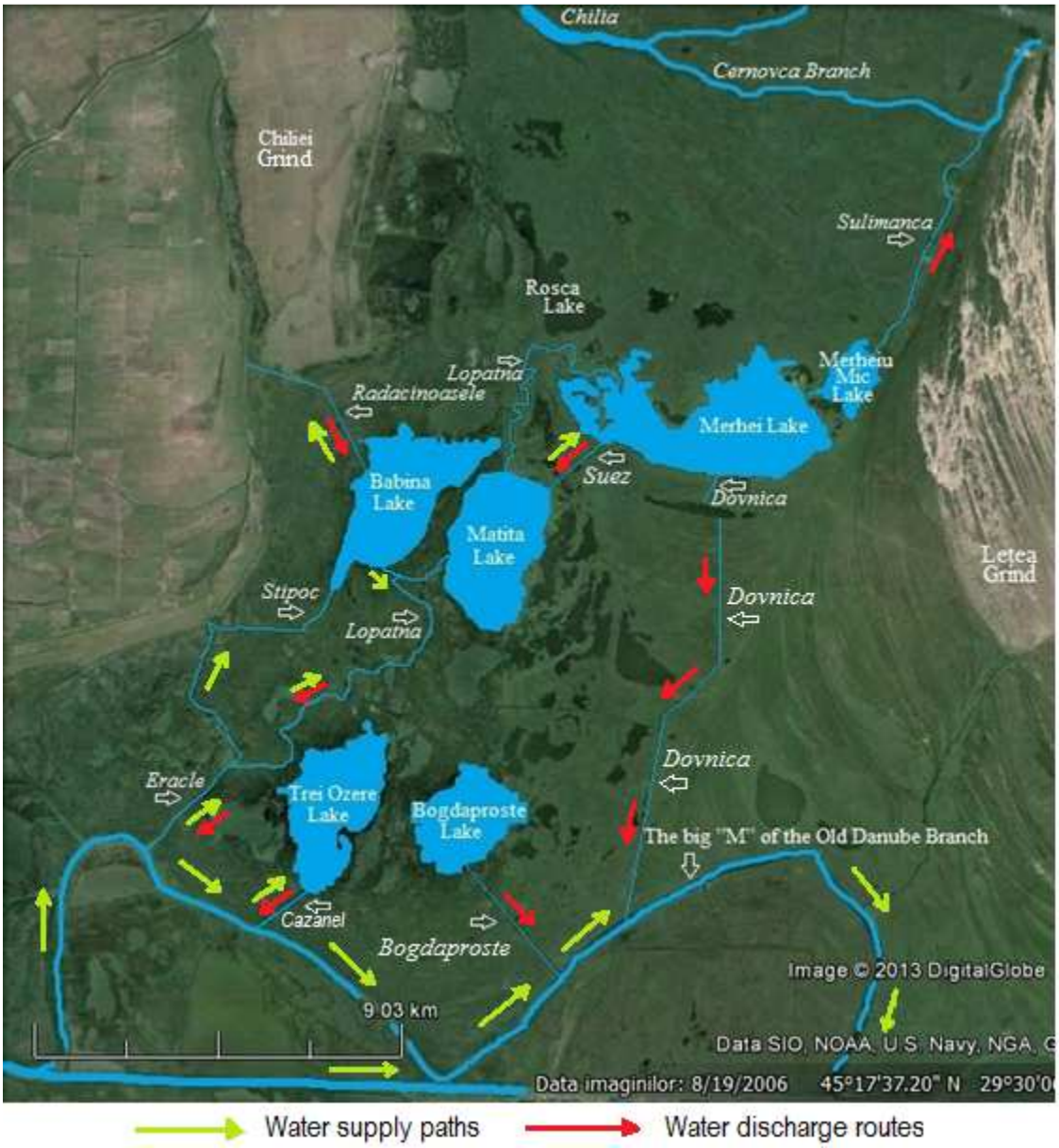


Fig. 2. Detailed view of the sample area locations, and the water circulation of the Matița - Merhei - Trei Ozere Depression (after, [10]), (sources of image: freely available on web services [13], modified).

2.3 LABORATORY METHODS

Laboratory analyses and sedimentological characterizations were conducted to provide more information that can be applied to evaluate the current sediment quality status of these lakes, to perform a medium-term monitoring in order to develop proposals for rehabilitation and improvement of the lake ecosystems, there, where it is sorely needed.

In this study, several surface sediment samples and some cores were investigated with respect to the visual sedimentological characterization (e.g., observations of the physical parameters as color, structure, texture, grain size, the dominant lithological composition etc.), loss on drying at 105^{o}C (for determining the percentage of moisture and dry sediment content), as well as loss on ignition at 550^{o}C and 950^{o}C (for establishing the percentage of total organic matter and, respectively, total carbonates).

2.3.1 THE VISUAL DESCRIPTION OF THE GRAB AND CORE SEDIMENT SAMPLES

The macroscopic structure of the collected sediment represents the primary types of examinations performed *in situ*, being then supplemented with laboratory observations.

The deltaic lakes, as any other inland bodies of stagnant water, act as a storage place for several materials brought into it by *allochthonous* and *autochthonous* sources (water flow, wind, products resulting from metabolic activities of plant and animal organisms etc.). These materials are represented by the fragments of rocks, fine particles of minerals and organic debris.

The investigated lakes are influenced more or less by the direct intake waters loaded with suspended solids from the Danube River.

Thereby, the grab sediment samples collected from these lakes are characterized by the presence of fine-medium and sometimes coarser particles (due to finely triturated vegetal fragments) of yellowish – gray – dark gray color of non-compacted and non-cohesive silts ([14]); the prevalent material is of organic origin, the silts being consisted of numerous vegetal fragments of reed, leaves, fragile and depigmented shell debris (e.g., *Viviparus viviparus, Dreissena polymorpha, Anodonta cygnea*, various types of *Cardiidae* species), insect larvae (*Chironomidae*) etc. A strong saprogenic odor was noticed in most grab samples.

The short sediment cores (at most 55 cm length) were predominantly gathered from the central area of the following lakes: Matița (2 cores), Babina (3 cores) and Bogdaproste (1 core).

The cores consist of an alternation of lithological sequences represented by silt, clay, silty clay sometimes with dispersed sand-sized granules intervals or intercalated with argillaceous and peaty material (see Fig. 6).

The visual observations of the sediment cores have generally allowed the identification of the following type of deposits based on their color and outward aspect: a fluffy layer of yellowish dark gray to dark gray of organic mud (silt) that accumulates at the top of the core. The interval comprising the median part of the core is represented by different units of sediments that are variable in color (ranging from greenish light gray to dark grayish) and grain size (fine to coarser particles). The lowermost part of the core is characterized by sediment layers that become increasingly more compact alternating in color and grain size, too. A more or less dense and vertical distribution of remnants of shells (various species of *Gastropods*, *Dreissenidae, Cardiidae* etc.), bits of reed, plant residues and clear burrowing that occurs along downwards, has been noticed.

2.3.2 GRAIN SIZE ANALYSIS

The grain size analysis yields basic information regarding the preliminary investigations of lacustrine sediments. Since the aim of this paper is not to use specifically the particle size analysis in order to identify and characterize the fine-coarse-grained, stagnant sediment layers in freshwater lake sediments it will be presented just some grain-size background references. Several data regarding the macroscopic characterizations and grain-size categories of sediments from different Danube Delta lakes were previously published by [15], [16], as well as by [17]. The grain size determinations were carried out with a Laser Particle Sizer. The results accomplished in other anterior surveys showed that the sediments collected from these areas are mainly composed of fine particulate organic material, with a particle size dominated by silt or clay (0.0039 to 0.0625 mm/0.00006 to 0.0039 mm, accordingly with the Udden-Wentorth scale), ([18], [19]), sometimes even coarser. Actually, the prevalence of silt represents a disintegration stage caused by the decomposition of live or dead plant and animal debris (microscopic algae, waste matter etc.), as well as the chemical decaying of various chemical products brought by the fluvial input, or which there exist in the respective lake water mass. The large majority of the organic material within the lakes considered in this study, has *autochthonous* origin, so that the particle size it is not linked excessively to the hydrodynamic conditions and potential sediment transport.

2.3.3 THE MOISTURE AND DRY SEDIMENT CONTENT

The moisture content of lake sediments is a very important evidence as it varies between wide limits in the same set of grab or core sediment samples. The dry sediment content is useful to analogize with the results obtained by ignition loss, showing also the degree of material compaction. The water and the dry matter content were determined volumetrically by the classical laboratory Loss On Drying method (LOD_{105oC}). The sediment samples were weighed (using a readable and

accurate to 0.1 mg, Partner AS 110/C/2 Analytical Balance), placed in pre-weighted crucibles and dried overnight at 105 ±5°C (using a Universal Memmert oven), cooled in the dry atmosphere of a desiccator, and then re-weighed again.

The results are expressed as a percentage of the mass (%), using the following empirical formulas:

$$W_{dm}\ [LOD_{105^{\circ}C}\ (\%)] = \left(\frac{m_{c-}\ m_a}{m_{b-}\ m_a}\right) \text{ x } 100 \qquad (1)$$

$$W_{wc}\ [LOD_{105^{\circ}C}\ (\%)] = \left(\frac{m_{b-}\ m_c}{m_{b-}\ m_a}\right) \text{ x } 100 \qquad (2)$$

Where:

W_{dm} = the weight of the dry matter of the sediment sample expressed in percentages;
W_{wc} = the weight of the water content of the sediment sample expressed in percentages;
ma = the mass of the empty crucible in grams;
mb = the mass of the crucible containing the wet sediment matter in grams;
mc = the mass of the crucible containing the dry matter in grams, dried at 105°C;

2.3.4 ESTIMATION OF THE MAIN LITHOLOGICAL COMPONENTS FROM SEDIMENTS BY LOSS ON IGNITION

The determination of the total organic matter, total carbonates and minerogenic clastic material content was performed by sequential weight Loss On Ignition (LOI) Method at 550°C and respectively, 950°C. The sequential loss on ignition is a customary and universally used procedure applied to the sediments in order to assess their organic matter and carbonate content through weight loss after ignition ([20], [21], [22] [23], [24]).

This technique involves the completion of two phases of heating, at 550°C and respectively, 950°C. The weight loss during the phases is exactly measured by weighing the sediment samples before and after the ignition, being strictly associated with the total organic matter and total carbonate content of the sediment sample. The leftover material that remains after a two-phase of ignition, it is considered to be the minerogenic clastic material (the residue of ignition).

In the first stage of heating, the organic matter is oxidized at 500-550°C. The dried sediment samples (at 105°C) are ignited in a SNOL 8.2/1100 furnace at 550°C for two hours, cooled in a desiccator, and re-weighted. In the second stage of burning, the carbon dioxide is released from carbonate at 900-1000°C, leaving instead the oxides. The dried sediment samples (at 550°C) are ignited again in the furnace at 950°C for two hours, cooled in a desiccator, and re-weighted. The loss on ignition (LOI) is expressed as a weight percentage of the dry mass, applying these empirical formulas:

$$W_{dm}\ [LOI_{550^{\circ}C}\ (\%)] = \frac{\left(m_{c} - m_{d}\right)\ x\ 100}{\left(m_{c} - m_{a}\right)} \qquad (3)$$

$$W_{dm}\ [LOI_{950^{\circ}C}\ (\%)] = \frac{\left(m_{d} - m_{a}\right)\ x\ 100}{\left(m_{c} - m_{a}\right)} \qquad (4)$$

Where:

W_{dm} = the weight of the dry matter of the sediment sample expressed in percentages;
ma = the mass of the empty crucible in grams;
mc = the mass of the crucible containing the dry matter in grams, dried at 105°C;
md = the mass of the crucible containing the dry matter in grams, dried at 550°C;
me = the mass of the crucible containing the dry matter in grams, dried at 950°C;

The results obtained from this method have been presented in the horizontal (areal) form distribution maps. The areal distribution maps have been plotted by Golden Software Inc. Surfer 8 Program.

3 RESULTS AND DISCUSSION

The sediment status represents an important issue of a freshwater ecosystem, as it is in interconnection with the water mass and several communities of aquatic organisms (pelagic and benthic) that are dependent on each other, as well as on their environmental conditions.

It is well known, that the depositional zones of lakes accumulate and store different types of sediments along the time. Assessing the physical composition of these deposited sediments contribute to obtain information about environmental change tendencies related to natural or anthropic factors, as determinants, in terms of past or medium/long-term evolution of the main characteristics of the Danube Delta environment. Lately, several scientific papers have taken into considerations different research studies about the sediments of the Danube Delta ([25], [26], [27], [28], [29], [30]). Although, due to the fact that there is not too much published data, there has been a growing interest to disseminate as many results as possible related to lithological characteristics of the Danubian lakes.

The deposited sediments placed on the bed of the lakes contain two main constituents as, an inorganic one (derived from upstream sediment flux or from the erosion of the lake geological substratum), and an organic part (provided by the decaying plant and animal matter, biological production and decomposition, plant and animal debris). The purpose of this paper is to evaluate the distribution of the main lithological components (the percentage of the total organic matter, total carbonates and minerogenic clastic material) from the sediment-water interface (grab) and bottom sediments (core). A significant contribution of the primary source of organic matter to these lake sediments is represented by the aquatic plants living in the water lake, or terrestrial plants that grow up on the lake edges. The association between the excessive development of the phytoplankton corroborated with the biomass of macroalgae and macrophytes result in a superabundant development of the biological productivity during the warmer months ([31]).

The predominant vegetation species of the Matița - Merhei - Trei Ozere Unit is represented by floating algae, periphyton, macrophytes and reed beds found mainly in the central part, and a subordinated association of reed and rush towards the adjacent edge areas of lakes.

Another source of organic matter is represented by the inputs resulted from plankton biomass, different in-lake biological processes caused by plant and animal organisms, residues etc.

Presumably, the nature and distribution of the total carbonate contents investigated in the collected sediment samples have an authigenic origin (due to the chemical precipitation and recristalization or, due to the mechanical abrasion of *autochthonous* or *allochthonous* skeletal or non-skeletal carbonate elements). Laboratory sample preparation has considered as much as possible the removal of the visible shell debris present in the material.

3.1 THE GRAB HORIZONTAL DISTRIBUTION PROFILES OF THE LITHOLOGICAL COMPONENTS OF THE INVESTIGATED LAKE SEDIMENTS

The accumulation of the recent sediments in the investigated freshwater lakes was assessed by linking the field observations and drainage basin morphology with the measurement and the analogy of the main lithological components investigated for 144 sampling stations. The percentage distributions of the investigated lithological components of the grab sediments are shown in the table 1.

As it was previously mentioned the lakes belonging to the Matița - Merhei - Trei Ozere Unit, are situated relatively further away from the Danube River water supply.

More than that, the accumulation of sediments from tributaries or streams and canals is supposed to decrease considerably as a result of their landscape context, as well as due to their temporary character. The anthropogenic factors such as river engineering and management has not a significant impact in this perimeter, the majority of the investigated lakes being under natural conditions.

The analysis carried out to figure the moisture and dry matter contents in the surficial sediments show different variations that are certainly dependent on the local specificities and the dynamics of the investigated lakes (see Table 1), as well as due to sediment sample's lithological type.

MERHEI LAKE

The Merhei Lake is located in the northern compartment of the Matița - Merhei - Trei Ozere Unit, being contiguous with the Letea grind (the access is only possible by boat). This lake is characterized by a poor water circulation due to the long distance from the main hydrological network of the Danube River (e.g, Chilia branch), (see Fig. 2). Also, the secondary hydrological network is rather poorly represented by some small streams and canals that are affected by long-term siltation.

The areal distribution of the total organic matter content in the Merhei Lake present maximal concentrations (values between 75 - 85%) that covers almost the entire surface of the lake (see Fig. 3).

The results were plotted together (meaning the data for Merhei and Merheiu Mic Lakes), taking into consideration the small area of the Merheiu Lake. The increased concentrations of the organic material accumulated on the bottom of this lake could be linked to the stagnant environmental conditions. Therefore, the organic matter is considered to be of *autochthonous* origin. Some exceptions of this trend occur in the northern part (namely in the Merheiu Mic Lake, 40 - 75 %), as well as in the southeastern part of the Merhei Lake (50 - 75 %), zones that are relatively in connection with the Sulimanca (north) and Dovnica (south) stream inputs. The water currents, even at lower rates can substantially impede the accumulation of the organic matter.

Generally, the distribution of the total carbonate content (%) contains values between 0.38 - 8 %. A zone of maximal concentration is observed in the central part of the lake. More than likely, the source of total carbonate content (in weight percent) is attributed to the carbonate detritus (fragments of shells, skeleton structural parts, internal waste products).

The minerogenic clastic fraction (the leftover material) reveals areas with both minimal and maximal values (there is an inverse correlation with the organic matter). Factors as, weak lake circulation, abundant sub-aquatic plants and substantial organic settlings are consistent with the quiescent environmental status of the lake.

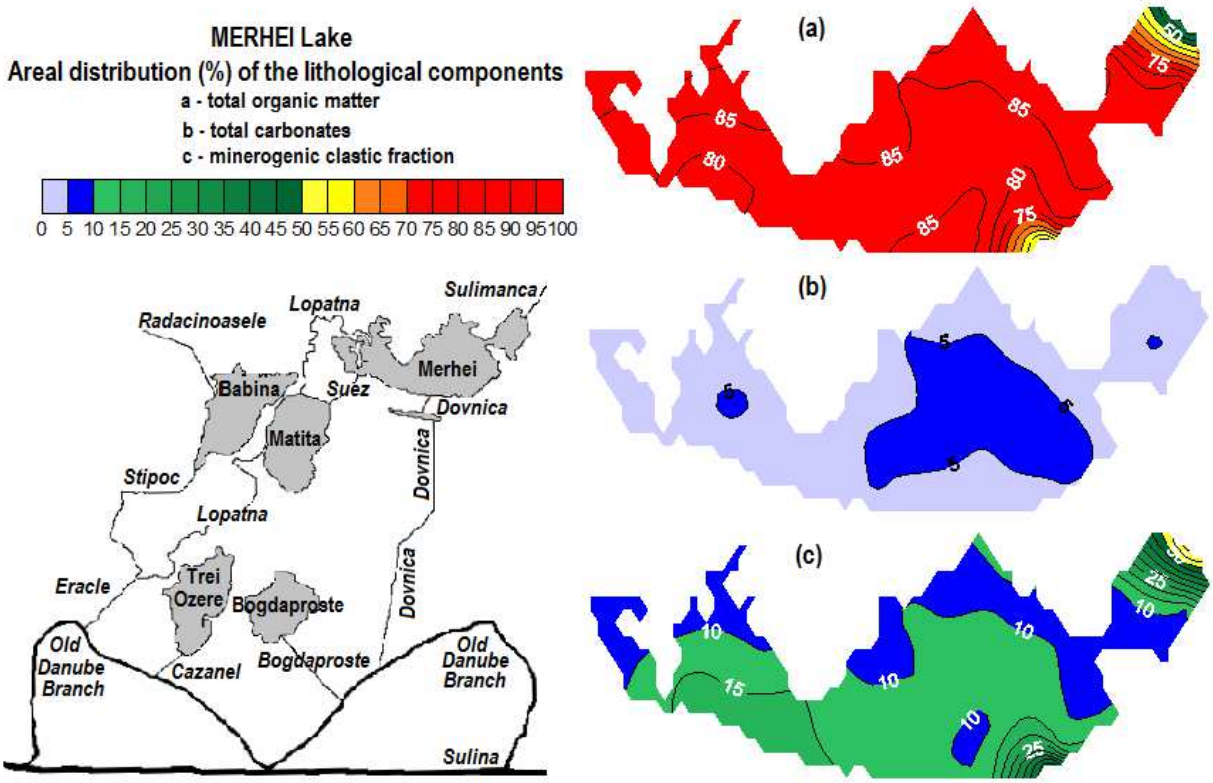


Fig. 3. Areal distribution and concentrations (%) of the investigated parameters in surficial sediments from Merhei Lake.

BABINA AND MATIȚA LAKES

To some extent, this pair of lakes is in the same stagnant environment, characterized by a considerable distance from the Danube River arms (e.g., Chilia and Sulina arms), a rather low rate of the surface water flow and sediment transport by streams and canals, and a richness of underwater plants.

The concentration of the total organic matter content, show areas with various values (34.36 - 84.58 %) that occur in different sediment sample locations in the Babina Lake (see Fig. 4).

In the northwestern sector of the lake, there is an area with relatively low values of the total organic matter, that could be associated with the Rădăcinoasele Canal (preventing probably the deposition of the organic material due to the water currents). The values of the total carbonate concentrations in grab sediments are registered between 1.06 - 13.89 % interval. The increase of several percent occurs in the northern part of the lake. The values obtained for the minerogenic clastic

fraction content, are in the 12.87 - 63.74 % range. An apparent increase take place in the northeastern part of the lake near the Rădăcinoasele Canal. As it was previously noted, the concentration of the minerogenic clastic fraction is frequently inversely related to the total organic matter content.

Concerning the total organic matter distribution in the Matița Lake it can be said that here prevails quite high contents, therefore this lake is entirely dominated by sediments full of organic matter (53.20 - 82.25 %).

The total carbonate content of the Matița surface sediments (2.69 - 8.55 %) is primarily attributed to the organogenous constituents (e.g., shells and skeleton pieces of different species). A relatively increase of the total carbonate several percents covers approximately three quarters of the lake surface.

The minerogenic clastic fraction contains a moderate percentage with values included in the 13.26 - 42.49 % range.

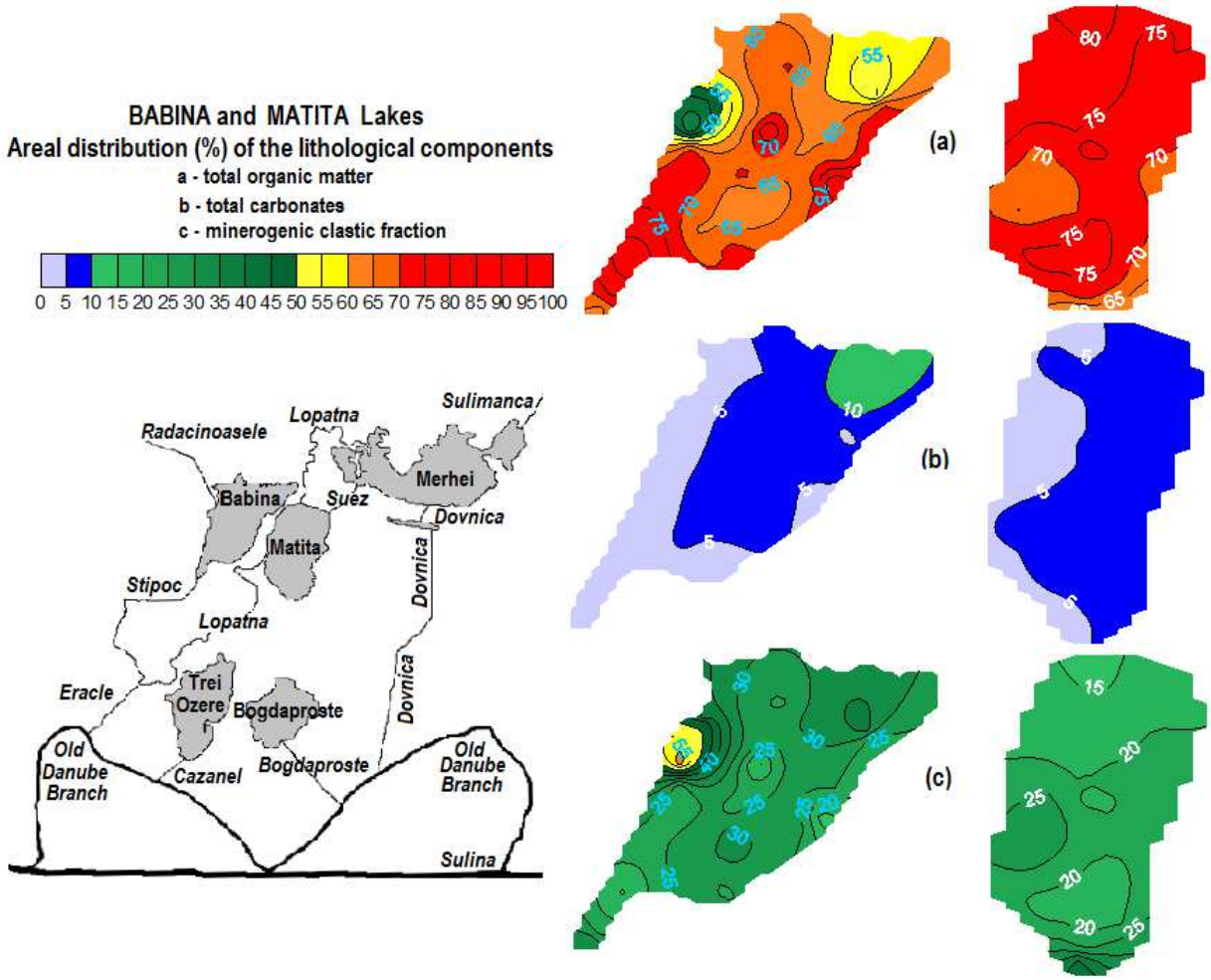


Fig. 4. Areal distribution and concentrations (%) of the investigated parameters in surficial sediments from Babina and Matița Lakes.

Table 1. The percentage distribution content (min./max./mean) of the lithological components of the grab/core sediment samples

Lake	Lake/Core Location		Number of samples	The dry sediment content (%)			The moisture content of sediment (%)			Total organic matter (%)			Total carbonates (%)			Minerogenic clastic fraction (%)		
	Latitude N	*Longitude E*		Min. value	Max. value	Mean value	Min. value	Max. value	Mean value	Min. Value	Mean value	Max. value	Min. value	Mean value	Max. value	Min. value	Mean value	Max. Value
GRAB SEDIMENT SAMPLES																		
Merhei	45°19'15.7"	29°26'48.2"	45	73,65	87,50	81,38	12,50	26,35	18,62	28,12	92,63	82,99	0,38	8,00	3,78	5,92	68,15	13,22
Babina	45°18'20.7"	29°20'28.3"	33	35,21	77,09	53,57	22,91	64,79	46,43	34,36	84,58	67,63	1,06	13,89	4,95	12,87	63,74	27,42
Matița	45°17'46.1"	29°22'8.0"	25	53,70	88,66	72,94	11,34	46,30	27,06	53,20	82,25	72,93	2,69	8,55	5,74	13,26	42,49	21,33
Trei Ozere	45°14'24.1"	29°19'4.6"	21	71,07	89,81	84,78	10,19	28,93	15,22	57,72	88,72	79,68	1,90	8,09	4,74	9,30	40,12	15,58
Bogdaproste	45°14'5.9"	29°21'37.9"	20	72,61	81,99	78,82	18,01	27,39	21,18	54,85	91,37	81,63	1,28	6,91	3,71	7,28	43,09	14,66
CORE SEDIMENT SAMPLES																		
Matița (DD10-01)	45°17'41.76"	29°22'8.94"	27	29,53	75,93	56,05	24,07	70,47	43,95	4,62	55,58	15,85	5,34	18,17	10,09	34,47	90,00	74,06
Matița (DD11-01)	45°17'49.8"	29°22'12.5"	23	67,08	81,35	73,49	18,65	32,92	26,51	11,81	85,69	58,11	3,26	12,29	6,47	10,77	79,74	35,43
Babina (DD10-18)	45°18'6.78"	29°20'6.18"	25	53,23	92,81	69,11	7,19	46,77	30,89	3,13	69,69	26,95	1,06	10,69	4,08	23,56	93,52	68,98
Babina (DD10-106)	45°18'19.4"	29°20'22.6"	21	60,19	77,15	67,91	22,85	39,81	32,09	10,43	79,66	55,55	0,99	9,48	5,47	15,38	88,09	38,98
Babina (DD11-49)	45°18'00.4"	29°20'05.4"	15	59,41	82,40	74,68	17,60	40,59	25,32	2,97	83,07	33,79	3,96	15,59	6,30	12,97	89,97	59,90
Bogdaproste (DD13-104)	45°14'01.4"	29°21'27.4"	24	40,22	77,67	58,89	22,33	59,78	41,11	3,10	82,97	49,80	1,40	15,17	4,20	12,63	91,35	46,00

Also, in this situation, it is assumed that the *autochthonous* inputs (e.g., physical, chemical and biological in-lake processes) of this couple of lakes (Babina and Matița) contribute to outlining the areal distribution pattern of the lithological components. This is consistent with the weak connection with the hydrographic system, low sedimentation rate, as well as the abundance of submersed aquatic vegetation.

TREI OZERE AND BOGDAPROSTE LAKES

The couple of lakes Trei Ozere and Bogdaproste, located in the southern compartment of the Matița - Merhei - Trei Ozere Unit, exposed the same trend of the lithological component distribution. The local environmental conditions are quite different in comparison with those mentioned above, meaning the nearest distance from the Danube River intake, benefiting moderately of an active water circulation. Nevertheless, the status of these shallow depth lakes is influenced by phytoplankton-macrophyte dominated species etc.

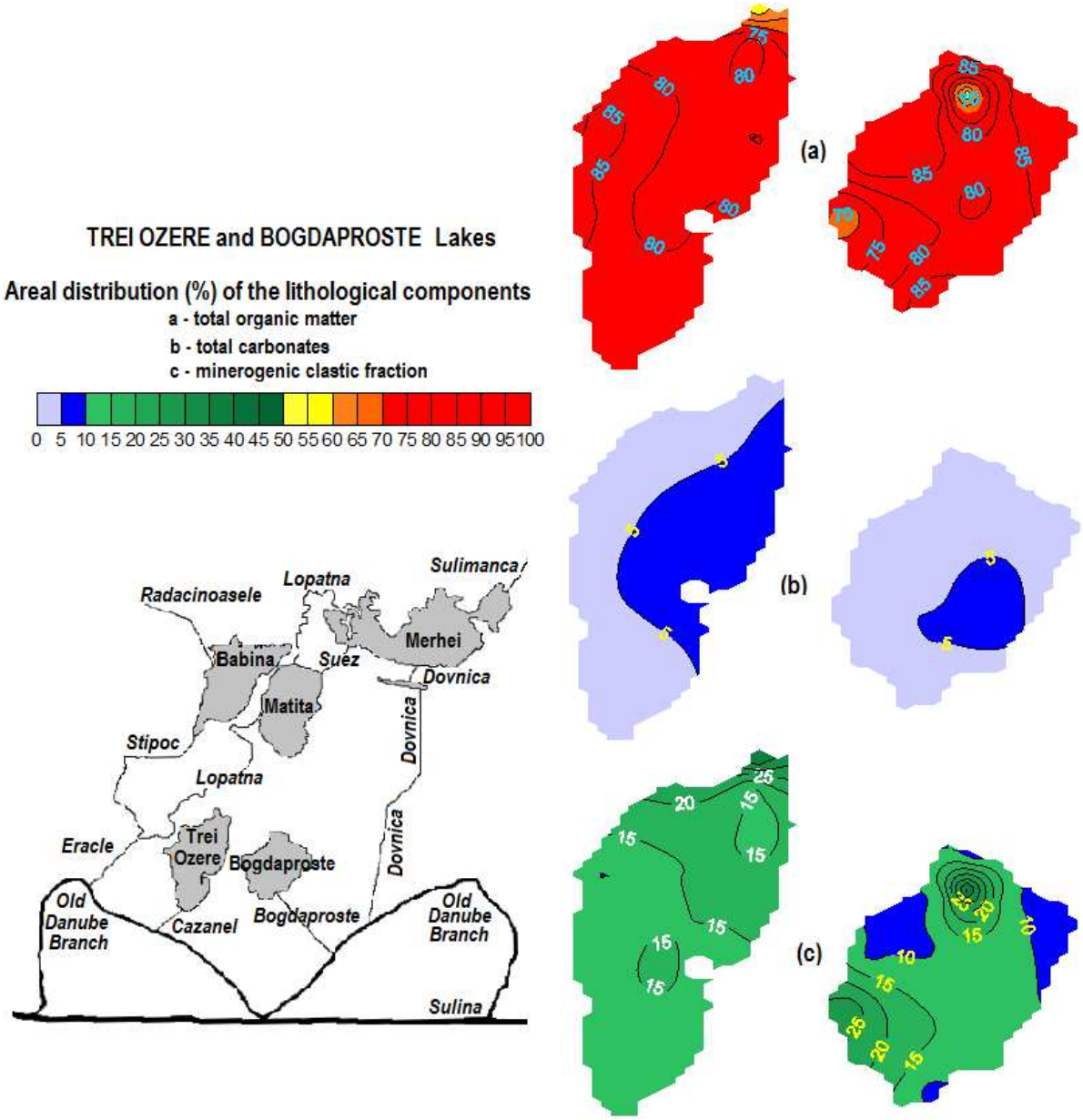


Fig. 5. Areal distribution and concentrations (%) of the investigated parameters in surficial sediments from Trei Ozere and Bogdaproste Lakes.

So, the total organic matter distribution in the Trei Ozere Lake is defined by high values ranging from 57.72 - 88.72 % (see Fig. 5). This suggests quiescent environmental conditions that control the accumulation of the organic matter input (vegetal and fauna settled on the bottom of lakes). The total carbonate content (1.90 - 8.09 %) reveals some increased percents in the eastern half of the lake. The minerogenic clastic fraction areal distribution includes a moderate percentage with values fluctuating from 9.30 up to 40.12 %.

Over its entire surface, the Bogdaproste Lake exhibit zones of maximal concentration of the total organic matter content (54.85 - 91.37 %). The organic settlement dominates this lake, too. The total carbonates content values (1.28 - 6.91 %) are somewhat lower compared to the other investigated lakes. An increase of several percent outline a spot area within the southeastern part of the lake. A variation of the minerogenic clastic fraction content (7.28 - 43.09 %) was noticed in different sediment sample locations that are related to the concentration of the organic matter content, with which is often inversely correlated.

3.2 THE CORE VERTICAL DISTRIBUTION PROFILES OF THE LITHOLOGICAL COMPONENTS

This investigation includes the analysis of core lake sediment lithological composition, some basic data, related to past and recent environmental changes. From the investigated area, three lakes were short cored, namely Matița, Babina and Bogdaproste.

Matița Lake lies in the northern compartment of the Matița - Merhei - Trei Ozere Unit. Two cores, labelled as DD10-01 and DD11-01, were extracted from this lake, during 2010 and 2011, respectively, in order to identify the lithological horizons and their analogy with the vertical distribution of the investigated parameters. The short core DD10-01, sampled near the central part of the lake, reached a maximum depth of 55 cm, and the DD11-01 core, was picked a short distance away towards the north end, being probed to a depth of 53 cm.

Babina Lake is situated in the middle compartment of the above mentioned unit. Three sediment cores designated as DD10-18, DD10-106 and DD11-49 were gathered from this lake, during 2010 and 2011. The first core (DD10-18) was taken from the middle of the lake, reaching at a depth of 55 cm and the other one (DD10-106), was drawn relatively towards the north end of the lake, going into 44,5 maximum depth. The third core (DD11-49), sampled in the south end direction, was captured the bottom lake sediments to the depth of 53 cm.

Within the Bogdaproste Lake, located in the southern compartment of the Matița - Merhei - Trei Ozere Unit, was collected one core, termed as DD13-104, during 2013. The core was probed near the center of the lake and reached a maximum depth of 48 cm.

A very generalized lithological description of the recovered sediments is summarized in the graphical representation of the lithological columns from the Fig. 6. A composite image of each of the short sediment cores has been plotted using Paint-Microsoft Windows, aiming to identify any similarities among the six cores. The depths are presented in centimeters from the bottom surface of the lake. The majority of the fresh core sediment characterization was performed on R/V board. The color codes of the lithological columns have been chosen aleatory.

Generally, all the log cores are homogenous in composition (texture and structure), exhibiting a fluctuation of intervals with remarkably organic and inorganic depositions.

In reference to visual description, these lake short cores mainly exhibit 3 distinct divisions: the top, the middle part and the bottom section. The upper part of the core, comprise intervals of green-dark gray, soft, unconsolidated fine-grained (silt and clay) organic lake bottom mud accumulations, mixed with debris flow deposits.

Sometimes these accumulations that generically represent the median part of the core, are standing over sandy or argillaceous deposits. As the sediment layers go down deeper, they become increasingly more compact. All these layers have a variable content of an organic material.

For a general overview it is noticed that the short cores collected from the Matița and Babina lakes exhibit relatively the same pattern of the sediment layer arrangement, in comparison with the Bogdaproste Lake that does not show a similar distribution patterning. A unique peaty coarse-grained sediment material layer packet is evidenced here, along with silty argillaceous enclaves, as well as peaty silt enclaves.

The distribution and the associations of this strata can be linked to the fact that the layers are deposited in a different environment (e.g., poor drainage flow conditions, grain-size and distribution, slowing rates of organic matter decomposition).

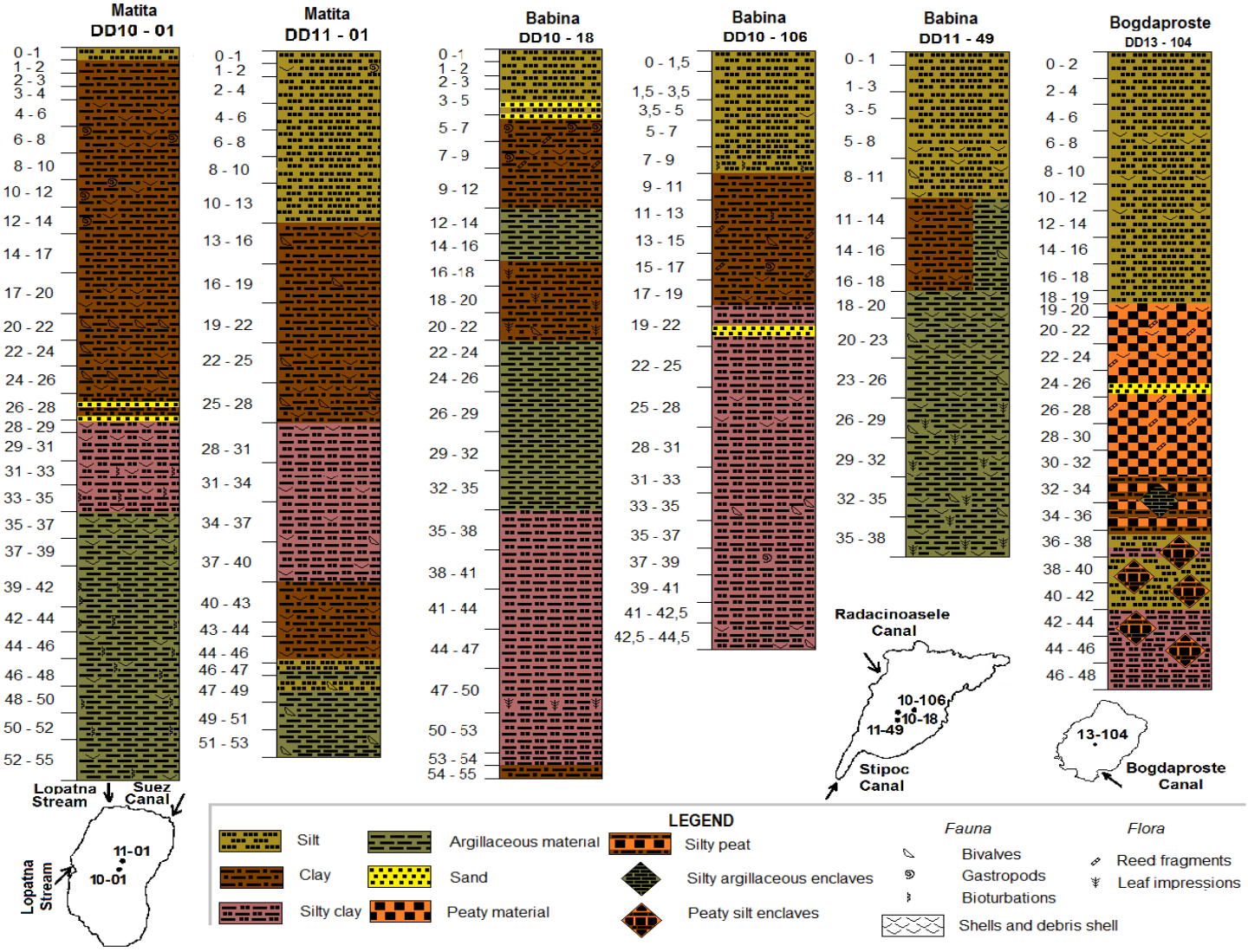


Fig. 6. The uppermost sedimentological layers captured in short cores from Babina, Matița and Bogdaproste Lakes

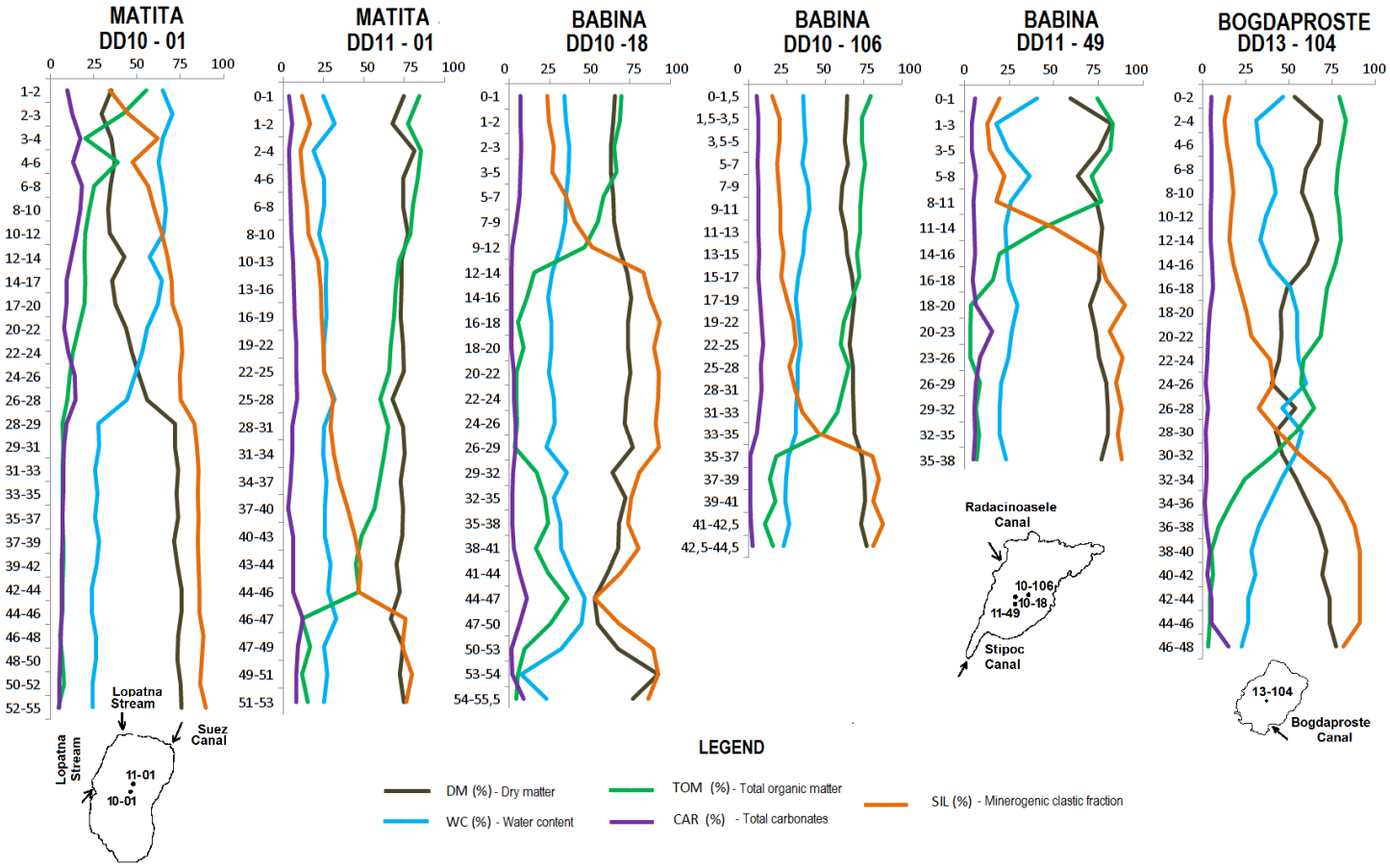


Fig. 7. Vertical distribution (%) of the investigated parameters (dry matter, water content, total organic matter, total carbonates and minerogenic clastic fraction) within the short cores sediments from Babina, Matița and Bogdaproste Lakes.

The total organic matter, the total carbonates and the minerogenic contents were measured to indicate if there exist any change patterns of these parameters during the time. The percentage distribution of the short core sediment parameters is shown in the table 1.

The results obtained from the LOD_{105oC} (Loss on drying) measurements performed to determine the moisture and dry matter contents, does not indicate major changes regarding the lithological profiles of the investigated lake sediment cores. The typical water content and dry matter tendencies, are complementary with depths, but their magnitude is unequal. Generally, the diagrams are characterized by a rapid loss of water in the upper part of the cores, and then it has noticed a downward decrease trend (showed with blue lines). The water content is inversely related to the amount of the dry matter content (showed with brown lines).

A relatively continuous water content variation was noticed in the cores (DD10-01 and DD11-01) collected from the Matița Lake. This might suggest that the particle settling has been accumulated during a quiescent depositional environment. Instead, a discontinuous water content variation was observed in the other cores, gathered from the Babina and Bogdaproste lakes (DD10-18, DD10-106, DD11-49 and DD13-104).

An explanation for this situation may be related to different changes of the environmental conditions during the sediment deposition (external and internal physical-chemical factors, grain-size, lithology type etc.). Thereby, it can be appreciated that in the investigated area, it was evidenced a fairly normal degree of the water and dry mater content spatial variability between lakes, related to their local environmental conditions.

By using the Loss On Ignition ($LOI_{105/550/950^{o}C}$) method, some interesting results regarding the vertical distribution of the total organic matter, total carbonates and minerogenic clastic contents, have been obtained.

The general total organic matter and minerogenic clastic content are, equally with depth, although their degree of variation is dissimilar. In the upper part of the majority of cores, it is observed a quite high content of the total organic matter

(showed with green lines) which then downward decreases. The total organic matter content is inversely correlated with the minerogenic clastic fraction (showed with orange lines). Each investigated cores has a specific high increase of the total organic matter percentage and a corresponding low percentage of minerogenic material (when the total organic matter values increase, the minerogenic fraction values decrease). This tendency persists downcore with fluctuating high and low percentages of the total organic matter and minerogenic material values.

For example, the DD10-01 core collected from the Matiţa Lake display some clear high/low peaks in total organic matter (values ranging from 4.62 to 55.58 %) and an interrelated low/high peaks in percentage minerogenic part (33.47 - 99.00 %), at a core depth of 3-4 cm, 4-6 cm and 6-8 cm (see Fig. 7).

Starting from the 6-8 cm interval, the organic matter, content, registered a quite linear downward decrease. This trend is similar in the other core, DD11-01, gathered from the same lake. Some distinct peaks of the organic matter content (11.81 - 85.69 %) and a corresponding low of the clastic material (10.77 - 79.74 %) were observed at 1-2 cm and 2-4 cm intervals. Then, the total organic matter gradient shows a relative continuum shape until the core depth of 44-46 cm, after which began to suddenly decrease. A strong negative correlation has been noticed between the total organic matter and minerogenic variables (see Fig. 8-Ac).

The three cores taken from Babina lakes shows a different pattern distribution regarding the investigated parameters (the total organic matter and the minerogenic fraction) (see Fig. 7).

For instance, the values of the total organic matter content (3.13 - 69.69 %) measured in the DD10-18 core, reveal a discontinuous downward decrease between 0-29 cm. Then, a gradient increase it is noticed at a core depth of 38-41 cm, that afterwards shows a low, but undeviating decrease in the percent of organic matter below 41 cm, downcore. At 44-47 cm a high peak of the total organic matter is registered, that then continue to decrease.

Certainly, that the minerogenic fraction percent values (23.56-93.52 %), are inversely correlated with the organic matter distribution (see Fig. 8-Cc).

The similar non-linear total organic matter distribution is evidenced also in the DD10-106 (10.43 - 79.66 %) and DD11-49 (2.97 - 83.07 %) cores, with values that downward decrease; a corresponding high/low percent of minerogenic fraction in DD10-106 (15.38 - 88.09 %) and DD11-49 (12.97 - 89.97 %) was registered (see Fig. 8-Dc and 8-Ec).

The last core, DD13-104, gathered from the Bogdaproste Lake, also present increased percentages of total organic matter values (3.10 - 82.97 %) at the top of the core, that then downward consistently decrease (see Fig. 7).

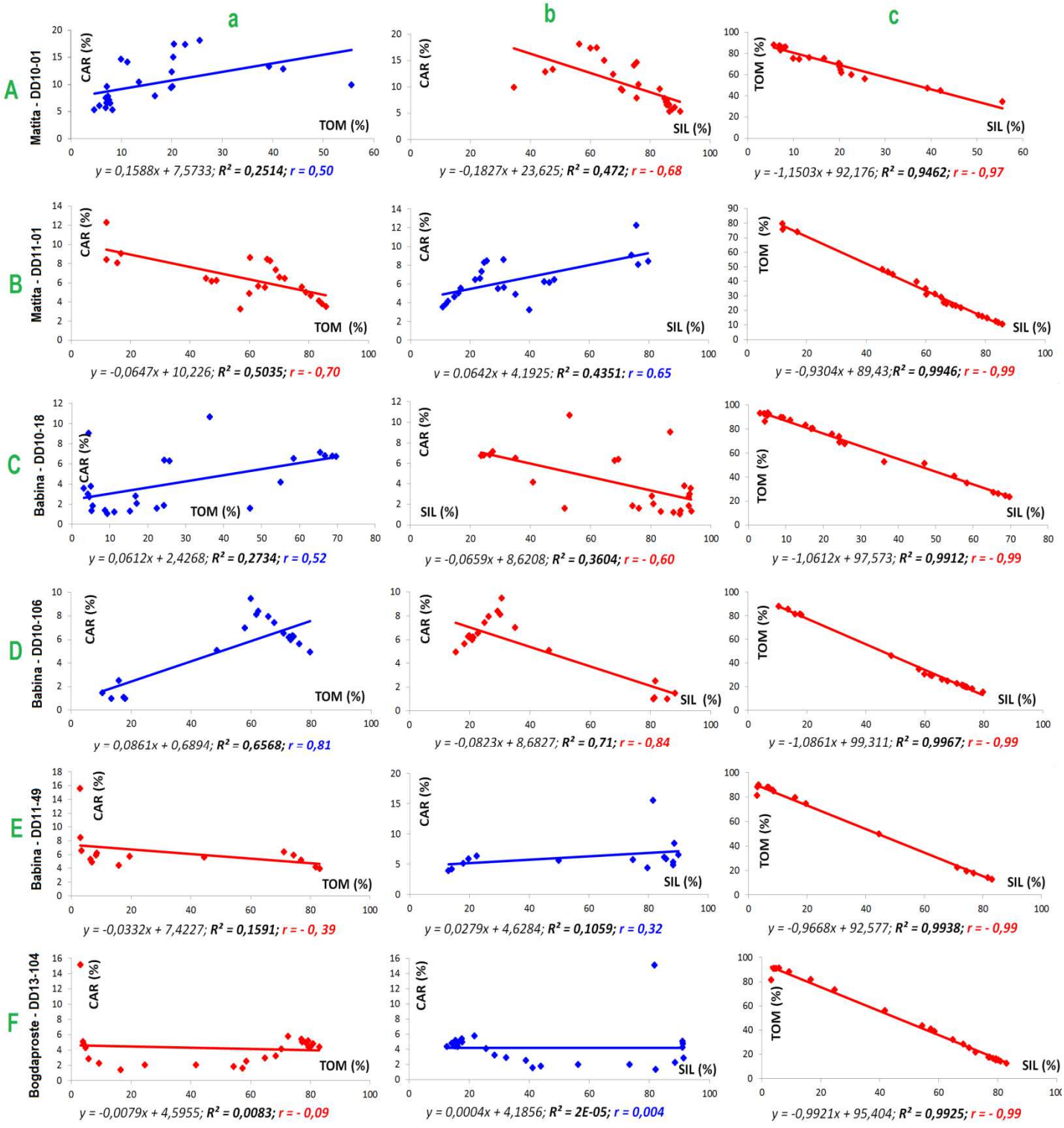


Fig. 8. Scatter diagrams and correlations between investigated parameters within the short cores sediments from Babina, Matița and Bogdaproste Lakes.

The minerogenic content (12.63 - 91.3 %) record high or low values, correspondingly with the total organic matter part, with which is inversely correlated (see Fig. 8-Fc).

The percent total carbonate results obtained from the investigated lakes show approximately the same orientation (see Fig. 7).

The determination of the total carbonate content (showed with violet lines), generally, registered different percent values.

For instance, the following values have been encountered in DD10-01 (5.34 - 18.7 %) and DD11-01 (3.26 - 12.29 %), respectively, cores extracted from Matița Lake (see Fig. 7).

The core collected quite close to each other, from the same Babina Lake (see Fig. 7), present similar values, as: DD10-18 (1.06 - 10.69 %), DD10-106 (0.99 - 9.48 %) and DD11-49 (3.96 - 15.59 %).

The core DD13-104, picked from Bogdaproste Lake (see Fig. 7), present values ranging from 1.40 - 15.17 %. There are some distinct high or low peaks, encountered along the investigated cores. A possible reason for the higher values could be linked to biogenic accumulations (debris shell or skeletal remains) or due to bio-induced precipitate.

In all investigated cores from Matița, Babina and Bogdaproste lakes (DD10-01, DD11-01, DD10-18, DD10-106, DD11-49 and DD13-104) a discontinuous gradient with respect to the total organic matter vertical distribution, was observed (see Fig. 7).

The variable peaks (higher or lower) encountered at different core depths could be related to the past environmental sedimentation process dynamic conditions.

It is assumed that the particular local conditions (e.g., the storage regime as the inflow and outflow of the lakes, intense biological activity and chemical processes etc.) have allowed the organic matter deposition in higher amounts.

The lower peaks of the total organic matter may be associated with an inorganic contribution affluence that prevails in some moments in the environment.

The discontinuous gradient applies also to the minerogenic clastic content, a trend that occurs in all investigated cores.

4 CONCLUSIONS

The accumulation of recent sediments in the investigated shallow lakes depends on several factors as the geological and geomorphological lake context, local and regional water and sediment transport capacity, climate influences, the prevalence composition of the flora and fauna associations that exist in that environment etc.

The obtained results, reveal that the areal distribution pattern of the most recent surface sediment cover accumulations of the investigated lakes had a uniform distribution. The only one category that is distinguished here is represented by the organic matter-rich sediments. The mean value of the total organic matter concentrations is very high in all lakes, as it follows: Merhei (82.99 %), Matița (72.93 %), Babina (67.63 %), Bogadaproste (81.63 %) and Trei Ozere (79,68 %).

The ranges of the mean value in total carbonate contents are also uniform, being recorded the following values: Merhei (3.78 %), Matița (5.74 %), Babina (4.95 %), Bogdaproste (3.71 %) and Trei Ozere (4.78 %).

In this sense, it can be said that the probed lake sediments have similar characteristics, incorporating largely organic matter-rich sediment type (about 80 % total organic matter), low in carbonate content (to around few percent of the total carbonates).

It appears that, the autochthonous source (biological and microbiological production and decomposition within the water body) plays a major role, dominating in this area, any contrast being registered between lakes.

Even the Bogdaproste and Trei Ozere lakes, located in the southern part of the Matița-Merhei-Trei Ozere Unit, and which are considered that are standing hydrologically open (through Sulina Arm), does not present any difference in surface sediment characteristics.

Concerning the core sediments it can be said that the entire suite of deposited sediments are layered, being disposed as flat sheets, more or less thick. The type of sediment accumulations ranges in depth. The layers are characterized by fluctuating different color (from greenish light gray to dark grayish), grain-size (silty clay - fine sand), as well as other constituents (debris shells, plant fragments etc.).

By looking at the lithological composite image of each of the sediment cores gathered from Matița and Babina lakes no major differences were found. However, the exception is given by the core collected from Bogdaproste Lake, characterized

by the existence of a unique peaty coarse-grained sediment material layer, that is not rediscovered in the other cores. This suggests that these particular layers were deposited in a different manner in function of freshwater inflow variability and local lake conditions (specificity, dynamics, climate).

The in-depth distribution of the total organic matter is particularly within all investigated sediment cores, and frequently varying within the same aquatic basin. A possible cause of this situation could be represented by the seasonal climatic shifts (droughts alternating with floods), suggesting contrasting depositional environments on a local scale.

Generally, the vertical distribution pattern of the total carbonates is uniform with values included in the same approximate range. The encountered inconsistencies could be related to internal local changes (debris shells, skeletal remains or bio-induced precipitate).

The lake basins considered relatively hidrologically open (e.g., Bogdaproste and Trei Ozere), as well as lake basins considered relatively hidrologically close (e.g., Merhei, Matița and Babina) have been investigated. The results showed that the lake basins intercommunicates with the hydrological network (streams and canals) in diversified ways that are controlled by seasonally induced lake-level shifts (water depth, water and sediment influx), autochthonous productivity and local unstable depositional environment conditions.

The Loss of Ignition has proved to be a fast and reliable method relating to the global assessment of the main lithological components of the grab and core collected sediments, contributing to the identification of the main type of surficial sediment deposited, and respectively in the top 55 centimeters of the bottom of lakes. The hydrographic parameters and the nature of the deposited materials rule the local variations of the total organic matter and total carbonates in the investigated lakes.

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Mujeres y mercados de trabajo: análisis de la segregación ocupacional por sexo en México

[Women and the labor market: Analysis of Occupational Sex Segregation in México]

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ABSTRACT: The purpose of this paper is to measure and analyze the evolution of occupational sex segregation in Mexico between the years of 2000 and 2010, considering it as the expression of inequality between men and women in the labor market. Using the Encuesta Nacional de Empleo (ENE) and the Encuesta Nacional de Ocupación y Empleo (ENOE) based on the official labor surveys of INEGI, analyzes the labor force participation rates of women, the gender composition of employment by occupations, as well as the Karmel-MacLachlan segregation index, comparing the years of 2000 and 2010. The results show that: i) even though female participation in the labor market increased, labor segregation increased during the investigated period from .2351 in 2000 to .2420 in 2010; ii) during the decade, the women´s participation in female-dominated occupations remained stable; iii) historically, the concentration of women is constantly observed in the occupations that configure the occupational structure.

KEYWORDS: Female labor force participation, vertical segregation, horizontal segregation, labor markets, Karmel-MacLachlan index.

RESUMEN: El presente trabajo se propone medir y analizar la evolución de la segregación laboral por sexo en México entre los años 2000 y 2010 al considerarla como expresión de la desigualdad entre hombres y mujeres en los mercados de trabajo. Utilizando las Encuestas Nacional de Empleo (ENE) y de Ocupación y Empleo (ENOE) del INEGI se analizan por una parte, los niveles de participación de las mujeres y la composición por sexo de la estructura laboral y por otra, se mide la segregación ocupacional a través del índice de segregación de Karmel-MacLachlan y su descomposición, comparando los años 2000 y 2010. Los resultados muestran que: i) a pesar del incremento de la participación femenina en el empleo extradoméstico, la segregación laboral se incrementó en el periodo de estudio al pasar de .2351 en el año 2000 a .2420 en 2010; ii) la participación de las mujeres en ocupaciones feminizadas se mantuvo invariable durante la década; y iii) la concentración de mujeres históricamente se sigue observando en las ocupaciones que conforman la base de la estructura ocupacional.

PALABRAS CLAVE: Participación laboral femenina, segregación vertical, segregación horizontal, mercados de trabajo, índice de segregación Karmel-MacLachlan.

1 INTRODUCCIÓN

La segregación ocupacional representa una forma de exclusión, discriminación y falta de aprovechamiento de los recursos humanos en los mercados de trabajo. En este artículo se analiza y estima la segregación ocupacional por sexo en los mercados de trabajo de México durante la primera década del siglo XXI. Se muestra la distribución de hombres y mujeres en

las ocupaciones y se mide el grado de segregación entre los años 2000 y 2010. El tema principal que nos atañe es aplicar el índice de segregación de Karmel MacLachlan (1988) para el total de personas ocupadas en México en el periodo 2000-2010.

El trabajo refiere a la forma diferenciada de participación de hombres y mujeres en los mercados de trabajo. La segregación laboral por razón de sexo está presente en mayor o menor medida en todos los mercados de trabajo del mundo sin importar las características sociales, económicas, políticas o culturales que imperen (Anker, 1998). Este fenómeno conlleva la desigual distribución de las mujeres y hombres en las distintas ocupaciones, lo que provoca discriminación y exclusión laboral de las mujeres en determinados sectores y su concentración en un reducido número de ocupaciones.

El incremento de la participación económica de las mujeres en la fuerza de trabajo extradoméstico es un fenómeno generalizado en México desde los años setenta, siendo los últimos veinte años del siglo XX los de mayor aceleración (Rendón, 2003c). Un estudio realizado por Pacheco (2007) determinó que entre 1970 y 2004 la participación femenina en México se duplicó al pasar de 17.6% a 36.9%, alcanzando 37.7% en 2010 (INEGI, 2010). Esta ha sido la tendencia en los últimos 40 años.

El fenómeno de la participación de las mujeres en los diversos sectores económicos ha generado una nutrida producción académica, a partir de la cual es posible retomar elementos para la comprensión sistemática e histórica de esta participación creciente, así como factores sociales que determinan el marco de sus características. Diversos estudios afirman que fue durante los años ochenta y noventa cuando se observó en México un acelerado proceso de feminización de la fuerza de trabajo, pero también una marcada modificación del perfil sociodemográfico de mujeres que realizan actividades extradomésticas, generando con ello una reestructuración no sólo en el mercado de trabajo, sino también en otras instituciones como la familia; estas modificaciones substanciales se observaron principalmente en estudios de trabajo urbano a nivel nacional y regional (Ariza 2006; Grijalva 2004; Rendón 2003a; Ariza y Oliveira 2002; García y Oliveira 2001a; 2001b).

Los aumentos en las tasas de participación femenina son resultado, en gran medida, de los procesos crecientes de urbanización, los periodos recesivos y de crisis económica que impactaron los activos de la mayoría de la población, así como la reestructuración productiva y los procesos de apertura económica, comercial e industrial que por un lado han obligado a un número gradual de mujeres a integrarse al mercado de trabajo, formal e informal, para mantener niveles de consumo y por otro, ha favorecido a algunos segmentos productivos en los sectores económicos, por las características que reviste el empleo femenino (Grijalva 2004).

El objetivo del presente trabajo es analizar y estimar la segregación ocupacional por sexo en los mercados de trabajo de México durante el periodo 2000-2010, para lo cual se hará uso de los índices de participación y concentración femenina lo que permitirá observar la distribución de mujeres en los subgrupos ocupacionales más representativos en la estructura laboral de acuerdo con la Clasificación Mexicana de Ocupaciones (2009). Como medida de la divergente estructura ocupacional de hombres y mujeres en su participación laboral se utiliza aquí el índice de segregación ocupacional Karmel-MacLachlan (1988) calculado con los datos agregados para toda la población ocupada de México correspondientes al segundo trimestre de los años 2000 y 2010, con datos de las Encuestas Nacional de Empleo (ENE) y de Ocupación y Empleo (ENOE) generadas por el INEGI.

En el texto se plantea en su apartado número dos el significado de los conceptos segregación ocupacional; en el tercer apartado se plantea la situación de las mujeres en los mercados de trabajo de México, con énfasis en el incremento de la participación de las mujeres en el empleo extradoméstico, así como la distribución de mujeres en las distintas ocupaciones. De igual forma se describe brevemente la metodología propuesta por Karmel-MacLachlan (1988) para estimar la segregación ocupacional y se presentan los resultados para el periodo de estudio a nivel nacional. Posteriormente se evalúan los cambios a través del análisis de la descomposición del índice y por último se presentan las conclusiones del trabajo.

2 EL FENÓMENO DE LA SEGREGACIÓN OCUPACIONAL POR SEXO

A pesar del proceso de inserción masiva de las mujeres en las actividades de mercado, las diferencias existentes respecto a la ubicación en la estructura laboral entre hombres y mujeres no han disminuido, por el contrario, persisten y en algunos casos se han incrementado. La segregación ocupacional por sexo del mercado de trabajo, entendida como la distribución desigual de hombres y mujeres a lo largo de la estructura ocupacional y en la que los primeros ocupan mayoritariamente las posiciones más aventajadas, es fundamental para comprender la dimensión de la desigualdad y las diferencias entre hombres y mujeres en su inserción laboral, presentándose como uno de los fenómenos más persistentes en el mundo.

La segregación por razón de sexo es una manifestación primaria de diferenciación sexual de las actividades en la división sexual del trabajo, según la cual los hombres se especializan en actividades de trabajo de mercado mientras las mujeres lo hacen en el trabajo doméstico (Reskin y Bielby 2005). En este orden de ideas, siguiendo a Guzmán (2001) la separación de hombres y mujeres en la estructura laboral significa exclusión social de las segundas al ubicarse en ocupaciones con menor

estatus y condiciones de trabajo menos favorables, concentrándose en ocupaciones predominantemente femeninas y los hombres en las masculinas, vinculadas con lo que significa, de acuerdo con lo autora, ser mujer y hombre y su quehacer construido social y no biológicamente.

En el mercado, esta división sexual del trabajo se reproduce a través de patrones de representación social de género sobre las ocupaciones, así como en la construcción de las diversas jerarquías o estatus en los empleos, definiendo ocupaciones más o menos "adecuadas" para ser desempeñados por unos y otras, por lo que se puede considerar la segregación como el resultado de procesos multidimensionales que atañen tanto a la oferta como a la demanda de trabajo, así como al conjunto de instituciones que conforman los mercados de trabajo. En el ámbito de las empresas, Bielby y Baron (1986) coinciden con Acker (1990) en que la segregación ocupacional se construye dentro de la jerarquía de la organización, recreando los estereotipos de sexo dentro de los lugares de trabajo y moldeando las relaciones sociales que ahí se desarrollan.

A pesar del aumento en la participación femenina en los mercados de trabajo, hecho ampliamente documentado en México a través de diversos estudios (Grijalva, 2004; Ariza 2006; García 2009), las diferencias entre hombres y mujeres dentro de la estructura ocupacional prevalecen y es posible distinguir las dos dimensiones de la segregación: la segregación horizontal que implica una agrupación de mujeres en actividades asociadas a labores típicamente femeninas según la división sexual del trabajo, y la segregación vertical, que hace referencia a la jerarquización de los puestos de trabajo, lo que provoca la concentración de mujeres en los niveles más bajos de la estructura laboral (Anker 1998; Guzmán 2001; Rendón 2003b).

3 TRABAJO FEMENINO EN MEXICO DURANTE LA PRIMERA DECADA DEL SIGLO XXI

Durante la primera década del siglo XXI México experimentó profundas transformaciones políticas, sociales y económicas, que han tenido un impacto importante en el mercado de trabajo y las relaciones laborales a nivel nacional. Entre el año 2000 y el 2010 es posible apreciar dos contracciones en la economía nacional; la primera en 2001, con una caída del PIB de aproximadamente uno por ciento respecto al año anterior, resultado de la desaceleración económica de Estados Unidos. En el mismo sentido, durante los últimos años de la década se presenta una crisis considera como la más importante desde la Gran Depresión (Larrañaga, 2009; CEPAL, 2010; Pearson y Sweetman, 2011). En 2007 una crisis de hipotecas *subprime* en Estados Unidos genera un efecto de "contagio" debido a la globalización financiera, convirtiéndola en una crisis financiera mundial a partir del 2008. El impacto de la crisis financiera en México se observa en la súbita reducción de la actividad económica nacional que se resumió en una contracción de 6.3% del PIB en 2009.

A pesar del contexto, la tasa de actividad económica (TAE) femenina aumentó entre 2000 y 2010, de 38 a 42.5%, mientras que en el caso de los hombres disminuyó, al pasar de 79.9 a 77.6% en el mismo periodo. Entre los años 2000 y 2010, la participación de las mujeres en la población ocupada a nivel nacional mostró una tasa de crecimiento media anual de 2.6%, al pasar de 34.3% a 37.7%. En este sentido, las cifras muestran que el aumento de la participación femenina en el empleo se produjo de manera constante durante toda la década.

Sin embargo, el incremento en estos números no representó una redistribución más equitativa en la estructura laboral. Para determinar el grado de participación y concentración de las mujeres en las diferentes ocupaciones se estimaron dos índices, el de participación y el de concentración. De acuerdo con Nicolás, López y Riquelme (2009), estos índices contribuyen a medir la magnitud del fenómeno. Concretamente, se aplicarán para comparar los niveles de participación y concentración femenina por subgrupos ocupacionales de acuerdo a la Clasificación Mexicana de Ocupaciones para los años 2000 a 2010.

El índice de participación (IP) se utiliza para analizar la proporción de mujeres en una determinada ocupación. Se calcula como el número de mujeres en la i-*ésima* ocupación entre el número total de trabajadores de esa ocupación (F*i*/T*i*). El índice de concentración (IC), se utiliza para determinar en qué ocupaciones trabajan con más frecuencia las mujeres. Su cálculo resulta de dividir el número de mujeres en la i-*ésima* ocupación entre el número total de mujeres empleadas (F*i*/F). Con los resultados del primer índice es posible clasificar a las ocupaciones en femeninas, masculinas y mixtas de a cuerdo a los criterios de la Organización Internacional del Trabajo (OIT) y desarrollado en el trabajo de Guzmán (2001). Al respecto la OIT propone una clasificación que toma como línea de referencia el 35% de participación de la mujer en la fuerza de trabajo que promedian diversos países y un intervalo de 15% a su alrededor para definir las ocupaciones de la siguiente manera: Masculina (M) si la proporción de mujeres en la ocupación es menor a 20%, Integrada-Mixta si la proporción de mujeres en la ocupación es entre 20% y 50%, Femenina (F) si más del 50% de la ocupación es desempeñada por mujeres. Los resultados se muestran en la *Tabla 1*.

Tabla 1. Clasificación de las subocupaciones (CMO) en México de acuerdo al Índice de Participación femenina

Año	**2000**	**2010**
Total de ocupaciones	133	133
Masculinas (M)	81	82
Femeninas (F)	26	27
Mixtas-Integradas (I)	26	24

Fuente: Elaborado a partir de datos de la ENE y ENOE, 2000 y 2010, segundo trimestre, INEGI

Como se observa, la mayor parte de las ocupaciones pueden clasificarse como masculinas y prácticamente no hay variación al respecto entre los años de estudio. Por otra parte, la *Tabla 2* se muestra que en el periodo de análisis, las ocupaciones con una población femenina superior a tres cuartas partes de la población ocupada no varían y básicamente son las mismas, con excepción de la ocupación de lavanderos, planchadores y otros que aparece en 2010 en quinto lugar, desplazando a la ocupación de telefonistas, que ocupaba ese lugar en el año 2000.

La misma tabla muestra a su vez, en términos relativos la distinta distribución de hombres y mujeres en las ocupaciones así como el alto grado de segregación horizontal. Entre las principales están: profesores de enseñanza especial y preescolar, secretarias, trabajadoras domésticas, recepcionistas, peluqueros, técnicos en medicina humana y los trabajadores en limpieza de ropa; todas ellas asociadas a actividades de servicio y cuidados, adjudicadas a las mujeres de acuerdo con la división sexual del trabajo (Anker, 1998). Por su parte, las principales actividades masculinas son las relacionadas con las actividades agropecuarias, jefes y supervisores en la industria, ayudantes y peones, conductores de transporte y directivos (no mostradas).

Tabla 2. Ocupaciones con participación femenina superior a tres cuartas partes de la ocupación total por año

Año	**2000**	**Año**	**2010**
Profesores de enseñanza preescolar	96.0	Profesores de enseñanza especial	95.3
Secretarias, taquígrafos, capturistas y similares	88.9	Profesores de enseñanza preescolar	94.3
Trabajadores en servicios domésticos	88.0	Trabajadores en servicios domésticos	90.4
Técnicos en medicina humana	85.2	Secretarias, taquígrafos, capturistas y similares	89.9
Profesores de enseñanza especial	84.2	Peluqueros, embellecedores y similares	86.8
Peluqueros, embellecedores y similares	77.3	Técnicos en medicina humana	77.1
Telefonistas y telegrafistas	76.7	Lavanderos, planchadores y otros trabajadores en la limpieza de ropa	76.8

Fuente: Elaborado a partir de datos de la ENE y ENOE, 2000 y 2010, segundo trimestre, INEGI

Ahora bien, el periodo de estudio muestra que la segregación vertical se incrementó durante la década pasada, es decir, entre el 2000 y el 2010 hubo un aumento en términos relativos de la concentración de mujeres en las ocupaciones que se encuentran en la base de la estructura laboral, como es el caso de comerciantes, agentes de ventas y vendedores ambulantes, que en conjunto pasó de 24 a 27 por ciento entre el 2000 y el 2010; o el caso de las trabajadoras en servicios (personales y domésticos) que pasó de 20 a 23 por ciento entre durante el mismo periodo. Por otra parte, las ocupaciones donde las mujeres disminuyeron su presencia en términos relativos, fueron en aquellas relacionadas con actividades del sector primario -agrícolas, ganaderas, etc.- y del sector secundario principalmente en la industria.

Tabla 3. Índice de concentración femenina por ocupación principal y año

Grupo ocupacional/Año	IC 2000	IC 2010
Profesionistas	3.2	4.5
Técnicos	4	4
Trabajadores de la educación	6.2	6.4
Trabajadores del arte, espectáculos y deportes	0.4	0.6
Funcionarios y directivos de los sectores público, privado y social	1.6	1.8
Trabajadores en actividades agrícolas, ganaderas, silvícolas y de caza y pesca	6.6	3.6
Jefes, supervisores y otros trabajadores de control en la fabricación artesanal e industrial y en actividades de reparación y mantenimiento	1.4	0.9
Artesanos y trabajadores fabriles en la industria de la transformación y trabajadores en actividades de reparación y mantenimiento	9.4	8.9
Operadores de maquinaria fija de movimiento continuo y equipos en el proceso de fabricación industrial	6.1	3.3
Ayudantes, peones y similares en el proceso de fabricación artesanal e industrial y en actividades de reparación y mantenimiento	3.5	3.2
Conductores y ayudantes de conductores de maquinaria móvil y medios de transporte	0.05	0.1
Jefes de departamento, coordinadores y supervisores en actividades administrativas y de servicios	2.2	2.1
Trabajadores de apoyo en actividades administrativas	11.4	11
Comerciantes, empleados de comercio y agentes de ventas	19.5	19.5
Vendedores ambulantes y trabajadores ambulantes en servicios	4.2	7.2
Trabajadores en servicios personales	8.4	11.6
Trabajadores en servicios domésticos	11.6	11
Trabajadores en servicios de protección y vigilancia y fuerzas armadas	0	0.5

Fuente: Elaborado a partir de datos de la ENE y ENOE, 2000 y 2010, segundo trimestre, INEGI

4 METODOLOGÍA Y RESULTADOS SOBRE SEGREGACIÓN LABORAL

Con la intención de captar la realidad y estimar la magnitud y variación en el tiempo de la segregación ocupacional por sexo, se utilizó el índice de Karmel-MacLachlan (1988) ya que permite realizar comparaciones en el tiempo, así como reconocer la incidencia de diversos factores en los cambios en la segregación, aislando sus efectos (Ariza 2006; Salas y Leite 2007; Sollova y Salgado 2010). La comparación entre las expresiones del índice KM para el periodo 2000 y 2010 permiten deducir cambios en ese periodo de tiempo debido a cambios en la estructura ocupacional; cambios en la proporción de hombres o mujeres en el empleo total y por último, cambios en la composición por sexo en cada ocupación.

El índice de Karmel y MacLachlan, representado por KM, se define como:

$$KM = 1/T \sum n_i \mid F_i - a\,(M_i + F_i) \mid \qquad (1)$$

donde, T y a representan el empleo total y la proporción de mujeres en el conjunto del empleo, respectivamente, mientras que F_i y M_i representan el número de hombres y de mujeres en la ocupación *i*.

El índice toma valores entre 0 (cuando no existe segregación) y 0.5 (cuando la segregación es absoluta); y denota la proporción de personas que deben de cambiar de ocupación para conseguir una segregación igual a cero por razón de género pero manteniendo la estructura ocupacional y la proporción de mujeres en el empleo constantes.

Para comparar los cambios en el periodo de tiempo, el índice de Karmel-MacLachlan está representado en el tiempo 1 y 2, respectivamente como sigue:

$$KM1 = \sum t_i 1 \mid f_i 1 - a1 \mid$$

$$KM2 = \sum t_i 2 \mid f_i 2 - \alpha 2 \mid \quad (2)$$

Las expresiones anteriores son útiles para visualizar entonces que los cambios en el tiempo en la segregación ocupacional por sexo medida por el índice KM se derivan de las transformaciones que ocurran no sólo en la composición por sexo en cada ocupación (a través de las f_i), sino también en la estructura ocupacional (captada por las ti), así como en la proporción de mujeres en el empleo total (α).

El índice KM se puede descomponer en un efecto composición y en un efecto mixto. A su vez, el efecto mixto se puede descomponer en efecto ocupación, efecto género y efecto residual. El efecto composición muestra los cambios del índice entre periodos por variaciones en la composición por sexo en las ocupaciones, manteniendo constante la estructura ocupacional y la participación de hombres y mujeres en el total del empleo. El efecto mixto, por el contrario, recoge cambios del índice entre periodos originados por cambios en la estructura ocupacional y cambios en la proporción de hombres y mujeres en el empleo total pero manteniendo constante la composición por sexo de las ocupaciones. El efecto mixto como ya se señaló, se puede descomponer en efecto ocupación, debido a cambios en la estructura ocupacional; efecto género, por cambios en la proporción de hombres y mujeres en el empleo total y en efecto residual, que representa la parte del efecto mixto que no puede ser explicada por los efectos ocupación y género.

A continuación se presentan los resultados de la descomposición del índice, considerando los cambios en el índice entre los años 2000 y 2010 respectivamente, utilizando los datos de la ENE y ENOE, segundo trimestre para el agregado de la población ocupada a nivel nacional, tomando como base una clasificación de 133 subocupaciones.

Índice KM 2000 = .2351

Índice KM 2010 = .2420

Tabla 4. Descomposición del Índice de segregación KM para el periodo 2000-2010

Año	**2000-2010**
Cambios en el periodo (Efecto total)	2.95
Efecto composición	3.41
Efecto mixto	-0.46
Efecto ocupación	-0.72
Efecto género	1.14
Efecto residual	-0.88

Fuente: Elaborado a partir de datos de la ENE y ENOE, 2000 y 2010, segundo trimestre, INEGI

Como señalamos antes, el valor del índice para cada año es interpretado como la proporción de personas que deberían cambiar de ocupación para lograr una distribución equitativa de la fuerza de trabajo entre hombres y mujeres, manteniendo constante la estructura de las ocupaciones. Así observamos que en el primer periodo, el 23.5% de los trabajadores ocupados debieron haber cambiado de ocupación en 2000 para alcanzar la igualdad entre los 2 grupos, mientras que para el 2010, el valor aumentó al 24.2% de los ocupados, lo que nos permite afirmar que las diferencia en la ubicación de hombres y mujeres en las ocupaciones aumentó en la década.

Siguiendo los resultados reportados en la *Tabla 4*, la descomposición del índice en el periodo 2000-2010 muestra que los cambios se debieron principalmente al efecto composición (de signo positivo), al ser el efecto que presenta el valor más alto en la descomposición. Su interpretación es que para mantener igual la distribución entre hombres y mujeres en el año 2010 comparado con el año 2000, el 3.4% de personas debieron cambiar de ocupación en el 2010. Por su parte, el efecto mixto, es de -0.46%, por lo que no pudo contrarrestar las repercusiones del efecto composición. A su vez, el efecto mixto está dominado por el efecto género, de signo positivo, lo que indica que a pesar del cambio en la proporción de hombres y mujeres en el empleo total, 1.14% durante la década, éste no fue suficiente para contrarrestar la segregación.

5 CONCLUSIÓN

La primera década del siglo XXI presentó importantes retos económico para México y sus mercados de trabajo al experimentar dos periodos recesivos, el segundo de ellos con consecuencias de impacto global. A pesar ello, fue posible constatar el crecimiento de la participación femenina en el empleo total, al representar poco más del 37% de la población ocupada en México. A pesar del incremento en la participación económica femenina durante la primera década de este

nuevo siglo, el predominio femenino en los mercados de trabajo del país se concentra en un reducido número de ocupaciones, muchas de ellas caracterizadas por condiciones precarias y vulnerables como son los servicios domésticos o las ventas ambulantes.

Este crecimiento se da en actividades poco especializadas como trabajadoras domésticas, comerciantes y dependientes, vendedoras ambulantes y otras actividades propias de servicios personales, concentrando en el año 2010 a casi 50% de la población ocupada femenina, mientras que en el 2000 era el 44%. Por otra parte, las mujeres mantuvieron su participación en ocupaciones históricamente feminizadas prácticamente sin variación durante la década, como fue el caso de profesoras de enseñanza especial y enseñanza preescolar y trabajadoras en servicios domésticos, donde la participación masculina apenas representa entre el 5 y 10 por ciento de la participación total.

Fue posible observar en este trabajo que la segregación ocupacional por razón de sexo persiste en los mercados laborales de México al incrementarse el índice de segregación entre los años 2000 y 2010, esto debido a que tanto hombres como mujeres ocupamos posiciones diferenciadas y desequilibradas en la estructura ocupacional y el reparto del trabajo es desigual pero sobre todo, ligado a la división sexual del trabajo. Según los cálculos realizados, para lograr una distribución de la fuerza laboral de hombres y mujeres tendiente a la igualdad, el 24.2% de las personas debieron cambiar de ocupación en 2010, 0.7% más personas que en el año 2000. El efecto composición indica que en el periodo 2000 a 2010 podría haber existido un aumento de casi 3.5% en la proporción de personas que necesitaban cambiar de empleo para igualar la distribución de femenina y masculina en la estructura ocupacional.

Sin duda, la segregación ocupacional por razón de sexo es un fenómeno persistente y las implicaciones que esto tiene en el empleo femenino ponen de manifiesto que las desigualdades entre hombres y mujeres en la estructura laboral, lo que sugiere discriminación y exclusión laboral de mujeres en determinados sectores. Particularmente es de llamar la atención el incremento en la segregación vertical –mayor participación femenina en trabajo menos calificados y de menor paga- puesto que implica que las mujeres se encuentren la base de la pirámide laboral.

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Effect of different doses of ferrous gluconate drug on some biochemical parameter in male rat

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ABSTRACT: The study was designed to investigate the effect of different doses and different durations of ferrous gluconate drug administration on some blood criteria, using 36 males of rats. The animals were divided into four main groups (9 males for each group), the first group control and the other three groups were orally intragastric administrated with (50,75,100) mg/kg bw for three periods (4,6,8) weeks .The blood samples were collected to measure the haematological criteria that include Red Blood Cells count (RBCs) , blood haemoglobine (Hb),Packed Cell Volume(PCV),Mean Corpuscle Haemoglobine Concentration (MCHC), Mean Corpuscular Haemoglobine (MCH) and Mean Corpuscle Volume (MCV).

Results of this study revealed, that ferrous sulfate administration causes a significant elevation for all haematological parameters which proportionally increased with the dosage levels and dosage durations. It was also observed a significant effect of interaction between different doses and periods on most haematological parameters except MCH and MCHC. All results compared with control group and between treated groups, and had no signefecant effect in ALT, AST, bilirubin, creatinin.

The results suggested that the administration of ferrous glugonate drug in high dosing level and long durations may causes defect in haemopoesis especially erythropoiesis that indicated by increased blood parameters level rather than treatment of iron deficiency anemia because of iron supply increase.

KEYWORDS: Iron deficiency anemia, ferrous gluconate.

ملخص: صممت الدراسة الحالية لمعرفة تأثير الجرع وفترات التجريع المختلفة من عقار كلوكونات الحديد على بعض المعاير الكيموحيوية اذا استخدم 36 ذكر جرذ قسمت الى اربعة مجاميع رئيسية (9 ذكر لكل مجموعة). المجموعة الاولى سيطرة والمجاميع الثلاثة الاخرى جرعت بواسطة التجريع داخل المعدي (100,75,50) ملغم/ كغم من وزن الجسم لثلاث فترات (8,6,4) أسابيع . جمعت عينات الدم لقياس المعايير الكيموحيوية التي تضمنت تعداد كريات الدم الحمر ,نسبة هيموكلوبين الدم ,حجم خلايا الدم الحمر المتكدسة , متوسط تركيز الهيموكلوبين في كريات الدم الحمر , متوسط الهيموكلوبين الخلوي ومعدل حجم كريات الدم الحمر.

أظهرت نتائج هذه الدراسة ان تجريع كلوكونات الحديد يسبب ارتفاع معنوي في كل معايير الدم متناسبا مع ازدياد الجرع وفترات التجريع . كما لوحظ تأثير معنوي للتداخل بين الجرع والفترات المختلفة على معظم معايير الدم عدا متوسط تركيز الهيموكلوبين في كريات الدم الحمر ومتوسط الهيموكلوبين الخلوي. اما انزيمي ALT, AST والكرياتنيين والبليروبين فليس هناك تأثير معنوي.

تقترح هذه النتائج بان تجريع عقار كلوكونات الحديد بجرع عالية ولفترات طويلة ممكن ان يسبب خللا في عملية تكوين الدم خصوصا عملية تكوين كريات الدم الحمر وهذا يتضح من خلال ازدياد مستوى معايير الدم.

1 INTRODUCTION

Iron is a nutrient that is related to health and immunity(1). It is the most common element on earth , unfortunately iron is chemically unstable and easily oxidized into an insoluble ferric form , ferric iron is unavailable in most biological system(2). Iron is an essential component of haemoglobin , myoglobin and several enzymes such as catalase, peroxidase , cytochrome oxidase and ribinucleotide reductase (3).Iron of organic (heme)or inorganic (non- heme) origin is physiologically important element that plays vital role in erythropoiesis , oxygen transport , oxidative energy production and mitochondrial respiration (4).

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Iron deficiency anemia is the most prevalent nutritional deficiency worldwide and it is often associated with trace iron change, it is a major public health affects over two billion people (5). The main cause of iron deficiency is the low iron bioavailability of the diet that's lead to depletion of iron in haemoglobin and reduction in the numbers of Red Blood Cells (RBCs) , the consequences of iron deficiency are many and serious, affecting not only individuals health but also the development of societies and countries (6). The main treatment of iron deficiency anemia include treatment with ferrous iron as ferrous gluconate which is much better absorbed than ferric iron e.g. ferric citrate (7). But, numerous studies concluded that oral administration of iron for long durations may be lead to defect in haemopoisis provided by an increase in haematological parameters in human (8 ; 9)and animal (10). Therefore , this study designed to clarify the effect of different doses and periods of oral administration of ferrous gluconate on some biochemical parameters in rat.

2 MATERIALS AND METHODS

2.1 ANIMALS

thirty six healthy adult males of rat weighing (216±18) g and approximately age (12-14) weeks,. Water was supplied ad libitum. They were fed a normal commercial stock diet which contained 35%wheat grains, 35% corn grains,18% Soya, 10% protein and 2% minerals and vitamins. The animals were housed under a 14h:10h light/dark cycle and maintained in controlled temperature (25±2ºC).

2.2 EXPERIMENTAL DESIGN

These thirty six males of rat were divided in four main groups, with 9 animals in each one , and then each of these groups were divided into three groups (3 males of each). The first group served as a control and received tap water, other three groups were exposed for administration of (50 , 75 and 100) mg ferrous gluconate / kg B.W by orally intragastric intubations for (4 , 6 , 8) weeks . At the end of each three administration periods sacrifice (3 rats) for each four subdivided groups and used to collection of samples.

2.3 COLLECTION OF SAMPLES

5 ml of blood was collected from each rat by cardiac puncture using sterile disposable syringeand put in a test tube containing ethylene-diamine-tetraacetic acid (EDTA) and used for haematological examinations.

2.4 BIOCHEMICAL EXAMINATIONS

All haematological examinations were performed in the haematology center of Al-Diwanya teaching hospital in Al-Diwanya city. Hemoglobin was measured by the cyanomethaemoglobin method using Randox kits, Randox: Laboratories, USA (11). Hematocrite was measured by centrifugation of blood collected into heparinized microcapillary tubes no. 563 supplied by Bio Merieux and calculate the percentage of PCV by particular ruler (12). Red blood cells count (RBCs) was counted manually (Monica, 2004). Mean cell hemoglobin concentration (MCHC) was calculated using the equation: MCHC = [(Hb*100) / PCV]. Mean cell hemoglobin (MCH) was calculated using the equation: MCH = [(Hb*10) / RBC]. Mean red cell volume (MCV) was calculated using the equation: MCV = [(PCV*10) / RBC] (12).

Estimation of total bilirubin concentration in serum as in (13) Estimation of creatinine concentration in serum from (Biolabo company)as in (14) Estimation of alanine amino transferase (ALT) activity from Biomerieux companyas in (15) Estimation of aspartate amino transferase (AST) colored method from Biomerieux companyas in (15)

2.5 STATISTICAL ANALYSIS

All results were expressed as the mean ±SD. Statistical analysis was performed with statistical package for the social science for windows (SPSS, version 10).One-way ANOVA was used to find the effect of ferrous sulfate according to the dose and period of treatment on measured haematological parameters .Also one-way ANOVA use to find the interaction between the dose and period .Differences between observations were considered significant at $P<0.05$.

3 RESULTS

Table 1 : Effect of different doses of ferrous gluconate administration on haematological parameters in rats:

Parameters	Group	Ferrous gluconate (mg/kg)	SD ± Mean
RBCs ($x10^6/\mu l$)	C	0	0.14 ±8.03
	G1	50	0.69 a±9.12
	G2	75	0.70 a± 9.20
	G3	100	0.86 abc±9.55
Hb (g/dl)	C	0	0.27 ±8.57
	G1	50	0.41a±9.80
	G2	75	0.65a± 10.08
	G3	100	0.82 abc± 10.73
PCV (%)	C	0	0.56 ± 26.21
	G1	00	1.53a± 30.29
	G2	75	1.35ab± 31.43
	G3	100	1.86 abc± 32.74
MCH (Pg)	C	0	0.23 ±10.67
	G1	50	0.44 ± 10.74
	G2	75	0.39 ±10.95
	G3	100	0.21a± 11.23
MCV (fl)	C	0	0.66± 32.64
	G1	50	0.61± 33.21
	G2	75	0.72ab± 34.16
	G3	100	0.98ab± 34.28
MCHC (%)	C	0	0.72 ±31.93
	G1	50	0.91 ±32.35
	G2	75	1.08 ± 32.07
	G3	100	1.16 a± 32.77

C: control, G1 - G3: treated groups.
a: means there are a significant difference between treated groups and control group.
b: means there are a significant differences between (G2 ,G3) and G1.
c: means there are a significant differences between G3 and G2. number of animals:9/group.

Table 2: Effect of different durations of ferrous gloconate administration on haematological parameters in rats:

Parameters	Group	Duration (weeks)	SD ± Mean
RBCs ($x10^6/\mu l$)	G1 G2 G3	4 6 8	0.29 ±8.42 0.63 ±8.89 0.57**ab**±9.56
Hb (g/dl)	G1 G2 G3	4 6 8	0.38 ±9.13 0.65 ±9.85 1.07 **ab**± 10.63
PCV (%)	G1 G2 G3	4 6 8	1.32 ±28.54 2.00**a** ±30.63 2.23 **ab**±32.98
MCH (Pg)	G1 G2 G3	4 6 8	0.41±10.84 0.55±11.07 0.30±11.11
MCV (fl)	G1 G2 G3	4 6 8	0.78 ±33.89 1.13 **a**±34.45 1.29 **a**±34.49
MCHC (%)	G1 G2 G3	4 6 8	1.04±31.99 1.11±32.15 0.95±32.23

a: means there are a significant differences between (G2 ,G3) and G1.
b: means there are a significant differences between G3and G2.

Table 3:Effect of different doses of ferrous gluconate administration on biochemical paramrters in rat

Parameters	Group	Ferrous gluconate (mg/kg)	SD ± Mean
ALT	C G1 G2 G3	0 50 75 100	2.17 ± 44.9 2.23±70.0 2.31±66.9 2.7±51.2
AST	C G1 G2 G3	0 50 75 100	1.87±70.0 1.97±83.4 2.39±88.4 2.08±79.0
Bilirubin	C G1 G2 G3	0 50 75 100	0.05±0.63 0.7±0.69 0.08±0.74 0.13±0.74
cereatinin	C G1 G2 G3	0 50 75 100	6.11±98.98 7.27±110.1 5.47±87.82 6.81±89.1

Iron an essential component of a number of protein involved in oxygen transport and utilization, one of these proteins is haemoglobin (16). Thus, iron supply necessary for production of RBCs by erythropoiesis process (17). RBC parameters are used most commonly to monitor erythropoiesis, these parameters include RBCs count, Hb, PCV, MCHC, MCH and MCV (18). Regarding the effect of the dosing level of FeSo4 administration on RBCs parameters, FeSo4 elicited a significantly increases in RBCs count, Hb concentration , PCV, MCHC, MCH and MCV in treated groups when compared with contral and between it, these increases were eminent when the dosing level elevated, hence the variation being significant in those groups of animals administered higher levels of FeSo4. These results were in agreement with previous studies concluded that iron

administration as FeSo4 provided an increase in RBCs parameters in rats (6). Similar results have been also reported by several studies (19) who utilized forty male rats were given as120 mg/daily for 45 days. (20) who use twenty rats treated with 150 and 250 mgFeSo4/day for 28 days. Other findings use more than one type of orally iron administration were consistent with our results such as (21)that use twenty four male mice to study haematological changes following administering of different haematinics 60mg Cuso4/mice/day and 120mg FeSo4 /mice/day for one month,. The analysis of the results of the durations dependency of RBCs parameters revealed approximately comparable data of those obtained for the dosing level. RBCs count and Hb level were significantly increased in the groups of animals treated for 8 weeks(G3) relative to those of 4 weeks(G1) and 6weeks group (G2). Such increased was also demonstrated for MCH and MCHC but the variation was insignificant. PCV was significantly increased in all durations and MCV was raised in G2 and G3 groups in comparison with G1 animals. It seemed that the duration of administration plays a prominent role in directing the RBCs parameters variation in the treated rats. Similar findings were reported by other researches (22, 2). Other researches were in agreement with the result of this study as (23) that used 60 rats administrated 80mg/daily for 1,2,3 months. (24) who observed increased in these parameters in twenty neonatal calves gave iron in diet for 14 days. Increased of RBCs count may be attributed to increased iron level in the serum and body storages , as the result of this increase, Hypoxia-inducible factor (HIF) which orchestrates erythropoiesis by mediating genes is increased this lead to HIF raised promotes erythropoeitin hormone (EPO) secretion from the kidney and other non-renal sources (e.g., liver) and up-regulates EPO receptor (EPO-R) in the bone marrow then, increased of targeting colony forming unit-erythroid (CFU-E) that promote increase of erythroblast numbers . HIF also activates factors that improve iron absorption from the gut, mobilization from storage sites, and transport to the bone marrow (e.g., transferrin, transferrin receptor, ferroportin, ceruloplasm, DMT, and DcytB) (24).

It is also believed that several enzymes also either contain iron or are activated by iron because of iron overload stimulate heme production by interfering with enzymes involved in heme biosynthesis such as ferrochelatase that inserts iron into the ring structure of protoporphyrin IX to produce heme, hence raised Hb synthesis ,RBCs count and other haematological parameters (25). Also may be result from increased of other enzymes that contain iron in their structures and have vital role in Hb synthesis like Hemeoxygenase (26) and Levulinic Acid Dehydrogenase which has an essential role in first step of Hb synthesis and Aryl Sulphatase A, B, C (27).

Increased of hemoglobin and red blood cells could also be due to sufficiency of protein synthesis that mainly induces increase of an essential amino acids and long age of energy source of protein synthesis incorporated in hemoglobin production (28,29).

Biochemical parameters (ALT , AST , Bilirubin , cereatinin) are slightly increase (no significant effect) that mean the different doses of **ferrous gluconate had no** significant effect on **biochemical paramrters.**(30).

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Contribution des eaux usées ménagères et des eaux de ruissellement dans la pollution des eaux du chenal de Cotonou au Bénin

[Contribution of household wastewater and stormwater in pollution of waters of the channel of Cotonou in Benin]

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ABSTRACT: Management of domestic sewage and runoff poses enormous problems in major cities of Benin. These waters are mostly dumped in the streets or gutters that drained them to make referrals for various rivers without any treatment, causing the chemical pollution of these.
This study focused on the physicochemical characterization of household sewage and runoff from the city of Cotonou and the impact of the spill on their chemical quality of the channel of the city. Indeed, they are water troughs and water seeping from very heterogeneous and harmful to human body wastes deposited by residents on the banks of the channel. These wastes contain sources of phosphate, sulfate, chloride and nitrate from the decomposition of nitrogenous.
The results of this work indicate the parameters analyzed for the following values: dissolved O_2 (1.5 to 3.2) mg / L; BOD5 (165 to 940) mg/L ; COD (350 to 2250) mg / L; NO_3^- (1.1 to 3.8) mg/L ; NO_2^- (0,07 to 2,6) mg/L ; PO_4^{3-} (1.0 to 3,6) mg/L.These values are very high and demonstrate the levels of physical and chemical pollution enough pronounced of the water of the channel. The quality of the channel's water is mortgaged. This raises a number of measures to clean up it.

KEYWORDS: characterization, degradation, chemical quality, surface water.

RESUME: La gestion des eaux usées domestiques et des eaux de ruissellement pose d'énormes problèmes dans les grandes villes du Bénin. Ces eaux sont pour la plupart déversées dans les rues ou drainées vers les caniveaux qui les acheminent vers les divers cours d'eau sans aucun traitement préalable, occasionnant la pollution chimique de ces derniers.
La présente étude s'est penchée sur la caractérisation physico-chimique des eaux usées ménagères et des eaux de ruissellement de la ville de Cotonou et sur l'impact de leur déversement sur la qualité chimique des eaux du chenal de cette ville. En effet, ce chenal reçoit les eaux des caniveaux et celles qui suintent des déchets très hétérogènes et nocifs à l'organisme humain déposés par les riverains sur ses berges. Ces déchets contiennent des sources de phosphates, de sulfate, de chlorure et de nitrate provenant de la décomposition des déchets azotés.
Les résultats de ce travail indiquent pour les paramètres analysés les valeurs suivantes pour les eaux du chenal : O_2 dissous (1,5-3,2) mg/L ; DBO_5 (165-940) mg/L ; DCO (350-2250 mg/L ; NO_3^- (1,1-3,8) mg/L ; NO_2^- (0,07-2,6) mg/L ; PO_4^{3-} (1-3,6) mg/L. Ces valeurs témoignent ainsi des niveaux de pollution physico-chimique assez prononcés des eaux du chenal car elles sont très élevées et se situent au-delà des normes nationales et internationales en matière de rejet des eaux résiduaires. La qualité des eaux du chenal est donc hypothéquée ; ce qui appelle un certain nombre de mesures pour l'assainissement de celles-ci.

MOTS-CLEFS: caractérisation, dégradation, qualité chimique, eaux surface.

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1 INTRODUCTION

Au cours du transport des eaux usées par les égouts et les canalisations de drainage vers les cours d'eau, celles-ci se détériorent sous l'effet de divers polluants provenant des activités anthropiques. Le chenal de Cotonou, reliant le lac Nokoué au nord à l'Océan Atlantique au sud est un débouché artificiel creusé au départ en 1855 par les colons français en vue d'évacuer le surplus d'eau pluviale et les eaux du lac lors des crues annuelles vers l'océan, pour éviter les inondations à Cotonou.

De nos jours, ce chenal recueille une importante quantité d'eaux usées domestiques et d'eaux de ruissellement de nombreux quartiers de Cotonou. Ces eaux s'y déversent sans aucun traitement par le biais de nombreux ouvrages d'évacuation d'eaux usées, entrainant avec elles divers polluants constitués, entre autres, des sels nutritifs notamment azotés, phosphatés et d'oligo-éléments pouvant provoquer une croissance excessive des algues et des végétaux dans le milieu aquatique.

Parmi les autres polluants déversés dans le milieu aquatique, on peut citer les colorants et détergents, les matières plastiques, les hydrocarbures, les pesticides, les métaux lourds dont les effets sont multiples et variés.

Le chenal de Cotonou est donc victime de multiples pollutions qui ne cessent de dégrader la qualité chimique de ses eaux.

De nombreuses études réalisées sur ce milieu, entre autres, celles de Soclo [1], [2] et de Sagbohan [3] ont cependant révélé une pollution organique peu alarmante.

La présente étude a pour objectif la caractérisation physico-chimique des eaux usées ménagères et des eaux de ruissellement de la ville de Cotonou et l'évaluation de l'impact de leur déversement sur la qualité chimique des eaux du chenal de cette ville

2 MÉTHODES ET MATÉRIELS

2.1 CADRE D'ÉTUDE

Le chenal de Cotonou a une longueur de 4500 m avec une largeur moyenne de 300 m. Il est un couloir de 5 à 10 m de profondeur relié au lac Nokoué par un entonnoir qui répartit son débit dans le lac au gré des versants [4] et ses eaux font l'objet d'intenses activités de pêche par ses riverains.

2.2 ECHANTILLONNAGE

Cette étude a été réalisée sur le chenal de Cotonou et dans les caniveaux qui y débouchent, respectivement dans sept (07) et cinq (05) stations dont les coordonnées géographiques sont les suivantes :

Tableau 1

Ecosystèmes aquatiques et ouvrages d'évacuation	Station de prélèvement et de mesures	Coordonnées géographiques	
		Latitude Nord	Longitude Est
Chenal	Dantokpa	06°22'725 "	002°26'133"
	Dédokpo	06°22'042"	002°26'359"
	L T Coulibaly[1]	06°21'970"	002°26'229"
	Embouchure	06°21'007"	002°26'058"
	Hindé	06°22'725"	002°26'008"
	Gbogbanou	06°21'970"	002°26'229"
	Djidjè	06°22'921"'	002°26'043 "
Caniveaux	Dantokpa	06°21'722 "	002°26'103"
	Gbogbanou	06°22'950"	002°26'259"
	Djidjè	06°21'821"	002°26'143"
	Hindé	06°21'705"	002°26'088"
	Xanadu	06°21'107"	002°26'055"

[1] *Lycée Technique Coulibaly de Cotonou*

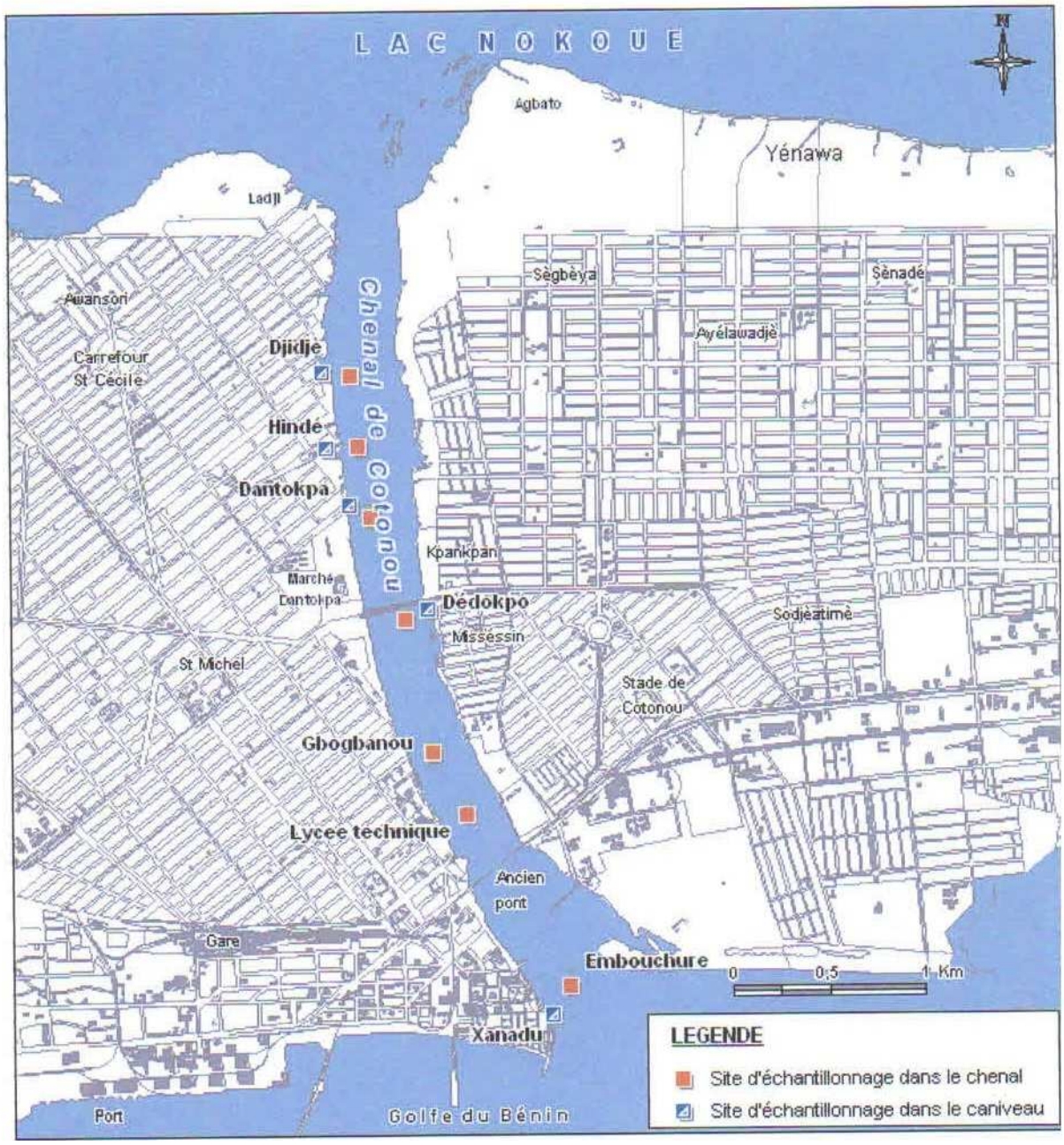


Fig 1 : Localisation des sites de prélèvement

Au total trois (03) campagnes ont été organisées. Tous les échantillons ont été prélevés à 50 cm en dessous de la surface de l'eau, au moyen de bouteilles en verre préalablement lavées et rincées à l'eau à échantillonner. Ces bouteilles ont été remplies à ras bord sans bulles d'air, fermées hermétiquement puis emballées dans du papier aluminium pour les protéger du rayonnement solaire. Parallèlement, un bécher en verre de 250 mL a été utilisé pour prélever l'eau pour les mesures effectuées sur le terrain. Le bécher a également été rincé 3 fois avec l'eau à analyser avant d'opérer les mesures et rincé avec de l'eau distillée avant tout nouvel échantillonnage. Les bouteilles ont ensuite été conservées à une température d'environ 4°C et leurs contenus analysés dans un délai de 48 h. Afin de contrôler et de confirmer la reproductibilité des mesures de ces paramètres, des échantillons supplémentaires ont été réalisés à chaque fois que cela s'est avéré nécessaire.

2.3 MÉTHODES D'ANALYSES

Sur les échantillons d'eau, la température, le pH ont été mesurés avec une sonde multiparamètre de marque Hana Instruments HI 8014, la conductivité, avec un conductimètre de terrain de type WTW/LF 197-S et l'oxygène dissous au moyen du kit de Winkler. Tous ces paramètres ont été déterminés sur le terrain.

Les matières en suspension sont connues par gravimétrie. La demande biochimique en oxygène (DBO) a été déterminée par incubation des échantillons de l'effluent liquide à l'obscurité et à 20 °C dans un DBO-mètre de type a6 posti BOD system 10 contenant des flacons munis de DBO sensor. La demande Chimique en Oxygène (DCO) a été déterminée par oxydation en excès au dichromate de potassium à chaud en milieu acide (AFNOR N T 90-101).

L'obtention des teneurs en ions :

- nitrate (NO_3^-) s'est faite par la méthode au salicylate de sodium;
- nitrites (NO_2^-), par la méthode au réactif de Zambelli ;
- phosphates ($H_2PO_4^-$, HPO_4^{2-}, PO_4^{3-}) par la méthode au molybdate d'ammonium [5].

3 RÉSULTATS ET DISCUSSIONS

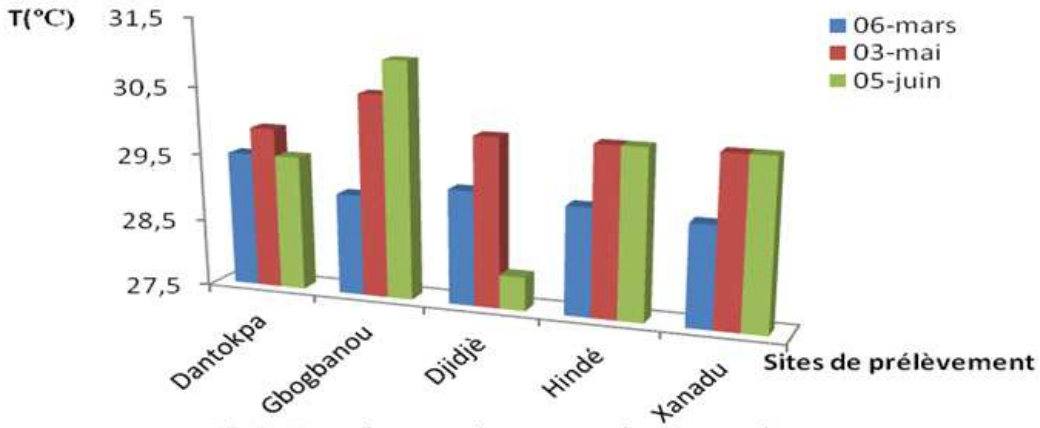


Fig 2: Température des eaux usées des caniveaux

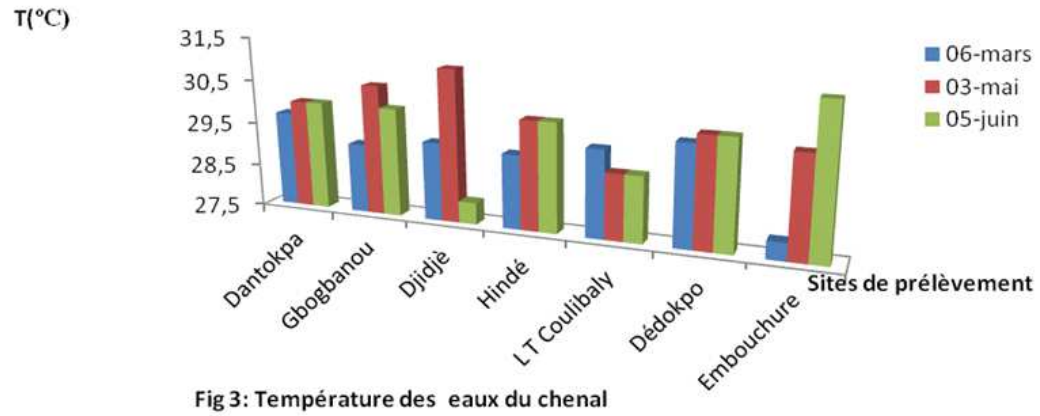


Fig 3: Température des eaux du chenal

La température varie entre 28°C et 31°C pour les eaux du chenal ainsi que pour les eaux usées des caniveaux avec une moyenne de 29,6°C pour ces dernières. Ces valeurs, comparables à celles enregistrées dans le milieu ambiant, sont en harmonie avec celles obtenues par Bonou et al [6] mais ne présentent pas d'importantes variations entre elles et ne

peuvent, par conséquent, pas présager de l'existence d'un risque de croissance accélérée des microorganismes et des algues pouvant conduire à une dégradation prononcée du milieu récepteur.

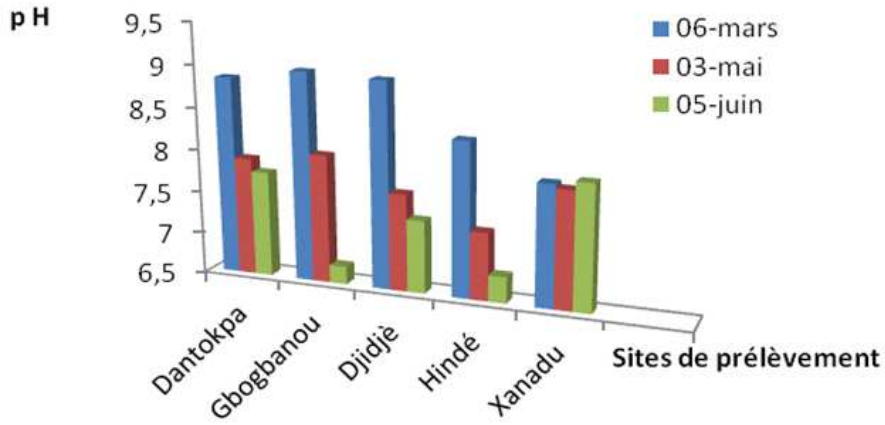


Fig 4: pH des eaux usées des caniveaux

Dans les eaux usées des caniveaux, le pH varie entre 6,7 et 8,8 avec une moyenne de 7, 8. Toutes les valeurs enregistrées respectent les normes béninoises en matière de rejet des eaux résiduaires (6≤ p H≤9) et les plus faibles d'entre elles s'observent en juin sur presque tous les sites tandis que les plus élevées sont obtenues au mois de mars. La plus importante, supérieure à la norme internationale (pH ≤ 8,5), a été enregistrée dans les caniveaux du haut lieu de rejets de diverses substances polluantes qu'est le grand marché de Dantokpa.

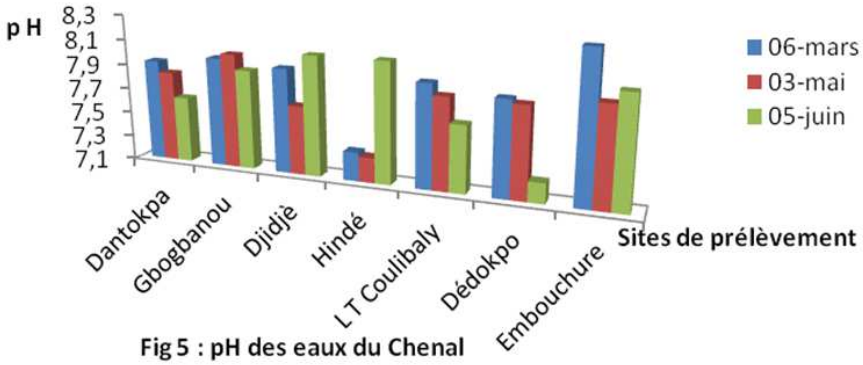


Fig 5 : pH des eaux du Chenal

Les valeurs du pH des eaux du chenal se situent dans la gamme de 7,2 à 8,1 avec une moyenne de 7,6 et sont comparables à celles enregistrées par Bonou et al [6] sur les mêmes eaux. Ces valeurs proches de la neutralité sont caractéristiques de la majorité des eaux de surface et n'indiquent, par conséquent, ni pollution acide ni pollution basique des eaux du chenal.

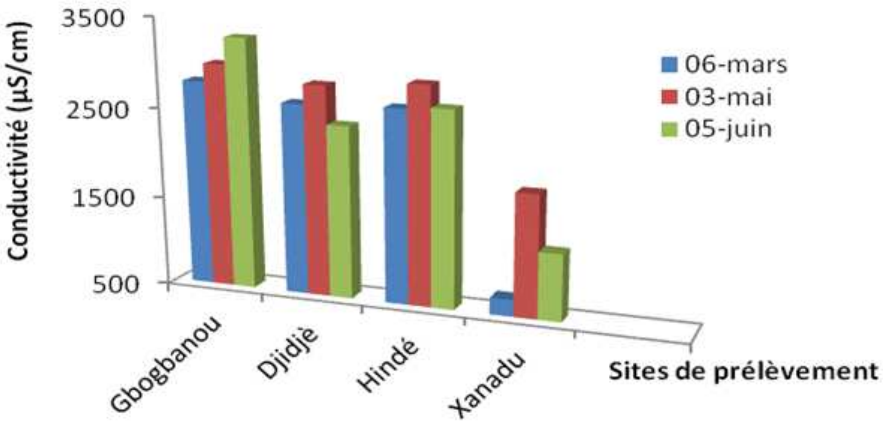


Fig 6: Conductivité des eaux usées des caniveaux

La conductivité des eaux des caniveaux présente des valeurs comprises entre 685 µS/cm, relevée au cours du mois de mars à Xanadu et 3290 µS/cm relevé au mois de juin à Gbogbanou avec une moyenne de 2193µs/cm. Les valeurs les plus élevées sont relevées à Gbogbanou, siège d'intenses activités anthropiques commerciales, de blanchiments et de teinte des toiles nécessitant de fortes consommations de soude et d'autres solutions électrolytiques. Notons que ces valeurs sont largement supérieures à celles observées par Bonou et al [6] et à la valeur limite 500µs/cm rapportée par Belaud [7] pour les eaux de surface.

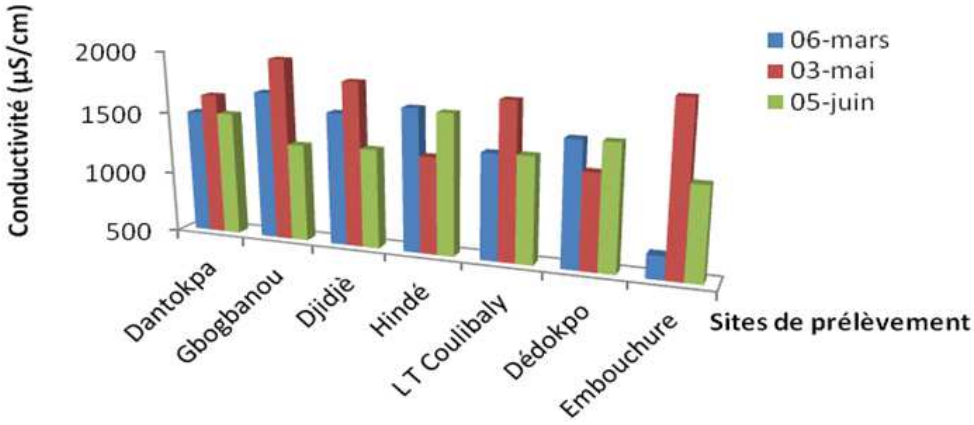


Fig7: Conductivité des eaux du Chenal

L'analyse de la figure 7 ne révèle à priori pas une influence des rejets d'eaux usées des caniveaux sur celles du chenal. En effet les valeurs de la conductivité de ces eaux sont comprises entre 685 µS/cm et 1968 µS/cm et sont plus faibles que celles des eaux des caniveaux. Cependant la diminution de ces valeurs pourrait s'expliquer par les phénomènes de dilution dus aux eaux douces venant du coté du lac Nokoué et circulant vers la mer.

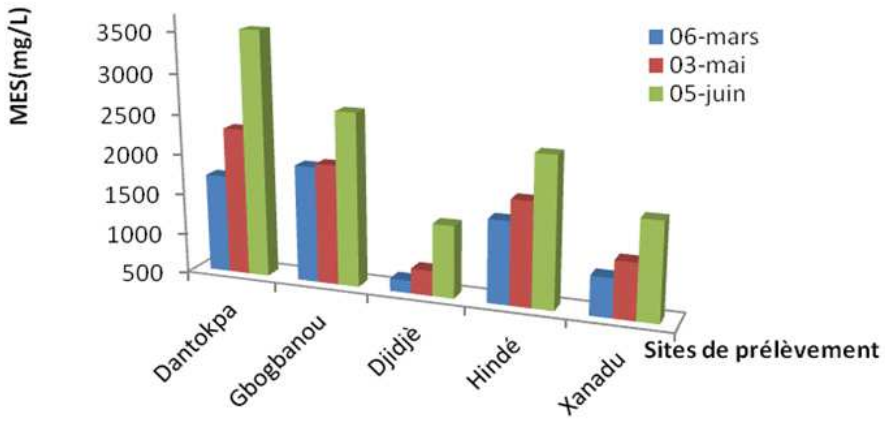


Fig 8: MES des eaux usées des caniveaux

Les teneurs en MES observées sont comprises entre 810 et 3540 mg/L avec une moyenne de 1500 mg/L et une évolution croisante de mars à juin pour toutes les stations. Elles sont largement supérieures à la norme nationale de 35 mg/L et internationale de 300 mg/L. Les taux plus élévés ont été rencontrés au niveau des stations situées non loin du marché Dantokpa.Ceci se comprend aisément par l'importante production de divers déchets peu hydrosolubles par les nombreux usagers dudit marché et qui sont directement jetés ou charriés par ruissellements dans les caniveaux.

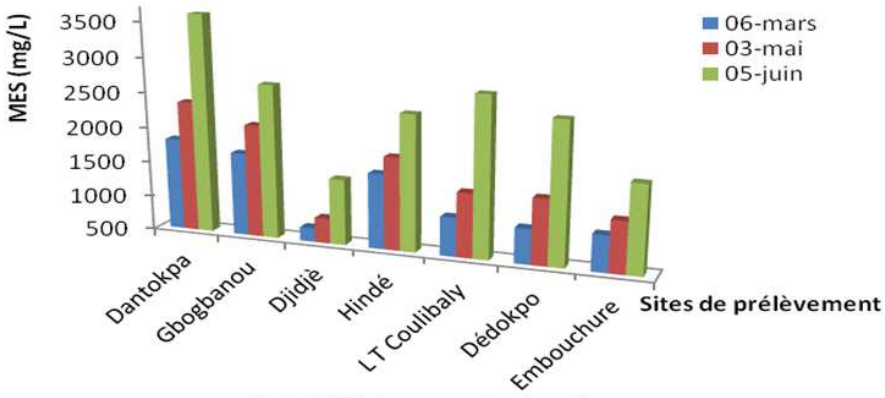


Fig 9: MES des eaux du chenal

Les eaux du chenal présentent également des teneurs très élévées en MES. Ceci témoigne de la forte contribution des eaux urbaines de ruissellement en matières en suspension dans ce chenal. Les conséquences de tels apports sont entre autres, l'augmentation de la turbidité et l'abaissement de la transparence de l'eau ainsi que le colmatage des branchies des poissons et par ricochet la baisse de la productivité de l'écosystème aquatique.

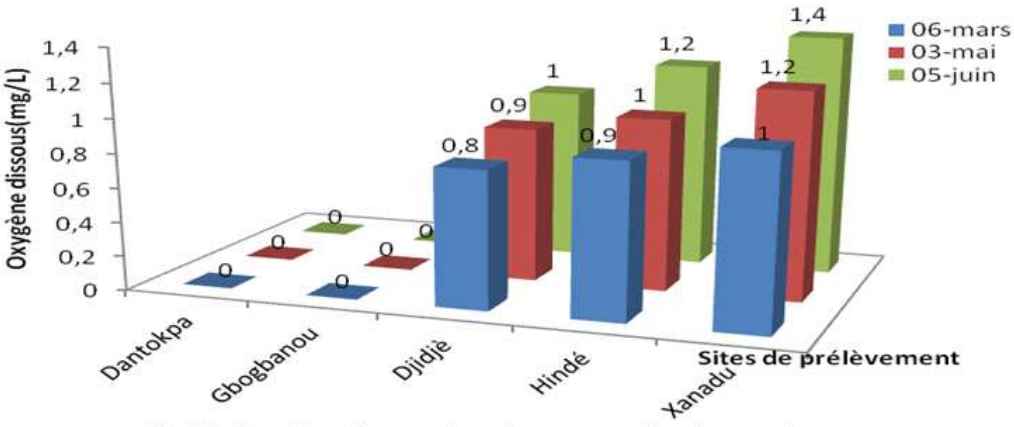


Fig 10: Oxygène dissous dans les eaux usées des caniveaux

Dans les caniveaux , les teneurs en oxygène disssous sont comprises entre 0 et 1,4mg/L avec une moyenne de 0,65mg/L. Ces très faibles valeurs, en dessous de la norme de 4mg /L admise pour les eaux résiduaires sont caractéristiques des eaux usées très chargées de matières organiques et indicatrices de conditions fortement anaérobies.

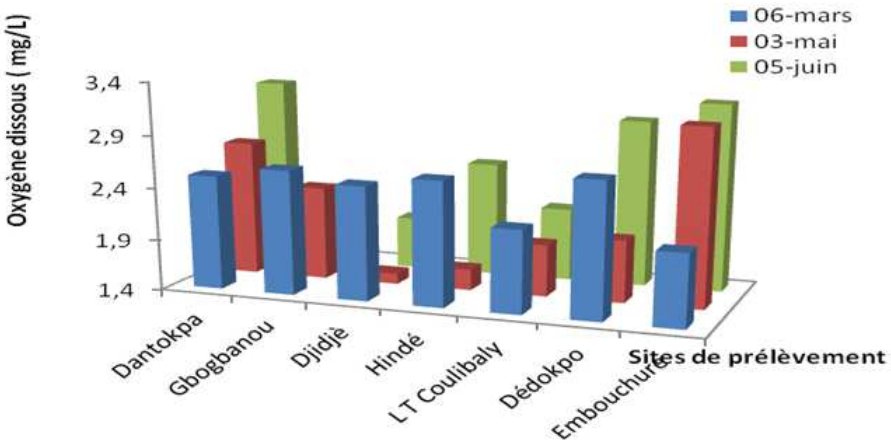


Fig11: Oxygène dissous des eaux du Chenal

Les taux d'oxygène observés dans les eaux du chenal sont comprises entre 1,5 et 3,25mg /L avec une moyenne de 2 ,47mg/L. Ces valeurs sont faibles pour des eaux de surface et font suspecter un degré de pollution non négligeable. Ceci est d'autant préjudicible aux espèces halieutiques vivant dans le chenal que ces dernières ont normalement besoin de beaucoup d'oxygène pour leur survie à cause des températures relativement élévées relevées sur les stations de prélèvement.

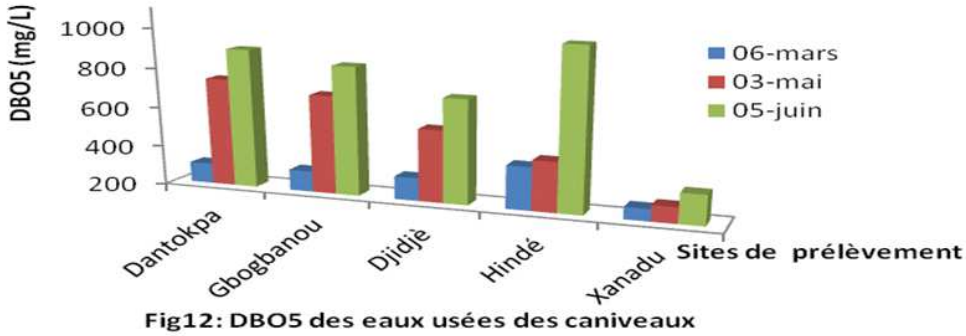


Fig12: DBO5 des eaux usées des caniveaux

Les valeurs comprises entre 260 mg/L et 1000 mg/L, avec une moyenne de 541 mg /L, observées dans les caniveaux, sont largement supérieures aux normes nationale et internationale de rejet d'eaux résiduaires fixées respectivement à 25 et 100mg /L. Ce constat peut s'expliquer par la forte charge en matières organiques biodégradables charriées par les eaux de ruisselement vers les caniveaux en saison pluvieuse, augmentant ainsi les charges organiques polluantes dans les égouts.

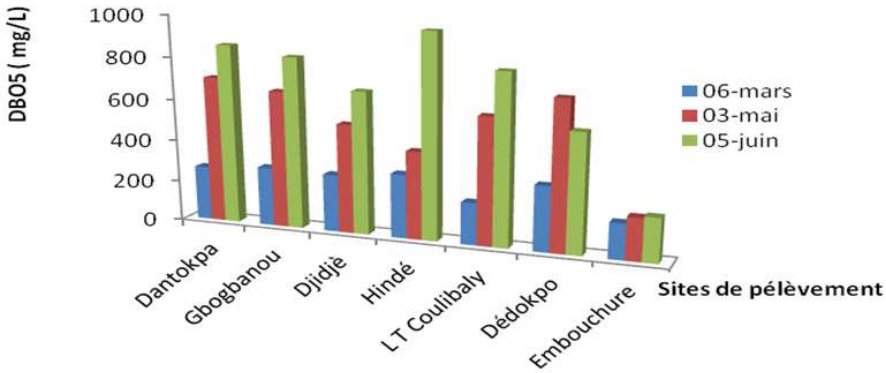


Fig 13 : DBO5 des eaux usées du chenal

La gamme de 165 et 970 mg/L dans la laquelle se situent les valeurs observées est largement supérieure à la valeur limite de 100 mg/L habituellement observée dans les rivières fortement polluées . Les eaux du chenal , receptacles des rejets d'eaux usées domestiques et urbaines et même quelque fois des boues de vidanges des fosses septiques des maisons riveraines, sont donc objet de diverses pollutions générées par celles-ci.

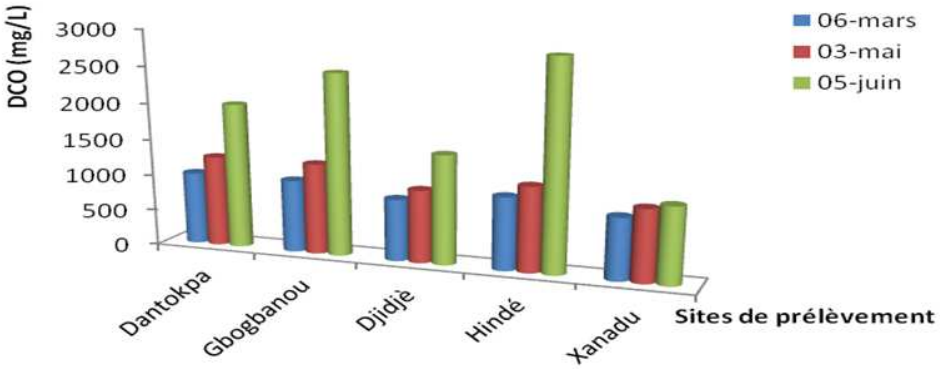


Fig 14 : DCO des eaux usées des caniveaux

Les valeurs de la DCO enregistrées sont largement supérieures aux normes nationale (125mg/L) et internationale (300mg/L) admises pour les eaux résiduaires . En effet, elles sont comprises entre 850 mg/L, relévées aux stations de Xanadu et Djidjè et 2850 mg relévée à Hindé avec une moyenne de 1200mg/L pour l'ensemble des stations . Elles suivent pratiquement la même évolution que la DBO_5 avec les pics de concentrations de charges organiques en juin.

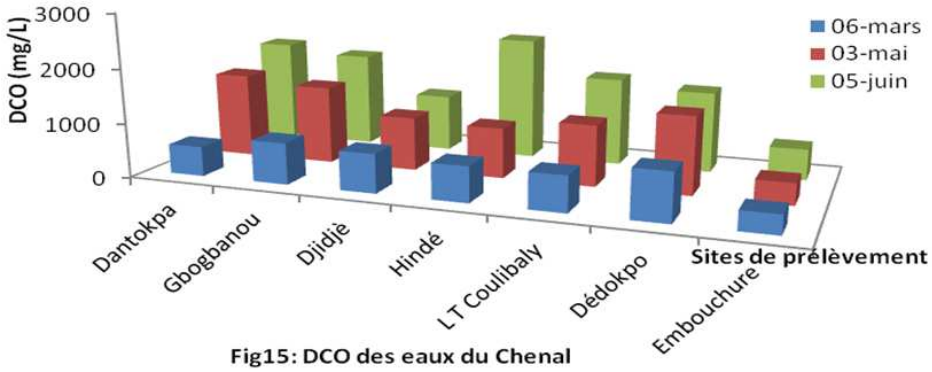


Fig15: DCO des eaux du Chenal

Les valeurs de la DCO obtenues sur les stations sont comprises entre 207 et 2250 mg/L avec une moyenne de 1094 mg /L. Elles indiquent un milieu fortement pollué et préjudiciable au développement des espèces halieutiques.

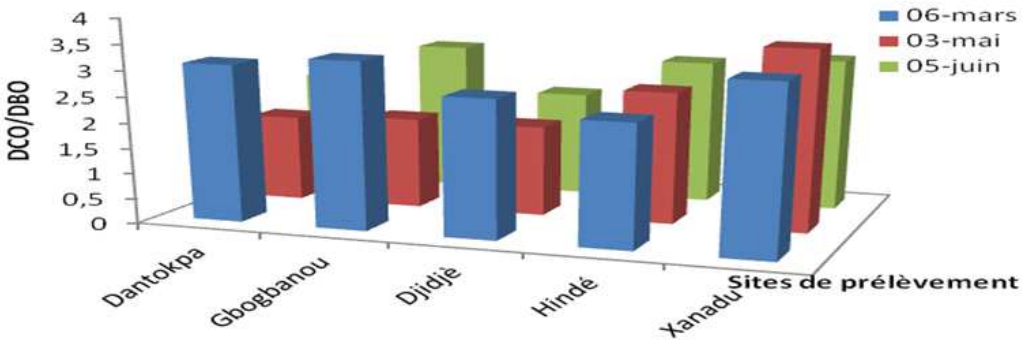


Fig 16 : Evolution temporelle du rapport DCO/DBO5 des eaux usées des caniveaux

Le rapport DCO/DBO_5 est un indicateur de capacité d'auto-épuration des écosystèmes aquatiques par rapport aux apports organiques polluants.

La figure 16 indique des valeurs inférieures à 3 pour toutes les stations au mois de mai sauf à Xanadu où ce rapport est supérieur à 3 sur toutes les stations pour les mois de mars et de juin .

Ces valeurs supérieures ou égales à 3 révèlent le caractère peu biodégradable des matières organiques charriées par les eaux des caniveaux de la plupart des stations étudiées.

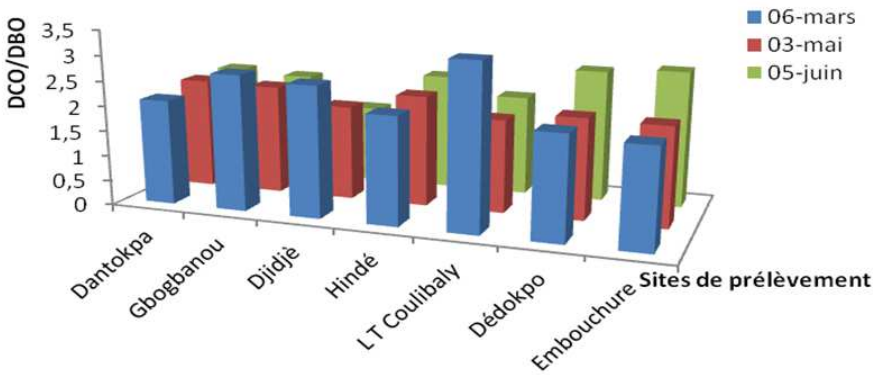


Fig 17: Evolution temporelle du rapport DCO/DBO dans les eaux du chenal

Les valeurs indiquées sur la figure 17 sont comprises entre 1,54 et 2,71 avec une moyenne de 2,17 et sont toutes inférieures à 3. Ceci témoigne de l'évidence du pouvoir auto-épurateur des eaux du chenal de Cotonou.

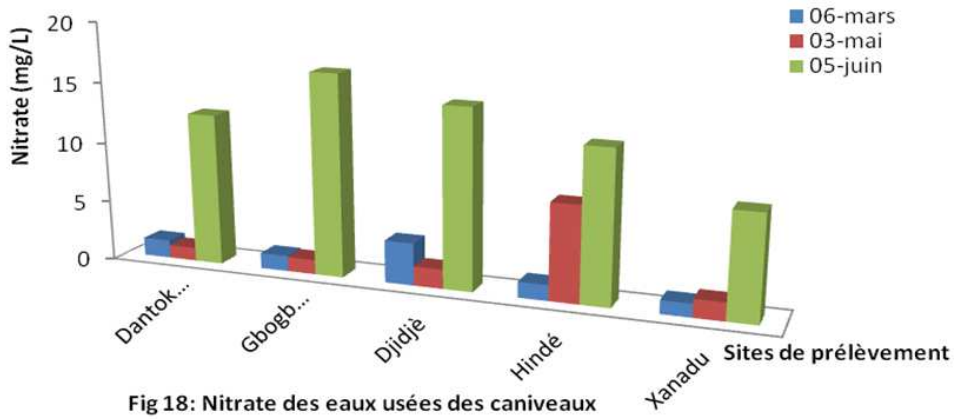


Fig 18: Nitrate des eaux usées des caniveaux

Les concentrations obtenues sont comprises entre 1,1 mg/L et 16,7mg/L dans les eaux usées des canniveaux. Les plus forts taux sont observés en saison pluvieuse (juin) et toutes les teneurs moyennes sont supérieures à la norme internationale fixée à 1,7 mg/L pour les eaux résiduaires. Ces eaux sont donc classées dans la catégorie de celles polluées, impropres à tout usage. Les teneurs en nitrates supérieures à 1,7 mg/L mais inférieures à 50 mg/L sont des indicatrices d'un développement poussé de conditions d'anaérobiose dans les réseaux d'égouts. Ces conditions rencontrées sur nos stations de prélèvement s'expliquent prioritairement par la présence des déchets solides ménagers et commerciaux de toutes sortes produits par les usagers du grand marché Dantokpa et jetés dans les caniveaux . Les eaux de ruissellement des aires de culture des centres maraichers de Cotonou où des engrais azotés sont utilisées pour l'amendement des sols et qui sont drainées par les caniveaux pourraient aussi expliquer les forts taux de nitrate constatés.

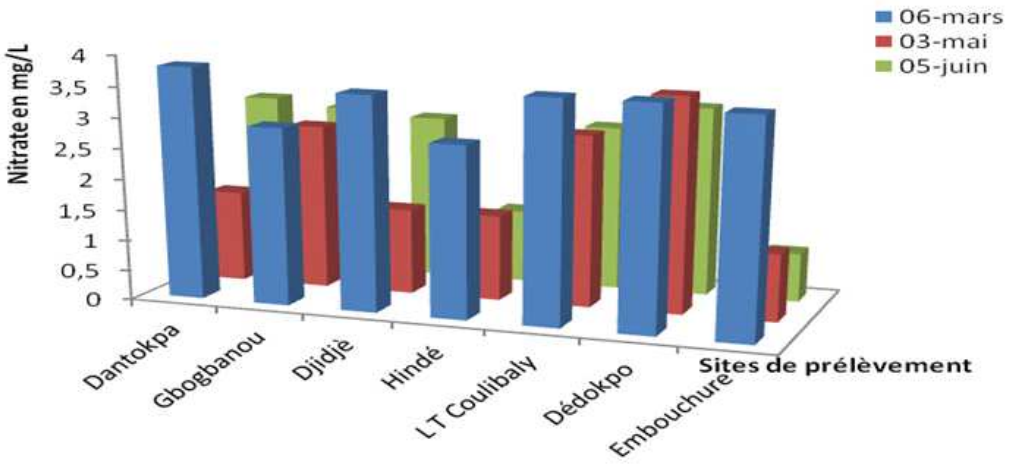


Fig 19:Nitrate dans les eaux du chenal

Les fortes teneurs en nitrates des eaux du chenal se situent dans la gamme de 0,8 mg/L à 3,8 mg/L. Ces valeurs sont toutes supérieures à celles obtenues par Vissin et al [8].

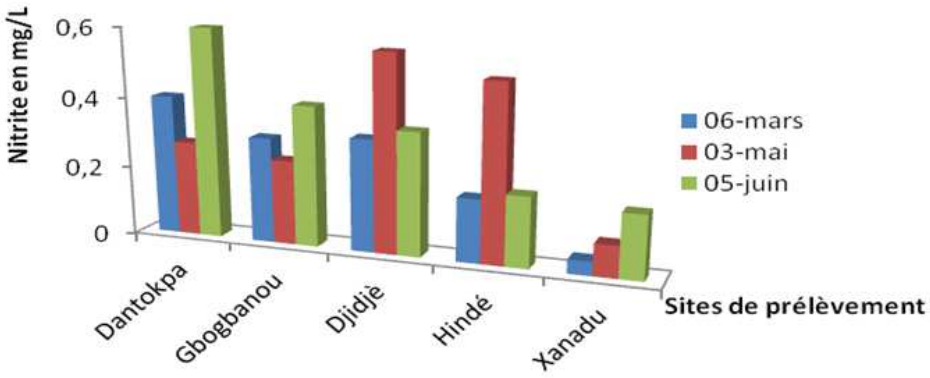


Fig 20: Nitrite dans les eaux uséees des caniveaux

Les concentrations en nitrites sont comprises entre 0,04 mg/L et 0,6 mg/L dans les eaux usées des caniveaux. Ces valeurs sont pour la plupart largement supérieures à la norme internationale de qualité admise pour les eaux résiduaires qui est 0,1mg/L. Ceci indique un état de pollution critique et prédispose les eaux réceptrices du chenal à des pertubations. En effet, une eau renfermant des nitrites, même à faibles doses, peut être considérée comme suspecte, voire létale, pour les poissons [8].

Le fort taux de nitrite observé à Dantokpa pourrait s'expliquer non seulement par la présence en quantité importante de substances azotées générées par les activités anthropiques telles que les urines, les déjections humaines et autres déchets liés aux intenses activités commerciales menées dans le marché et qui sont directement rejetés sans traitement préalable dans les égouts. Ces taux s'expliquent également par les conditions d'anaéorobiose existants par endroits dans ces égouts et favorisant une nitrification assez poussée des matières organiques.

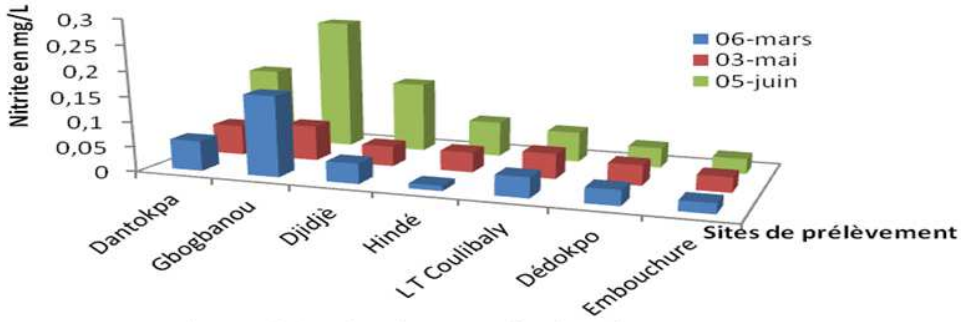


Fig 21:Nitrite dans les eaux du chenal

Les concentrations en nitrites sont comprises entre 0,01 mg/L et 0,26 mg/L dans les eaux du chenal avec une moyenne de 0,068 mg/L. Ces valeurs paraissent peu élevées mais sont cependant néfastes pour les espèces halieutiques exploitées dans les eaux du chenal.

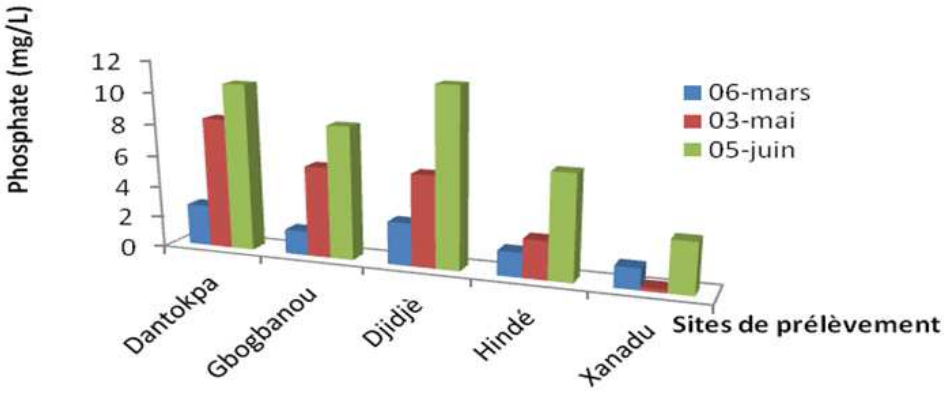


Fig 22: Phosphate dans les eaux usées des caniveaux

La figure 22 indique des teneurs en phosphates comprises entre 0,4mg/L et 11,6 mg/L avec une moyenne de 4,82 mg/L pour les eaux usées des caniveaux. Ces eaux contiennent généralement les rejets de matières fécales et les eaux de ruissellement provenant des fertilisants des exploitations agricoles traitées aux engrais phosphatés qui les enrichissent en phosphore. Les valeurs les plus élevées sont enregistrées au niveau de Djidjè et de Dantokpa. Ces endroits connaissent quotidiennement beaucoup d'activités d'origine anthropique générant des eaux usées potentiellement riches en composés phosphorés dues entre autres, aux détergents synthétiques.

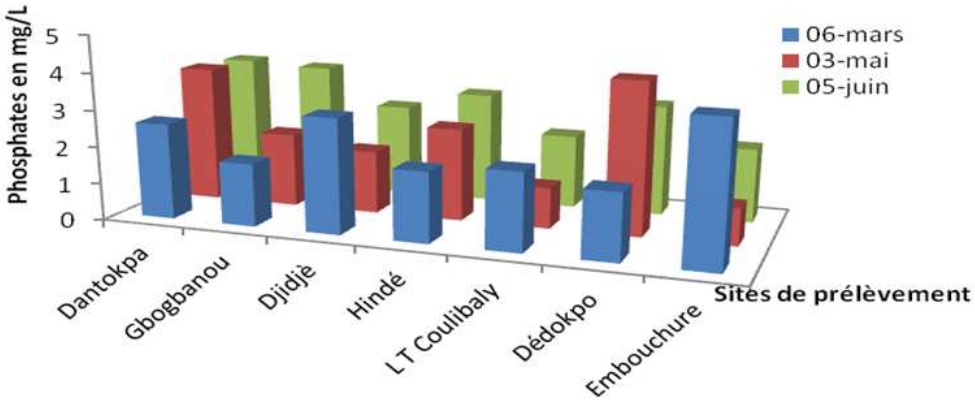


Fig 23: Phosphates dans les eaux du chenal

La figure 23 révèle que les fortes concentrations en phosphates enregistrées dans les eaux usées des caniveaux se répercutent sur les eaux du chenal pour lesquelles les valeurs enregistrées s'échelonnent entre 0,46 et 9,75 mg/L avec une moyenne de 4,01 mg/L sur la période d'étude.

4 CONCLUSION

Au terme de cette étude, il est à noter l'évidence des menaces que constituent les eaux usées ménagères et les eaux urbaines constituées des eaux de ruissellement pour les milieux qui les reçoivent surtout si celles-ci sont rejetées sans aucun traitement préalable dans ces milieux comme c'est le cas au niveau du chenal de Cotonou. Les données recueillies au cours de notre étude montrent des niveaux de pollution chimique relativement élevés, se situant au-delà des normes nationales ou internationales admises en matière de rejet d'eaux résiduaires. Ces apports polluants provenant de sources diverses et variées d'origine anthropique à savoir les activités domestiques, commerciales, industrielles et des eaux de ruissellements urbaines hypothèquent la qualité des eaux du chenal. Ce constat interpelle la conscience des autorités en charge de la gestion de la municipalité de Cotonou pour une intensification de la prise en charge de la gestion de ce chenal abondamment utilisé pour les activités de pêche.

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Evaluation de la morbidité échographique de la bilharziose urinaire chez les écoliers de 6 localités autour du barrage de Taabo (Côte d'Ivoire)

[Ultrasonographic evaluation of the morbidity of urinary schistosomiasis among school children in six locations around the Taabo dam (Ivory Coast)]

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ABSTRACT: Urinary schistosomiasis has been subject of numerous studies around the Taabo dam but the scanning aspect has never been studied. This study was therefore designed to determine the scan morbidity of urinary schistosomiasis among school children in six localities around the Taabo dam. A parasitological examination of urine and the scanner of bladder, ureters, kidneys, liver and spleen were performed in each school child selected. Urinary schistosomiasis was recorded at rates ranging from 1.67% to 68.97% indicating that it is no longer present at high levels in all localities around the dam. In this area, more than 65% of the infected had a mild infection and morbidity were mostly moderate with a scan severity index between 2 and 4. The majority of the 329 scanned school children presented abnormalities in the spleen (67.17%), bladder (40.43%) and liver (13.07%). Among the bladder lesions, mucosal irregularities were more frequent (27.36%), followed by thickening of the wall (14.89%) and weight (4.86%). They were found in all localities even in non-parasitized. Given the heterogeneity of the prevalence of parasitological and scan morbidity indicators, three strategies for reducing morbidity should be adapted to the epidemiological context of different homes.

KEYWORDS: Morbidity, ultrasound, schistosomiasis, urinary, dam, Ivory Coast.

RESUME: La bilharziose urinaire a fait l'objet de nombreuses études autour du barrage de Taabo, mais l'aspect échographique n'a jamais été étudié. Cette étude avait donc pour objectif de déterminer la morbidité échographique de la bilharziose urinaire chez les écoliers de six localités autour du barrage de Taabo. Un examen parasitologique des urines et un examen échographique de la vessie, des uretères, des reins, du foie et de la rate ont été réalisés chez chaque écolier sélectionné. La bilharziose urinaire a été enregistrée à des taux variant de 1,67% à 68,97% indiquant qu'elle n'est plus présente à des taux élevés dans toutes les localités autour du barrage. Dans cette aire, plus de 65% des parasités ont eu une infection légère et les morbidités ont été majoritairement modérées avec un index de sévérité échographique compris entre

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2 et 4. La majorité des 329 écoliers échographiés a présenté des anomalies au niveau de la rate (67,17%), de la vessie (40,43%) et du foie (13,07%). Parmi les lésions vésicales, les irrégularités de la muqueuse ont été plus fréquentes (27,36%), suivis des épaississements de la paroi (14,89%) et des masses (4,86%). Elles ont été retrouvées dans toutes les localités et même chez les non parasités. Au regard de l'hétérogénéité des prévalences des indicateurs parasitologique et échographique de la morbidité, trois stratégies de réduction de la morbidité devraient être adaptées au contexte épidémiologique des différents foyers.

MOTS-CLEFS: Morbidité, échographie, schistosomiase, urinaire, barrage, Côte d'Ivoire.

1 INTRODUCTION

La schistosomose urinaire est une parasitose eau-dépendante représentant la deuxième endémie parasitaire mondiale après le paludisme [1], [2]. C'est une maladie tropicale négligée qui est due aux œufs des schistosomes déposés par les vers adultes dans les vaisseaux sanguins entourant la vessie [3], [4]. Le signe classique de la schistosomiase urinaire est l'hématurie (présence de sang dans les urines). Une fibrose de la vessie et des uretères, ainsi que des lésions rénales sont couramment observées dans les cas avancés. Le cancer de la vessie est aussi une complication possible à un stade tardif. Les lésions urologiques sont mises en évidence par les techniques d'imagerie médicale [5], parmi lesquelles, l'échographie s'est révélée performante pour objectiver les lésions vésicales et rénales de la bilharziose urinaire. En plus, elle est utilisable sur le terrain sans inconvénient, bien acceptée des populations et apparaît comme la technique la plus adaptée aux enquêtes de masse [6], [7], [8]. Elle permet de connaître avec précision la morbidité de la bilharziose à *Schistosoma haematobium*.

En Afrique au sud du Sahara, la bilharziose urinaire est cause d'atteintes graves de la paroi vésicale chez 18 millions de personnes [9].

En Côte d'Ivoire, la bilharziose urinaire est un problème de santé publique [10], [11], [12]. Ici comme dans les autres pays endémiques, ses prévalences sont souvent élevées dans les localités autour des aménagements hydrauliques. C'est le cas des localités autour du barrage de Taabo où les prévalences dépassaient largement 50% [13], [14], [15]. Alors que cette maladie est pourvoyeuse de tumeurs vésicales dans les foyers hyperendémiques, aucune évaluation de la morbidité réelle de la bilharziose à *S. haematobium* n'a jamais été réalisée dans cette zone à notre connaissance.

Aussi, était - il important de connaître l'impact de la bilharziose urinaire sur les organes des personnes parasitées avant d'initier le traitement. D'où la question de savoir quelle est la morbidité échographique de la bilharziose urinaire chez les écoliers des localités autour du barrage de Taabo ? La réponse à cette question est décisive pour déterminer les actions de lutte adéquate d'une part et d'autre part mieux apprécier l'impact du traitement au terme de l'étude. En effet, le principal objectif de la lutte contre la bilharziose est de réduire la morbidité due à cette maladie par la chimiothérapie [4]. Cette étude avait pour objectifs de :

- déterminer les prévalences et les intensités des infections à *Schistosoma haematobium* ;
- déterminer les prévalences et la sévérité des lésions de l'appareil urinaire, du foie et de la rate ;
- comparer ces indicateurs de morbidité entre les différentes localités.

2 MATERIEL ET METHODES

2.1 PRESENTATION DE LA ZONE D'ETUDE

Une étude transversale sur la morbidité de la bilharziose urinaire des populations riveraines du barrage de Taabo s'est déroulée dans 6 localités. Il s'agissait d'Ahondo, Léléblé, Sahoua, Taabo cité, Taabo village et Tokohiri (figure 1). Ce sont des localités du centre de la Côte d'Ivoire, situées à proximité du grand lac artificiel du barrage de Taabo en zone préforestière. Taabo cité est une commune rurale. Il y a de l'eau courante et des latrines dans quasiment tous les ménages. Elle est située à 2 km du fleuve Bandaman sur lequel a été construit le barrage. Les localités d'Ahondo, Léléblé et Taabo village sont situées respectivement à 3 km, 10 km et 1 km. Dans ces dernières, l'eau courante et les latrines existaient en nombre insuffisant. A Sahoua et Tokohiri, non seulement les sources d'approvisionnement en eau étaient très insuffisantes, mais il n'existait pas de latrines. De plus, ces deux localités sont les plus proches du fleuve Bandama, à 150 m environ. Dans toutes les localités, les activités domestiques, de loisir et de pêche y ont été pratiquées régulièrement à l'exception de Léléblé et Taabo cité.

Dans chacune des localités, une école primaire a été retenue sur la base du plus grand effectif d'écoliers. Dans les écoles retenues, environ 60 écoliers à raison de 10 écoliers par classe, du cours primaire 1 (CP1) au cours moyen 2 (CM2) ont été sélectionnés par tirage au sort. La participation à l'étude a été volontaire. Les parents ou les tuteurs légaux des enfants sélectionnés ont été invités à signer une demande écrite de consentement éclairé après explication de l'objectif de l'étude et des procédures par les investigateurs. Les participants à l'étude ont fournit chacun un échantillon d'urine pour des examens parasitologiques avant de subir une échographie de l'appareil urinaire, du foie et de la rate.

2.2 COLLECTE DE DONNEES EPIDEMIOLOGIQUES

2.2.1 EXAMENS PARASITOLOGIQUES DES URINES

Les examens parasitologiques des urines ont été pratiqués une seule fois par la technique de filtration [16]. Après prélèvement des urines entre 10 heures et 14 heures, 10 ml d'urines ont été filtrés à travers un filtre Nytrel®, à l'aide d'une seringue et d'un porte filtre Swinnex Millipore. L'observation des filtres et le comptage des œufs de *Schistosoma haematobium* a été faite au microscope après la coloration des œufs au lugol. Le nombre d'œufs émis par écolier a été déterminé puis enregistré sur la fiche de résultats. Au terme de la lecture, 10% des lames lues ont été relues en vue de contrôler la qualité de la lecture. Les trois catégories d'intensité des infections à schistosomes définies par l'OMS ont été considérées [17]. Ainsi, l'intensité de l'infestation a été classée négatif en absence d'œuf dans l'échantillon d'urine, faible pour une oviurie de 1 à 49 œufs/10 ml d'urines, forte pour une oviurie supérieure ou égale 50 œufs/10 ml d'urines. L'intensité de l'infestation a été définie par la moyenne géométrique de l'oviurie des sujets infestés.

2.2.2 EXAMENS ECHOGRAPHIQUES DE L'APPAREIL URINAIRE

Les examens échographiques de l'appareil urinaire ont été réalisés sur le terrain conformément au protocole standard pour l'utilisation de l'échographie dans l'étude de la morbidité de la schistosomiase [18], [19]. Tous les examens ont été pratiqués par le même spécialiste grâce à un échographe portable ALOKA SSD 500 équipé d'une sonde sectorielle de 3,5 MHz. Ce spécialiste ne connaissait pas le statut parasitologique des sujets échographiés. Les examinés ont absorbé environ 600 ml d'eau, une demi-heure avant l'examen.

L'échographie pelvienne a consisté à examiner la vessie, les uretères et les reins. Les lésions vésicales recherchées étaient : une épaisseur de la muqueuse vésicale > 5 mm, l'irrégularité de la muqueuse vésicale et la présence de masses ou de polypes. En ce qui concerne les atteintes des uretères et des reins, il s'agissait d'une dilatation des uretères et une hydronéphrose. Les observations ont été faites selon les critères définis par l'OMS [18], [19]. Nous avons utilisé des scores obtenus par échographie pour mesurer la morbidité. En effet, les images de la vessie, des uretères et des reins ont été notées. Le score attribué à certaines images a été pondéré afin de prendre en compte la sévérité relative des lésions et pour créer un index de sévérité par addition des différents scores. L'index de sévérité échographique (ISE) était constitué par la somme des scores des images élémentaires. Quatre catégories ont été créées à partir de l'ISE : ISE = 1 : atteinte légère ; ISE = 2-4 : atteinte modérée ; ISE = 5-9 : atteinte sévère ; ISE ≥ 10 : atteinte très sévère.

L'échographie abdominale a consisté à examiner la rate et le foie.

2.3 ANALYSE DES DONNEES

Les données ont été saisies dans le logiciel Excel et analysées grâce au logiciel STATA, version 11 (Stata Cooperation, College Station, Tx, USA). Le test Chi-carré a été utilisé pour comparer les pourcentages avec un seuil de significativité fixé à $p< 0,05$.

La moyenne géométrique des œufs de *Schistosoma haematobium* a été calculée. Les scores des lésions vésicales, du haut appareil urinaire (uretères et reins) et hépatosplénique ont été enregistrés et analysés séparément. Les niveaux de morbidité des communautés ont été déterminés par les index de sévérité échographique moyen.

3 RESULTATS

3.1 PREVALENCES ET INTENSITES DE LA BILHARZIOSE URINAIRE

Cette étude a été réalisée dans six localités autour du barrage de Taabo. Les échantillons d'urines de 342 écoliers âgés de 6 à 15 ans ont été examinés. L'âge moyen des examinés était égal à 9,6 ans avec un sexe ratio de 0,77. La bilharziose urinaire

a été détectée chez 110 écoliers, soit 32,16% des examinés (tableau 1). Sa prévalence est comprise entre 1,67% et 68,97%. Les taux de prévalence enregistrés par localité sont significativement différents (Chi2 = 79,96 ddl = 5 ; P < 0,0001). Les localités peuvent être regroupées en trois catégories de communautés telles que décrites par l'OMS [17]. Les communautés à forte prévalence de bilharziose urinaire ont des taux supérieurs à 60%. Il s'agit de deux localités : Sahoua et Tokohiri. Celles qui ont une prévalence modérée sont retrouvées dans trois localités à savoir Ahondo, Taabo village et Léléblé. Leurs prévalences sont comprises entre 15,25% et 38,10%. Enfin, une seule communauté à faible prévalence a été identifiée à Taabo cité. Quelque soit la localité, les garçons ne sont pas significativement plus infestés que les filles (Chi2 = 0,6825 ddl = 1, P = 0,409).

En considérant les intensités des infections à *Schistosoma haematobium*, nous avons distingué les infections légères où l'oviurie est comprise entre 1 et 49 œufs pour l0 ml d'urines, les fortes infections où l'oviurie est ≥ 50 œufs pour 10 ml d'urines. Plus des 3/4 des élèves parasités ont une infection légère (tableau 1). Parmi les 110 parasités, 84 ont une infection légère. Ils ont été significativement plus nombreux (Chi2 = 21,04 ddl=1, p< 0,0001). Un total de 26 élèves a une infection forte. Ils ont excrété entre 50 et 482 œufs pour 10 ml d'urines. Ils ont été retrouvés dans quatre localités : Ahondo (13,10%), Sahoua (10,34%), Taabo village (5,66%) et Tokohiri (15,79). Contrairement à ces localités, aucun cas d'infection forte n'a été observé à Léléblé et Taabo cité où tous les parasités ont une infection légère. Le nombre moyen d'œufs excrétés par personne était égale à 2,76 et les intensités des infections étaient indépendantes du sexe. Il n'y avait pas de différence significative selon le sexe (Chi2 = 3,11 ddl = 1 ; p = 0,078).

3.2 PREVALENCE DES LESIONS UROLOGIQUES ET HEPATOSPLENIQUES

L'échographie pelvienne et abdominale a été faite chez 329 écoliers (tableau 2). L'échographie pelvienne a révélée 40,43% de lésions vésicales et 2,74% de dilatation des voies urinaires dont 0,91% d'atteinte rénale. Ces lésions ont été observées aussi bien chez les écoliers parasités que chez les non parasités (figure 2). Toutefois, elles ont été significativement plus élevées chez les parasités (Chi2 = 69,4256, ddl = 1, p < 0,0001). Parmi les lésions vésicales, les irrégularités de la muqueuse vésicale (27,36%) ont été les plus fréquentes, suivie des épaississements de la paroi (14,89%) et des masses (4,86%).

Les lésions vésicales ont été observées chez 55 (23,70%) écoliers n'excrétant pas d'œufs de *S. haematobium*. Parmi les 110 parasités, au moins une lésion vésicale a été observée chez 78 (70,90%) écoliers dont 54 avaient une infection légère. Les taux des lésions vésicales ont été compris entre 8,77% et 82,14%. Ils ont varié significativement d'une localité à l'autre (Chi2 = 97,84 ddl = 5; p < 0,0001). Les taux relativement bas, inférieurs à 30% ont été enregistrés dans les localités de Léléblé, Taabo barrage et Taabo village. Par contre, dans les trois autres localités, ils ont dépassé les 62%. Ainsi, les taux les plus élevés ont été enregistrés par ordre d'importance à Sahoua, Ahondo et Tokohiri. Toutefois, c'est à Ahondo que les atteintes urologiques ont été plus sévères pour avoir enregistré l'index de sévérité échographique moyen ISE = 3,86 le plus élevé. Les lésions les plus graves, les dilatations des voies urinaires y ont été enregistrées chez 6 (7,40%) personnes sur les 9 déterminées dans l'aire d'étude. Elles n'ont été observées que chez les garçons âgés d'au moins 11 ans en général. Les lésions vésicales aussi ont été significativement plus fréquentes chez les garçons que chez les filles (Chi2 = 15,19 ddl = 1, p < 0,0001).

L'échographie abdominale a révélé des pathologies au niveau de la rate et du foie. L'anomalie la plus fréquemment retrouvée a été la splénomégalie observée chez 221 écoliers, soit 67,17% (figure 2). Elle a été enregistrée dans toutes les localités à des taux dépassant largement 50%. Cette anomalie n'est pas significativement plus fréquente chez les sujets atteints de bilharziose urinaire que chez les sujets sains (Chi2= 1,64 ddl = 1 ; p = 0,199). Quant à l'hépatomégalie, elle a été moins fréquente que la splénomégalie. Elle a été observée chez 43 soit 13,07% des élèves. Ses taux étaient en deçà de 20% dans la plupart des localités. Comme pour l'appareil urinaire, des anomalies de la rate et du foie ont été également observées chez des écoliers sains. Les lésions échographiées sont plus importantes en termes de fréquence et de gravité chez les bilharziens que chez les écoliers non infesté. La figure 3 montre clairement que toutes les anomalies ont été trouvées à différents taux dans 4 localités Ahondo, Sahoua, Taabo village et Tokohiri où les prévalences de bilharziose urinaire ont été relativement les plus élevées.

4 DISCUSSION

La morbidité réelle liée à la schistosomiase urinaire a été évaluée chez les écoliers de 6 localités situées autour du grand barrage de Taabo. Nos résultats révèlent qu'aujourd'hui, les localités autour du barrage ne sont plus toutes des foyers à forte prévalence de bilharziose urinaire comme identifiés autrefois [13], [14], [15]. Trois catégories de foyers ont été identifiées

selon les critères de l'OMS [17]. Ce sont les communautés à faibles prévalences (Taabo cité), à prévalences modérées (Ahondo, Taabo village, Léléblé) et à fortes prévalences (Sahoua, Tokohiri). La réduction de la prévalence de la bilharziose urinaire à Taabo cité, Taabo village et Ahondo démontre l'impact des actions de lutte. En effet, des actions de lutte contre cette maladie ont été réalisées dans la zone. Nous pouvons citer entre autres, les traitements de masse contre la schistosomiase réalisés dans les écoles primaires hyperendémiques du district de Tiassalé dont la Sous-préfecture de Taabo fait partie [11]. C'est aussi le cas de Taabo village où, depuis plus d'une décennie, des actions de prévention et de lutte sont réalisées [13], [14], [15], [20] [21]. C'est la première fois à notre connaissance qu'une faible prévalence de bilharziose urinaire est enregistrée à Taabo cité. Elle a été relativement la plus faible pour les raisons suivantes : Les comportements à risque y seraient moins fréquents parce que c'est une commune rurale qui bénéficie de l'eau courante et des latrines dans quasiment tous les ménages. Quant aux localités à prévalence modérée, l'eau courante et les latrines existent en nombre insuffisant. Dans les localités à forte prévalence Sahoua et Tokohiri, non seulement les sources d'approvisionnement en eau potable étaient très insuffisantes, mais il n'existait pas de latrines. De plus, ces deux localités sont les plus proches du fleuve Bandama sur lequel le barrage a été construit. Elles sont à environ 150 m. Leurs populations s'y rendent régulièrement pour leurs activités domestiques, de loisir et de pêche. Au regard du contact permanent que ces populations entretiennent avec l'eau du barrage, il est logique que la plupart des personnes excrétant plus de 50 œufs pour 10 ml d'urines proviennent de ces localités.

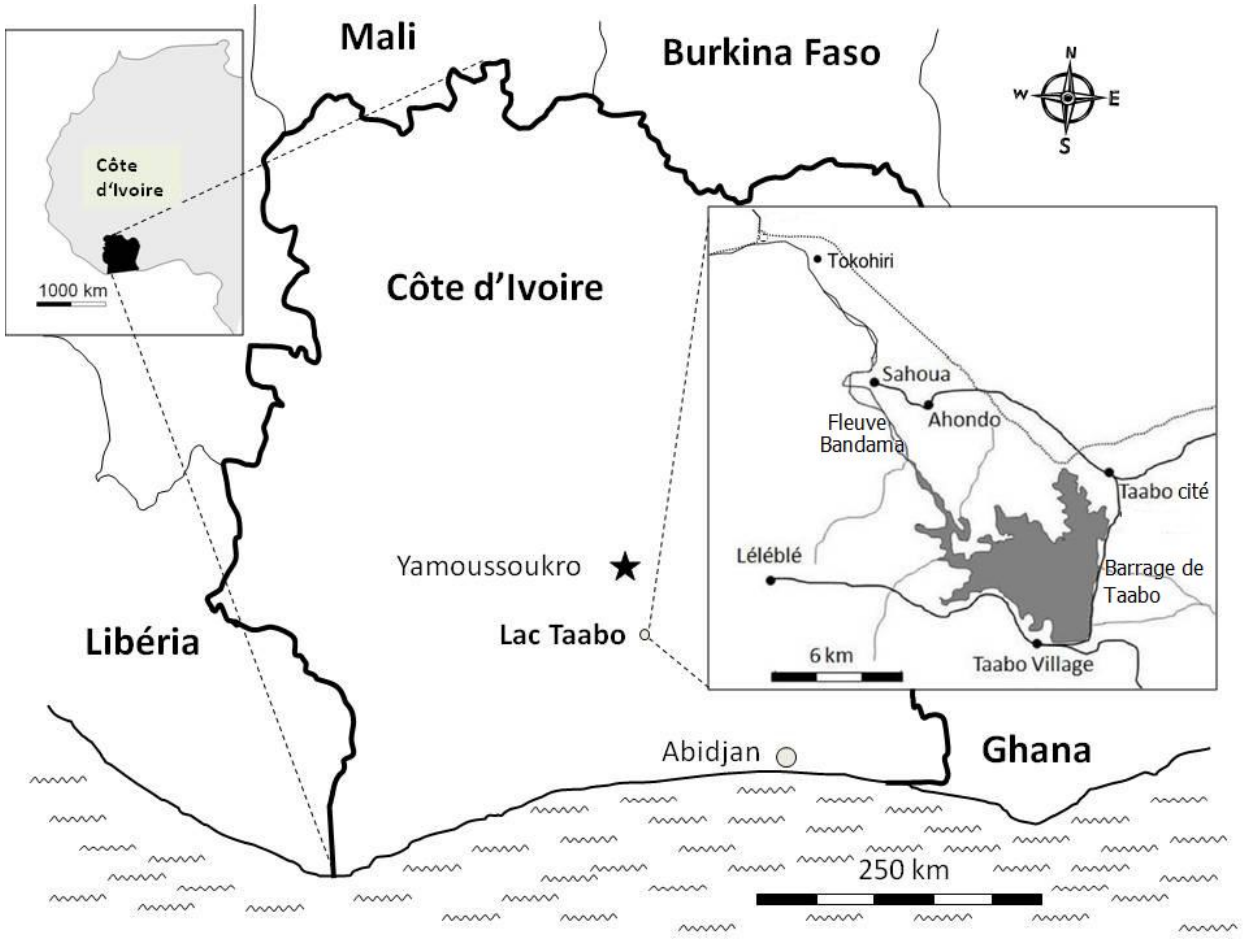
L'intensité de l'infection appelée aussi charge parasitaire, correspond au nombre de parasites présents dans l'organisme du malade. Elle s'évalue grâce à la mesure du nombre d'œufs excrétés dans les urines des personnes atteintes. Ainsi, les intensités d'infection majoritairement légère s'expliqueraient donc par une faible parasitémie. Les intensités d'infection légère ont été enregistrées chez 76,36% des parasités. Ce taux avoisine celui que Senghor et collaborateurs ont obtenu dans le district de Niakhar au Sénégal [22]. La moyenne de 2,76 œufs excrétés par personne dans la zone d'étude confirme la faible parasitémie et présage une faible transmission. Cette moyenne est relativement faible par rapport au 14,9 obtenus à Taabo village [14] et presqu'insignifiante à côté des 185 œufs pour 10 ml d'urines obtenus par Senghor et collaborateurs [22]. C'est probablement pour cette raison que la morbidité a été majoritairement modérée dans l'ensemble des localités. En effet, se sont les œufs des schistosomes déposés par les vers adultes dans les vaisseaux sanguins qui sont à l'origine de la complication de la maladie. Les lésions les plus fréquentes sont la splénomégalie, l'irrégularité de la muqueuse vésicale et l'épaississement de la paroi. La bilharziose urinaire est connue pour ses atteintes de l'arbre urinaire, dont les aspects échographiques ont été suffisamment décrits par de nombreux auteurs [6], [23], [24], [25], [26], [27].

Le taux de splénomégalie noté dans le village de Tara au Niger est proche des taux enregistrés dans la plupart des localités [23].

Les taux de splénomégalie par localité ont été trop importants par rapport aux taux de schistosomiase pour être imputable seulement à la bilharziose urinaire. D'autres affections, notamment le paludisme qui est la première parasitose hydrique en zone tropicale, pourraient être aussi en cause [28]. A contrario, les prévalences de l'irrégularité de la muqueuse vésicale (27,36%) et de l'épaississement de la paroi (14,89%) étaient peu importantes par rapport à la prévalence de la schistosomiase (32,16%). Ceci a été aussi constaté par Adama et collaborateurs [29] et s'expliquerait par les fortes fréquences des infections légères. L'absence d'anomalies chez les parasités s'expliquerait par une infestation récente. Une analyse d'urine négative n'exclut pas l'existence d'une pathologie des voies urinaire et hépatosplénique. Cissé et collaborateurs ont fait le même constat au niveau des voies urinaire [25] puis Medhat et collaborateurs [30] au niveau hépatosplénique. Ceci démontre clairement l'importance de l'échographie dans le dépistage de masse des morbidités liées à la bilharziose urinaire.

La morbidité a été beaucoup plus sévère chez les garçons que chez les filles. Cette prédominance masculine a été aussi remarquée par Kéïta et collaborateurs [24]. Elle serait sans doute occasionnée par leur forte fréquentation de l'eau du barrage, en particulier aux heures chaudes de la journée (12 à 15h) qui correspondent à la période d'émission massive des furcocercaires par les mollusques. A ces mêmes heures, les filles sont plutôt sollicitées par les travaux ménagers et vont plus tôt au lac du barrage.

L'hétérogénéité des prévalences des foyers de bilharziose urinaire autour du barrage de Taabo exige des actions de lutte adaptées au contexte écoépidémiologique [31]. Selon les recommandations de l'OMS [32], dans les foyers à haut risque comme Sahoua (68,97%) et Tokohiri (63,16%), tous les enfants d'âge scolaire et tous les adultes auraient besoin d'un traitement. Dans les zones à risque modéré comme Ahondo (38,10%), Taabo village (22,64%) et Léléblé (15,25%) 50% des enfants d'âge scolaire et 20% des adultes devaient être traités. Quant à Taabo cité, foyer à faible risque, 33% des enfants d'âge scolaire devraient être traités.



Légende :

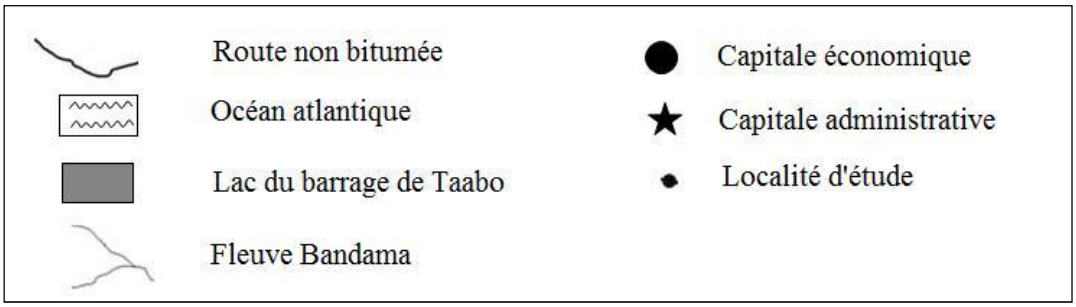


Figure 1. Présentation de la zone d'étude

Tableau 1. Prévalence de la bilharziose urinaire et moyenne géométrique de l'oviurie dans l'ensemble de la population examinée dans les 6 localités autour du barrage de Taabo

	Localités						
Indicateurs	**Ahondo**	**Léléblé**	**Sahoua**	**Taabo-cité**	**Taabo village**	**Tokohiri**	**Total**
Effectifs examinés	84	59	29	60	53	57	**342**
Prévalence bilharziose urinaire	38,10	15,25	68,97	1,67	22,64	63,16	**32,16**
Prévalence de 1 à 49 œufs	25	15,25	58,62	1,67	16,98	47,37	**24,56**
Prévalence de 50 et plus	13,10	0	10,34	0	5,66	15,79	**7,60**
Moyenne géométrique des œufs	1,54	0,3	3,87	0,05	0,95	6,52	**2,76**

Tableau 2. Prévalence des lésions urologiques et l'index de sévérité échographique (ISE) moyen dans l'ensemble de la population examinée dans les 6 localités autour du barrage de Taabo

	Localités						
Indicateurs	**Ahondo**	**Léléblé**	**Sahoua**	**Taabo-cité**	**Taabo village**	**Tokohiri**	**Total**
Effectifs examinés	81	57	28	57	50	56	**329**
Au moins une lésion vésicale	62,96	8,77	82,14	10,53	26	62,50	**40,43**
Dilatation urétéro-rénale	7,40	0	3,57	0	2	2	**2,74**
Atteinte légère ISE = 1	12,35	7,02	17,86	8,77	12	30,36	**14,29**
Atteinte modérée ISE = 2-4	37,04	1,75	57,14	1,75	10	28,57	**20,97**
Atteinte sévère ISE = 5-9	8,64	0	7,14	0	4	1,79	**3,65**
Atteinte très sévère ISE ≥ 10	4,94	0	0	0	0	1,79	**1,52**
ISE moyen	**3,86**	**1,2**	**2,13**	**1,17**	**2,08**	**2,03**	**2,68**

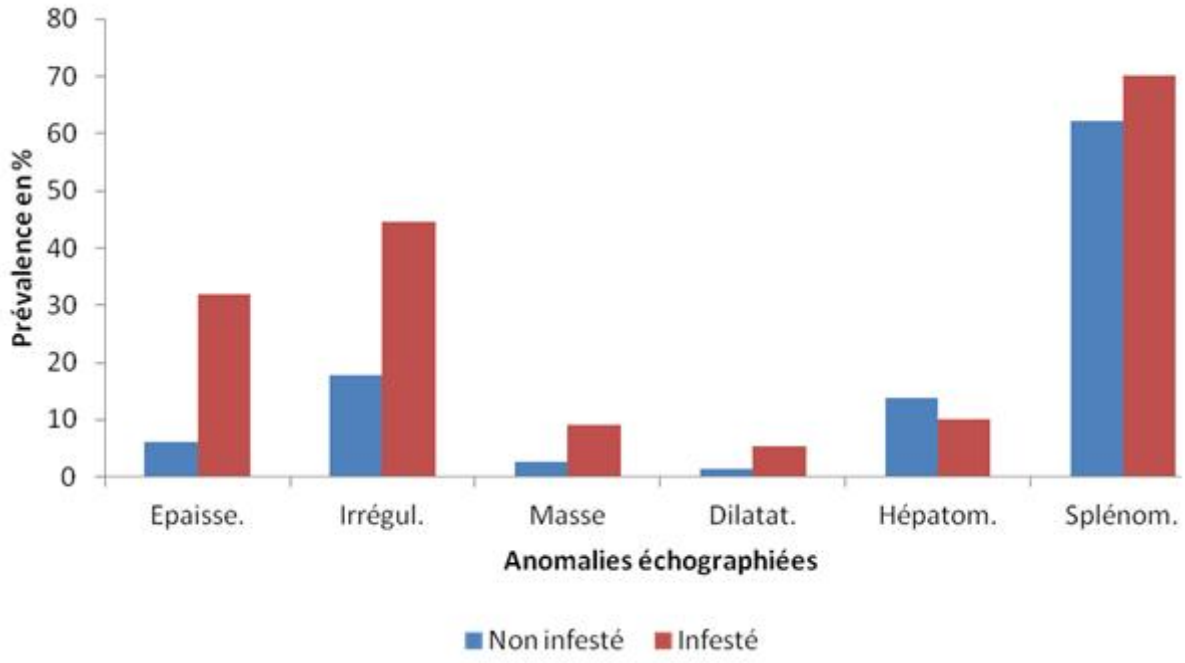


Figure 2. Prévalences des anomalies échographiées chez les écoliers infestés et non infestés par Schistosoma haematobium dans 6 localités autour du barrage de Taabo en Côte d'Ivoire

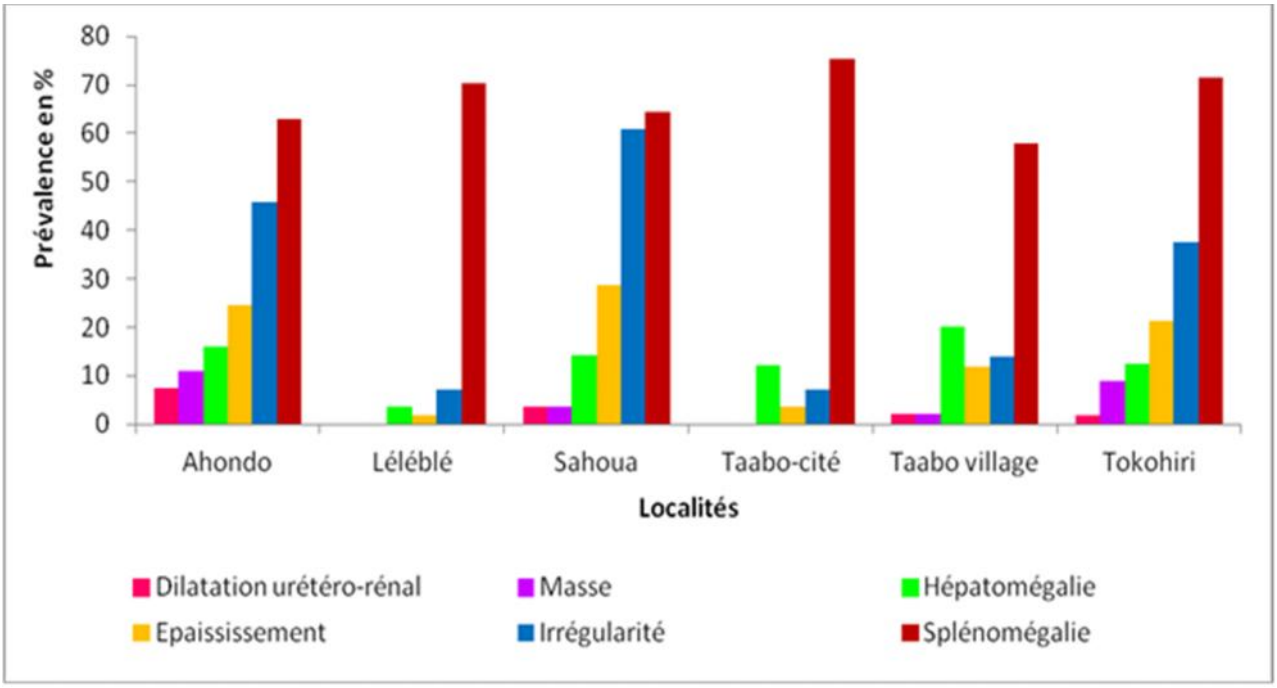


Figure 3. Prévalences des anomalies échographiées chez les écoliers de 6 localités autour du barrage de Taabo en Côte d'Ivoire

5 CONCLUSION

Notre étude fait ressortir le problème de santé publique que constituent les lésions causées par l'infection chronique par *Schistosoma haematobium* en zone d'endémie. L'échographie a permis de mettre en évidence la morbidité réelle de la schistosomiase urinaire dans les foyers autour du barrage de Taabo. La prévalence et l'importance des lésions urologiques et hépatospléniques sont désormais connues. Les prévalences ont été faible (Taabo cité), modérée (Ahondo, Léléblé, Taabo village) et forte (Sahoua et Tokohiri) mais, la morbidité a été modérée dans l'ensemble. Les principales complications révélées par l'échographie ont été la splénomégalie, l'irrégularité de la muqueuse vésicale, l'épaississement de la paroi vésicale et des atteintes sévères comme la dilatation des voies urinaires dans les localités à forte prévalence et à Ahondo.

Au regard de l'hétérogénéité des prévalences des indicateurs parasitologique et échographique de la morbidité, des actions de lutte adaptées au contexte écoépidémiologique ont été proposées. Toutefois, il reste à définir la périodicité du traitement pour réduire la survenue des atteintes néphro-urologiques.

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Inflation Targeting and Exchange Rate Pass-Through: A Comparative Study in Emerging Markets

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ABSTRACT: This paper examines the degree of Exchange Rate Pass-Through (ERPT) to prices in 6 emerging markets that adopt inflation targeting (IT) framework in Latin America and Asia. To achieve this, we employ a modeling strategy that examines the short-run and the long-run fluctuations of the exchange rates pass-through into prices over the period from 1990:Q1-2012:Q4. The paper also finds robust evidence for a positive relationship between the degree of the ERPT and inflation. We conducted a comparative study between countries with hyperinflation and countries with moderate inflation. Estimations results confirm the presence of a positive link between prices and ERPT in emerging markets adopting inflation targeting strategy, while plausible theoretically, finds only weak empirical support in the absence of implemented of inflation targeting regime. The results show that ERPT has declined after IT framework.

KEYWORDS: Exchange rate pass-through, Inflation targeting, Emerging Markets.

1 INTRODUCTION

Movements of exchange rate pass-through into inflation have been at the center of macroeconomic debates over the past two decades. These debates have broad implications for the conduct of monetary policy, for macroeconomic stability, international transmission of shocks and efforts to contain large imbalances in economics. More recently, exchange pass-through issues play a central role over inflation targeting monetary policies. Many emerging markets have opted to change the focus of their monetary policy from targeting the exchange rate or money supply to targeting inflation.

During the 80s and before the adoption of inflation targeting (IT), these countries have experienced high inflation, which has a negative impact on economic growth and investment. Since the early 1990s, the number of ITers countries has increased because this monetary strategy presented more advantages than disadvantages for countries that have adopted it. The implementation of the inflation targeting strategy has shown that countries that have adopted this strategy have experienced low inflation followed by an economic performance (Mishkin (1998) and Woodford (2009)). Mishkin (2001) showed that inflation targeting has improved the framework for monetary policy and (IT) contributes to reducing the rate of inflation and inflation expectations. Recently, Sek (2008) and Gerlach and Tillmann (2012) concluded that (IT) framework appears to be able to realize a stable macroeconomic situation. In this respect, the success of financial policy under inflation targeting has encouraged many other countries adopting this strategy (Kurihara (2010)).

Indeed, since the introduction of the system of floating exchange rates in emerging economies, the works were sometimes conflicting and representative empirical limits. The extent to which exchange rate movements are passed on to consumer prices is an important issue in monetary economics and exchange rate policy. An important empirical and theoretical study on exchange-rate pass-through (ERPT) into import prices is emerging. (ERPT) is one of the main issues in

economics. Formally, the exchange rate pass-through (ERPT) is the percentage change, in local currency, of import prices resulting from a one percent change in the exchange rate between the exporting and importing countries.

In this respect, theoretical and empirical researches on the exchange rate pass-through to aggregate import prices have attracted a renewed attention. In this context, the focus has shifted to the stability of exchange rate pass-through over time.

Calvo (2001) and Ho and McCauley (2003) showed that high degree of pass-through in emerging countries has an important effect on inflation. They concluded from the empirical results that the degree of pass-through, related to an important degree of openness, is higher in emerging market. Moreover, countries that are characterized by a high degree of openness, their economies are influenced by the fluctuation of exchange rates. In this regard, Ghash (2013) shows that the fluctuation of the exchange rate is very noticeable in countries adopting inflation targeting and volatility of the exchange rate has a significant effect on prices through the change in prices of imported consumer goods. In practice, the degree of pass-through plays an important role in the implementation of the policy of IT. Low exchange rate pass-through can lead to a fairly independent monetary policy, which facilitates the implementation of a policy of inflation targeting (Choudhri and Hakura (2006) and Frankel and al. (2012)). Various studies have shown that ERPT has declined in recent years. Beckmann and al. (2013) confirm that the adoption of inflation targeting strategy decreases the exchange rate pass-through into prices, production and importations. Taylor (2000) and Gagnon and Ihring (2004) showed that the degree of exchange rate pass-through and inflation variability, and average inflation are highly correlated. Gagon and Ihring (2002) claim that, a greater emphasis on inflation stabilization allowed both lower mean inflation and reduced pass-through. Adolfson (2007) and Flamini (2007) show that the effectiveness of monetary policy is often conditioned upon the degree of exchange rate pass-through. According to Adolfson (2007), when the pass-through is incomplete, an implicit response to pass-through via CPI inflation targeting is preferred for the conduct of monetary policy that integrates an explicit exchange target, suggesting that the degree of pass-through may contribute to the improvement of monetary policy and reduce average inflation. While for open adopting inflation targeting countries, the transmission of exchange rate changes to prices is an ambiguous effect. This ambiguity is explained by the role of the central bank to stabilize its objectives, namely price stability.

However, work addressing the role of the exchange rate within the framework of inflation targeting are very scarce and the theoretical and empirical analyzes are still mixed (Odría and al. (2013)).

To overcome this limitation, it is necessary to use the VAR model justifies by error correction model (VECM). This econometric model provides advantage to generate changes of ERPT in ITers emerging countries.

We are interested in analyzing two basic aspects of this issue:

- Whether ERPT is an important determinant of inflation in the short-run and in the long-run for these countries.
- Whether this effect has indeed decreased after the adoption of IT.

To answer these questions we estimate the short-run and the long-run ERPT after the adoption of IT. We also calculate ERPT for 6 emerging market that adopted IT (Brazil, Mexico, Peru, Thailand, Indonesia and Philippines) in order to compare results and hence to provide some evidence with respect to the hypothesis that ERPT is low for emerging that adopted IT framework. This evidence sheds some light on the relevance of ERPT for emerging markets adopting the IT framework.

The aim of this paper is to present new empirical evidence regarding ERPT in ten emerging markets that adopted IT (see table A in appendix). However, we investigate the effect of ERPT on prices particularly on inflation rates; distinguish between ITers emerging countries in Latin America that experienced hyperinflation and Asian ITers emerging countries with inflation rate moderated.

Thus, we hope to achieve two goals in this work: one is to contribute to the economic literature on the topic; and the other is to have a more reliable yardstick available in order to establish a comparative empirical approach that allows providing robust answers to analyze the relationship between the degree of pass-through and its effect on inflation in some ITers emerging market that experienced hyperinflation in 80 and 90s.

We structure the paper such that section two present empirical analyses and introduces the dataset. In section three gives the estimations results. Finally, we give the conclusion. The paper has additional table in the appendices.

2 EMPIRICAL STUDY

Our aim is to test the variability of (ERPT) over time. For robustness, we seek what are the common characteristics of (ERPT) in emerging countries and what are the factors behind this change.

The contribution of the paper is twofold; first, we estimate time-varying pass through using the VAR approach to account for gradual changes in exchange pass-through into the rate of inflation measured by the consumer price index (IPC). Second, we study the evolution of pass-through. We study the evolution ERPT specific explanations in case of emerging countries in our sample. Empirical estimates will contribute to the improvement of our knowledge of degree of exchange rate pass-through into inflation when the emerging market using inflation targeting framework.

2.1 ECONOMETRIC METHODOLOGY

In this paper, we look at the movements of ERPT for some emerging markets that adopted Inflation Targeting (IT). We consider a new approach to study the variations in the degree of exchange rate pass-through. We estimate the effects of proposed explanatory variables and test their significativity.

To estimate ERPT, it is generally useful to consider an augmented Phillips curve with the following structure:

$$\pi_t = \alpha + \sum_{i=1}^{k} \beta_i \pi_{t-i} + \gamma(y_{t-1} - \bar{y}_{t-1}) + \sum_{i=1}^{k} \theta_i \Delta txc_{t-i} + \varepsilon_i \quad (1)$$

Where: π_t is the inflation rate that is equal to the logarithmic difference of the CPI, $y_{t-1} - \bar{y}_{t-1}$is the output GAP, $\bar{y}_{t-1}$ is obtained from the Hodrick-Prescott filter applied to the GDP series and Δtxc_{t-i} is the log change in the exchange rate which is increasing the term of the Phillips curve.

Thus, the coefficient γ represents the short-run ERPT. However, the long-run ERPT is obtained by the calculated

$\emptyset = \sum_{i=1}^{k} \theta_i / 1 - \sum_{i=1}^{k} \beta_i$.

However, it should be noted that in the long-run the entire variable may represent a long-run stationary relationship.

Therefore, the long-run ERPT represented by β_0 is obtained by considering the following equation:

$$cpi = \alpha + \beta_1 y_t + \beta_0 txc_t + \epsilon_t \quad (2)$$

In this case, the short-run dynamics cannot be shown until a ECM via equation (3) and the impact of short-run ERPT in this case is equal to $\omega = \theta_1 + \varphi\beta_0$.

$$\pi_t = \alpha + \sum_{i=1}^{k} \beta_i \pi_{t-i} + \gamma(y_{t-1} - \bar{y}_{t-1}) + \sum_{i=1}^{k} \theta_i \Delta txc_{t-i} + \varphi ECT_{t-1} + \varepsilon_i \quad (3)$$

Where: $ECT_{t-1} = cpi - \alpha - \beta_1 y_t - \beta_0 txc_t$

2.2 DATA

The methodology used is as follows, when there is no co-integrating relationship, the analysis focuses on a VAR model in logarithmic difference. But at this work considering that ERPT is shown in terms of the VECM. In the absence of a co-integrating relationship, we add other variables such as the price of oil and IPP and find their theoretical justification on augmented Phillips curve.

According to IMF researchers, 6 of the emerging member countries had adopted IT (with flexible exchange rates) by 2007. The data are quarterly and span the period 1990:1-2012:4. They are obtained from International Financial Statistics. In this regard, we use GDP, IPC (consumer price index) and IPP (production price index) are expressed in logarithm and the nominal exchange rates variable (txc) as a dependent variable. The application of Augmented ADF tests ensures that all variables retained are integrated of order I (1), in this case the Johansen co-integration test is applied. In most cases, the test of the maximum eigen-value confirms the existence of a co-integration relationship within each group of variables at significance level of 1%. The choice of the number of lags is determined using Information Criteria (AIC), Bayesian Information Criteria (BIC) and Hannan-Quinn (HQ), on the criterion of non-autocorrelation of the residuals, the absence of heteroscedasticity (portmanteau test). The results in general show a certain stabilities when changing the number of lags.

3 ESTIMATION RESULTS

In order to achieve our objective of estimating the ERPT on CPI inflation for the ITers emerging markets: Asia and Latin America economies, we presents the econometric test of the variability of ERPT over time. For robustness, we seek what are the common characteristics of ERPT in emerging countries and what are the factors behind this change. We are interested to the dynamic of the long and the short-run of ERPT into inflation.

Results in table 1 suggest that the variation of the exchange rate is transmitted to the inflation with 30% and 35% in (respectively 31.3% in Mexico and 35.25% in Brazil) in the long-run. However, specific estimates in case of ITers Asian countries (Thailand, Philippines) show that the variation of the exchange rate is transmitted to the inflation only 17.58 % to 24.02 % in the long-run, excepted Indonesia the rate is higher (44%).

For the case of Peru, prices respond about 18.19 % for a 1% change in the exchange rate. These results show that ERPT is incomplete and the transmission of the variation in the nominal exchange rates to the real rate is low. According with Taylor (2000) proposition that the decline of pass-through coefficient is caused by a fall in inflation, estimation results of the sign of coefficient corresponds to a decline of both inflation and pass-through. Incomplete ERPT is explained by the low exchange rate mechanism. Monetary authorities do not have enough knowledge to respond quickly to price changes despite implementing inflation targeting framework by their Central Bank. In this context, recent studies suggests that the depreciation of currency should lead to decrease inflation and there is a negative relationship between exchange rate depreciation and inflation for some economies (Mwase (2006), Ca' Zorzi, Hahn and Sánchez (2007)). In this regard, an explanation has been provided by He, Liu and Zhang (2009).

Table 1. Long-run and short-run ERPT and their average in ITers emerging markets

	β2, txc	Short-run ERPT	On %	On%
Thailand	0.24	0.0169	24.02	1.692
Philippines	0.17	0.05	17.58	0.549
Peru	0.18	0.039	18.19	3.93
Mexico	0.35	-0.14	35.25	-14.09
Indonesia	0.43	-0.043	43.90	-4.30
Brazil	0.31	0.03148	31.13	3.14
Average	0.28 28%	-0.0076 -0.76%		

Source: Author's estimations.

However, our estimations in table 2 show that there is some evidence of co-integration between all variables of model. On the short-run dynamics, all the coefficients of error correction terms are negative. This confirms that the dynamic system converges to a long-run equilibrium (see table 2).

Table 2. Long-run ERPT into CPI inflation in ITers emerging markets

Periods		C	β_0, GDP	β_1, oil	β_2 , txc	β_2 , IPP	CointEqua
1995Q1→ 2010Q4	Brazil	3.075	-1.729 (57.62)		-0.311 (17.65)		-0.149 (-5.074)
1990Q1→ 2012Q4	Mexico	1.956	0.076 (0.734)	0.059 (9.07)	-0.352 (5.569)	-1.195 (16.58)	-0.310 (-7.807)
1990Q1→2 011Q4	Peru	-1.881	-0.488 (-11.56)		-0.1819 (-3.907)		-0.1142 (-17.78)
1993Q1→ 2011Q4	Thailand	-2.160	-0.221 (-4.261)		-0.240 (-3.225)		-0.020 (-0.843)
1995Q1→ 2011Q4	Indonesia	5.228	-1.225 (-11.85)		-0.439 (-2.01)		-0.199 (-2.731)
1995Q1→ 2011Q4	Phillipines	1.579	-1.146 (-12.54)		-0.175 (-1.965)		-0.119 (-4.217)

Source: Author's estimations.
Numbers in parenthesis are t-student.
CointEqua: error-correction parameter

Flowing, comparing the results in table 1 and table 2, in this sample, it is clear that the long-run ERPT is higher than the short-run ERPT, as expected. In all countries, the average of short-run ERPT is (-0.16 %). This result show a 100% increase in the exchange rates leads to a decrease of 0.16 % inflation one quarter later.

Among the 6 countries studied, only Indonesia and Mexico have a negative short-run ERPT (- 4.3 % and -14.09 %) respectively. Thailand, Philippines, Peru and Brazil marked a positive short-run ERPT (see table 3). These results are same to Choudhri and Hakura (2006) and Ca'Zorzi, Hahn and Sanchez (2006) study for emerging markets. Furthermore, they show that ERPT has declined for both regions after IT for most emerging markets economies analyzed. However, ERPT still seems to be an issue for the achievement of the inflation targets.

The results show that ERPT has decreased after the adoption of IT for most of emerging markets sample. Nevertheless, the reduction of ERPT after the adoption of IT in the emerging economies analyzed (Latin America and Asia) is justified by the important role of the monetary policy change.

For the two groups ITers economies, the contemporaneous impact of the exchange rate on inflation in the long-run is positive suggesting that the depreciation of exchange rate would lead to decrease in inflation after the implemented in inflation targeting framework during 2000s' (see table A in appendix).

Moreover, the results confirm that the literature on this issue acknowledges the importance of the inflation environment and the monetary policy credibility in determining ERPT (Eichengreen (2002) and Schmidt-Hebbel and Werner (2002). In this regard, when inflation is lowered and stabilized, the economists can explain this by the importance of the institutional role of the Central Bank to counter inflation which justifies the gains on credibility of monetary policy facing decrease of the ERPT (He, Liu and Zhang (2009)).

Table 3. ERPT into CPI inflation: Error correction model

	Thailand	Philippines	Peru	Mexico	Indonesia	Brazil
Constant	0.0051 (1.308)	0.0272 (4.2901)	0.0282 (18.589)	0.0102 (5.288)	-0.0005 (-0.033)	0.0185 (5.277)
π_{t-1}	0.432 (2.937)	0.0247 (0.195)	0.066 (2.685)	0.833 (5.128)	0.1303 (0.857)	0.374 (0.467)
π_{t-2}	-0.1948 (-1.203)	-0.1568 (-1.258)	0.0638 (3.3025)	-0.367 (-1.915)	0.091932 (0.5631)	-0.0874 (-0.897)
π_{t-3}	-0.0541 (-0.347)	-0.1687 (-1.399)	____	0.3715 (2.035)	0.0727 [0.461)	____
π_{t-5}	-0.207 (-1.246)	-0.132 (-1.077)	_____	_____	-0.0612 (-0.445)	____
π_{t-4}	0.1869 (1.210)	_____	0.2144 (1.174)	0.1239 (0.839)	_____	_____
Δtxc_{t-1}	0.0119 (0.493)	-0.0155 (-0.436)	0.0372 (2.312)	-0.250 (-10.768)	-0.1307 (-0.505)	-0.0149 (-1.184)
Δtxc_{t-2}	0.0082 (0.328)	-0.0046 (-0.127)	0.0019 (0.148)	0.0097 (0.239)	0.0838 (0.333)	-0.010 (-0.843)
Δtxc_{t-3}	0.0121 (0.406)	-0.044 (-1.194)	_____	-0.068 (-1.761)	0.306 (1.315)	_____
Δtxc_{t-4}	-0.018 (-0.565)	-0.083 (-2.209)	_____	-0.030 (-0.834)	0.267 (1.184)	_____
Δtxc_{t-5}	-0.007 (-0.225)	-0.046 (-1.215)	_____	_____	0.294 (1.252)	_____
ECT_{t-1}	-0.02 (-0.843)	-0.119 (-4.217)	-0.114 (-17.78)	-0.310 (-7.807)	-0.1998 (-2.731)	-0.1491 (-5.074)
Short − run ERPT	0.0169	0.05	0.039	-0.14	-0.043	0.031

Source: Author's estimations.

Numbers in parenthesis are t-student. ERPT = $\omega = \theta_1 + \varphi\beta_0$

4 CONCLUSION

In this work, we presented evidence on (ERPT) for a set of emerging market economies. Our analysis comparing the dynamic of (ERPT) in ITers countries that experienced hyperinflation in 90s (Latin America economies) and others that experienced a moderated inflation (Asian economies).

We examine the (ERPT) of CPI inflation, for selected economies including 6 emerging market adopting inflation targeting by the end of 2007. Using a VECM model to detect long and short-run relationship**.** We ask if this regime change was followed by a decrease of ERPT into inflation, and therefore the extent to which monetary policy can be restructured to control inflation and achieving goals. Regarding the hypothesis that ERPT is high in emerging markets, we find robust results: it seems that after implemented of inflation targeting regime ERPT is reduced remarkably in countries that experienced hyperinflation. In this regard, we find similar results between our sample emerging markets. In this respect, we find that ERPT into CPI inflation plays an important role in emerging market when the IT is implemented. However, a decrease in (ERPT) decreases inflation. Nevertheless, the role of ERPT is strong for the economies analyzed, and still appears to be a significant variable driving inflation over the short and the long-run.

Empirical results are consistent with economic theory and are robust to the specification of parameters of the model. In this respect, the literature on this issue acknowledges the importance of the inflation environment and the monetary policy credibility in determining ERPT. The problem of having a high ERPT is that it implies that Central Bank has a greater difficulty for attainment of the inflation targets (Fraga, Goldfajn and Minella (2003). In this context, Eichengreen (2002) suggested that the main reason for a higher ERPT in emerging market lies on the lack of credibility of their monetary authorities.

Likewise, the estimation results will help to understand the relationship between the exchange rate and inflation, which could help policy-makers to better guide the adopted monetary policy. From the results above it is possible to observe that ERPT is an important issue under IT framework, as exchange rate movements have serious inflationary implications and our contribution to the economic literature on the topic can invite others emerging market in MENA region like Tunisia, Morocco and Egypt to converge to adopt this monetary regime.

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APPENDIX

Table A. Effective IT adoption dates and average inflation in emerging inflation targeters

	Effective IT adoption date	Pervious anchor	Average inflation 1981-90	Average inflation 1991-02	CPI inflation rate at start of stable targeting
Brazil	1999M6	Exchange rate	699.8	507.4	5.7
Mexico	2001M1	Money supply	69.8	16.5	5.7
Peru	2002M1	Money supply	1,061.7	200.7	-0.1
Thailand	2000M5	Money supply	4.4	4,0	0.8
Indonesia	2005M7	Money supply	11.4	8.41	-------
Philippines	2002M1	Exchange rate And Money supply	14.8	8.1	1.8

Source: Pétursson (2005), IFS and Roger (2009).

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An Appraisal of Water Supply and Sanitation Situation in Some Selected Areas of Kaduna Metropolis

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ABSTRACT: This study examines water supply and sanitation situation in some selected areas of Kaduna metropolis. Primary data was collected from households residing in the area and. 366 copies of well structured questionnaires were administered to the households. Questions were related to the water supply and sanitation situation of households. Data collected were analyzed using descriptive methods. The study result reveals that majority of households in the study area use hand dug wells as their major source of water supply while privately owned boreholes; Kaduna State Water Board, water vendors and streams are other main sources. The risk of various sanitation related infections and diseases are high in the study area due to the poor methods of solid waste disposal. The implication of these poor solid waste disposal methods by the households in the study area is that; people who live close to waste dumps are exposed to various health risks. The paper recommends that the private sector be involved in water supply in the areas of fund mobilization for the construction, maintenance, rehabilitation and expansion of water supply and sanitation facilities in Kaduna metropolis as well as government agencies responsible for the provision of water supply and sanitation facilities should be adequately funded and equipped to carry out their services to the people in order to reach the goal 7 of the MDG 2015 target.

KEYWORDS: Water Supply and Sanitation (WSS); Waste Disposal; Service Provision and distance covered; Urban water use; Water resources

1 INTRODUCTION

Water and sanitation are the main components of public health, which means that once we can secure access to clean water and to adequate sanitation facilities for all people, irrespective of the difference in their living conditions, a huge battle against all kinds of diseases will be won. .Water and sanitation targets feature under the United Nations' environmental sustainability - Goal 7 - of the Millennium Development Goals (MDGs). There have been calls on governments to "halve", by 2015, the proportion of people without sustainable access to safe drinking water and sanitation (UN, 2009)

Water supply is seen as the available water provided to fulfill a particular need; if the need is domestic, industrial, or agricultural, the water must fulfill both quality and quantity requirements. Water supplies can be obtained by several types of water resources projects, such as wells, dams, or reservoirs. Of all municipal services, provision of portable water is perhaps the most vital. All people depend on water for drinking, cooking, washing, carrying away wastes, and other domestic needs, water supply systems must also meet requirements for public, commercial, and industrial activities. Providing daily

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water needs is a burden on households with inadequate services in a number of ways, in addition to the direct health threats. Often, water has to be carried long distances to the house which takes time and effort, a burden borne mainly by women and children. In urban and urban fringe areas, water is often only available from vendors at a price which is usually several times more expensive than the water provided through formal services and it is usually of poor quality. Inadequate water supplies are both a cause and an effect of poverty. (Shanmugham and Solomon, 2011).

With the growing population of Kaduna metropolis, pressure on water supply is being mounted in some parts of Kaduna metropolis especially in Kaduna South. The provision of water supply and sanitation services and their management facilities have not kept pace with the ever increasing population. The remarkable population growth translates to ever increasing pressure on water supply and sanitation services. Linkages between water supply and sanitation (WSS) and a cluster of key sectors, including health, education, agriculture, and environment are intuitively obvious, and documented with varying precision in different developing countries. Some of the data and project experience in Nigeria in these sectors suggest clear linkages between poor WSS standards and decline in health, education and productivity. Specifically, these include low enrollment in schools, particularly of girls who must spend time collecting water, higher crime against women due to lack of toilet privacy, as well as the more obvious impacts of disease, higher infant mortality, high absenteeism in schools and at work, and lower productivity.

2 AIM AND OBJECTIVES OF THE STUDY

The aim of this paper is to appraise water supply and sanitation situation in some parts of Kaduna metropolis.

OBJECTIVE

The above aim will be achieved through the following objectives;

(i) To identify the sources of water supply in the study area.
(ii) To appraise the existing sanitation facilities in the study area.
(iii) To examine the existing sanitation situation in the study area.
(iv) To identify health related effects of inadequate water supply and poor sanitation in the study area between January to April 2012.

THE STUDY AREA

Kaduna, the study area, situates in north western part of Nigeria, between latitudes 8^0 43’ N to 10^0 32’N and longitudes 5^0 48’ E to 7^0 26’ E. Kaduna is an urban agglomeration with a population of about 1.6 million people (Brinkhoff 2010). It is a flat city is at about 600 m above sea level, on the Kaduna River. Climate is tropical wet and dry (Koppen Classification Aw).



Fig1 Map of Nigeria showing Kaduna State

3 METHOD AND MATERIALS

The method of data collection was through the use of simple random sampling techniques. Since the research population is made up of the households in the study area, there are numerous areas in the study area. Out of the numerous areas in the study area, six were selected for the purpose of the study; i.e. two (2) areas per Local government Area as three (3) Local Governments make up the study area namely: Kaduna North Local Government, Kaduna South Local Government and part of Chukun Local government, these selected areas include;

Table 1. Sampled Areas And Number Of Households

SAMPLED AREA	NUMBR OF HOUSEHOLDS	SAMPLE
Ungwan Dosa	1226	62
Ungwan Rimi	2377	118
Barnawa	620	31
Kakuri	306	15
Ungwan Pama	1059	53
Mararaban Rido	1739	87
Total		366

Source: Health Unit of Kaduna North, Kaduna South and Chukun Local Government Areas

The research population is made up of the households in the study area, the researchers carried out a stratified sampling to delimit the area of study into sampled areas. The research chose a sample size of 5% for the households in the study area. The sample size of 5% was chosen for convenience due to the limited time available to carry out the research; a total number of 366 questionnaires were prepared and administered to selected households in the sampled areas by the authors.

SOURCES OF WATER SUPPLY

The tables below shows water supply sources in the study area, information on water supply sources, quantity of water used and distances to the source of water supply, problems faced as a result of sourcing water and others are presented.

Table 2. Sources of water supply in the sampled areas in the dry season

	Sampled Areas							
Sources	Ungwan Dosa	Ungwan Rimi	Barnawa	Kakuri	Ungwan Pama	Mararaban Rido	Total	Percentage
Pipe	10	2	8	1	5	6	32	10
Hand dug Well	62	6	47	32	10	21	178	55
Borehole	18	5	18	16	11	16	84	26
Vendors	8	2	6	5	3	3	27	8
River/stream	0	0	1	1	0	1	3	1
Others	0	0	0	0	0	0	0	0
Total							324	100

Source: Field Survey, 2012

The major sources of water supply in the study area are shown in Table 2. The results shows that 55% of the study sample gets their water supply source from hand dug wells while 26% of the respondents get their water from boreholes. This situation was also observed by the researcher during the field survey. Many residents of the study area go to private borehole owners to purchase water on a daily basis especially during the dry season when the water levels of most hand dug wells drop. Only 10% of the respondents get their water supply from the government owned piped water system while 1% of the respondents' source of water supply is from streams. This shows that there is little dependency on the government for water supply as people resort to "self help" in sourcing for water. This situation is worrisome as the target for sustainable

water supply to at least 80% of households in Kaduna metropolis by 2015 might not be realized. Those that get their water supply through water vendors make up 8% of the respondents.

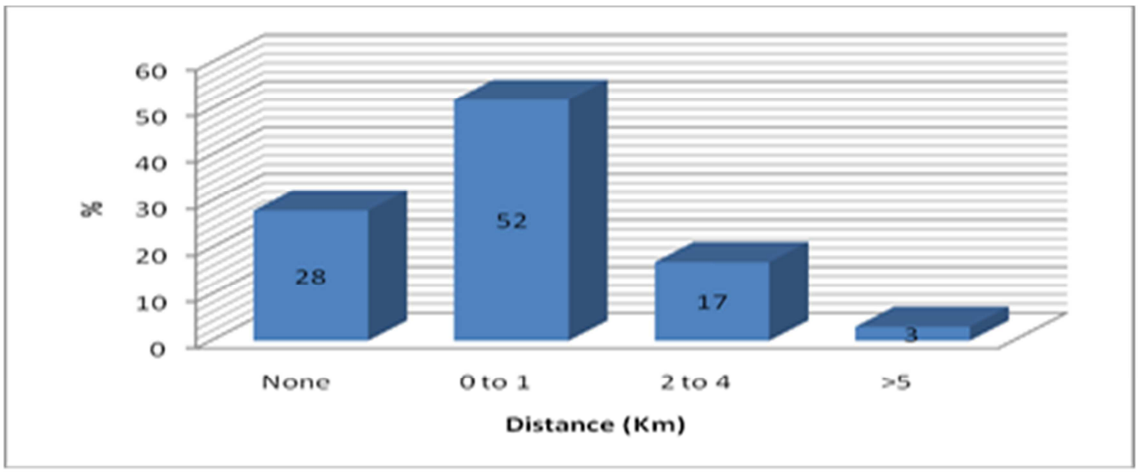


Fig 2: Distance to water supply source in the sampled areas

Source: Field work, 2012.

Fig 2 shows the distance travelled by the respondents to source for water. The finding reveals that 28% of the respondents do not travel any distance to source for water. This can be attested to the fact that most of the households that source their water form hand dug wells have the facility within their compounds. Fifty two percent of the respondents travel a distance of up to 1km to source for water while 17% of the respondents travel between 2km-4km to source for water. A little proportion of 3% travels more than 5km to source for water. This finding validates that of Buhari, (2010) in his report in This Day/allafrica.com "Nigeria: Water Scarcity Hits Kaduna Metropolis". He discovered that the main perceived problem associated with water use is poor access to water supply. He further stressed that the problems include the burden of drawing water from wells and conveying it through the long distance, and water shortage during the relatively long dry season.

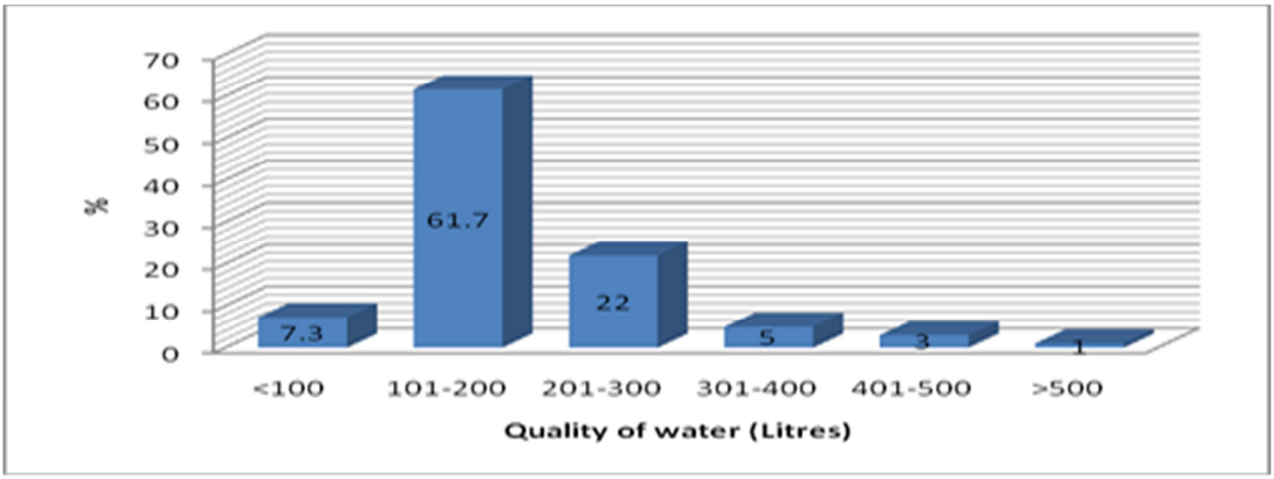


Fig 3: Average daily water usage by the households

Source: Field work, 2012.

Figure 3 shows the average daily water usage per household in the study sample. The result indicates that about 7% of the respondents use below 100 litres of water in their households per day. This is inconsistent with the UNICEF's stipulated 50 litres of clean water a day per individual which it considered necessary to stay healthy - for drinking, washing, cooking, sanitation and personal hygiene. A greater proportion of the respondents make use of about 100-200 litres of water per day. Twenty two percent of the respondents make use of 201-300 litres of water per day while 5% of the respondents use between 301-400 litres of water per day. Those that use about 401-500 litres of water per day were just 3% while as little as 1% of the respondents make use of more than 500 litres of water per day. These shortfalls could be attributed to the fact that most of these respondents do travel some distances to access water as seen on Figure 2

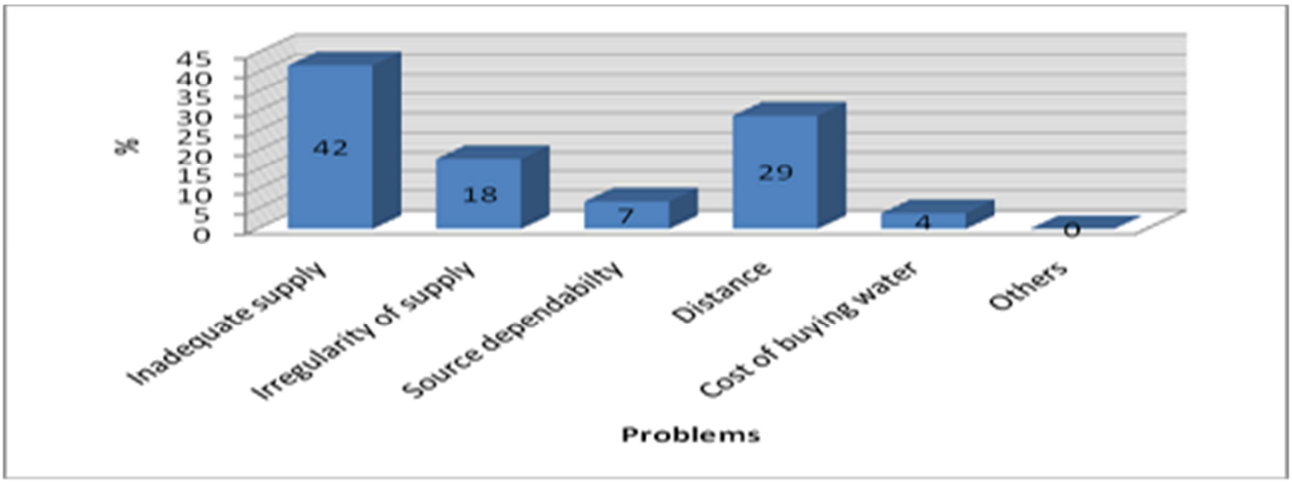


Fig 4: Problems of water supply in the sampled areas

Source: Field work, 2012.

The problems of water supply are shown in Figure 4. The table shows that most of the respondents face the problem of inadequate supply of water. This group represents 42% of the total respondents. 29% of the respondents attributes distance to the source of water supply as a problem to them whereas, 18% of the respondents are facing the problem of irregularity in water supply in their respective households. 4% of the respondents attribute their water supply problems to the cost of buying water from water vendors such as tankers, cart vendors and borehole owners. The problem of low reliability/dependability of water supply source is faced by 7% of the respondents which is as a result of uncertainty of source of water.

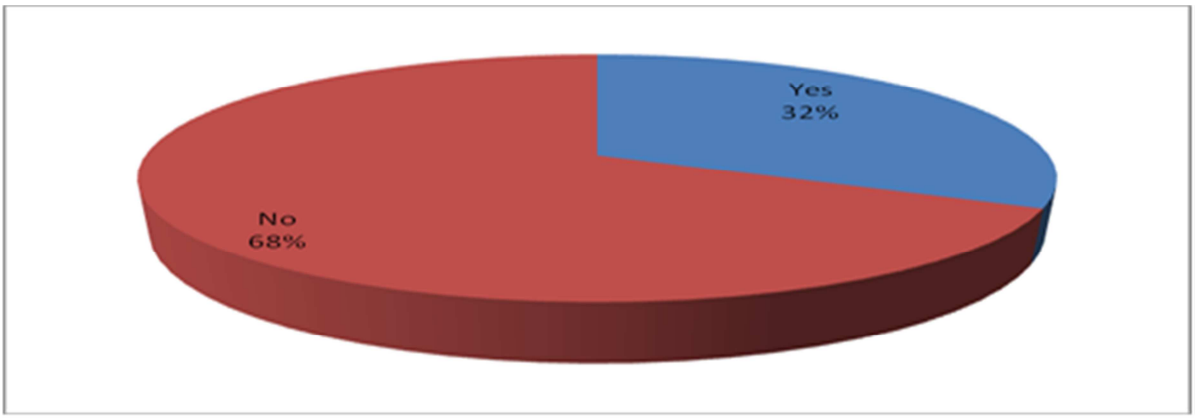


Fig 5: Sickness as a result of water usage in the sampled areas

Source: Field work, 2012.

The respondents were asked if any of their household members have experienced any sickness as a result of water usage from the sources listed in Figure 5 above. About 32% of the respondents admitted that members of their households have fallen sick as a result of water usage from the afore mentioned sources while about 68% of the respondents have never recorded any sickness as a result of water usage.

SANITATION

The sanitation situation of the study area is presented in tables and succinct analysis is made on each variable. The data presented includes the methods of waste water and solid waste disposal by the respondents, the available toilet facilities in the study area and the problems encountered as a result of usage of the available sanitation facilities.

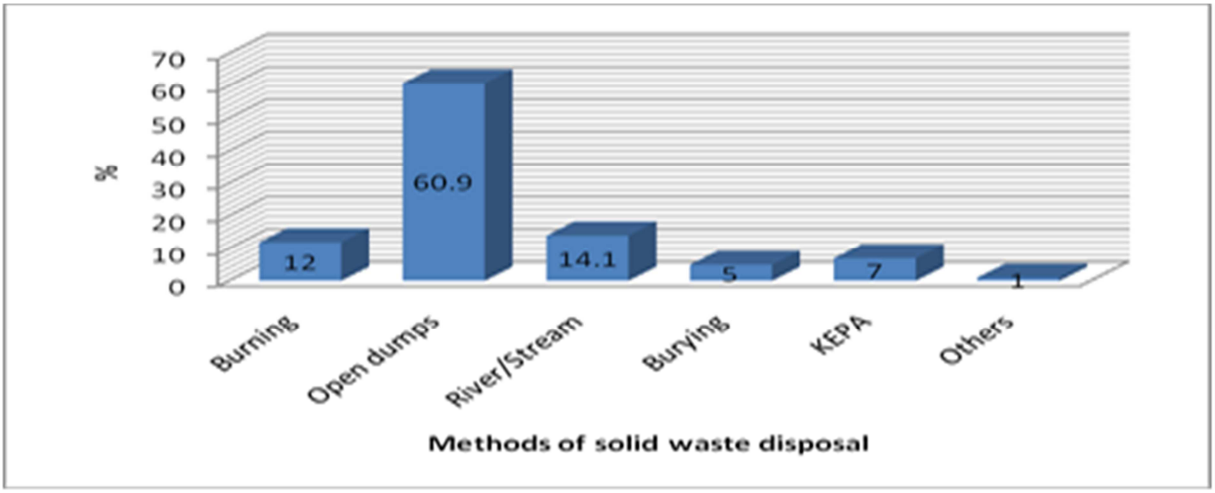


Fig 6: Methods of solid waste disposal in the sampled areas

Source: Field work, 2012.

Figure 6 reveals that open dumps, burning, burying, river/stream and through Kaduna State Environmental Protection Agency (KEPA) are the major solid waste disposal methods of the study area. They show that 39% of respondents dispose their solid wastes by burning; about 61% dispose theirs in open dumps. This explains why the researcher observed numerous open waste dumps on major streets in the study area. This method of solid waste disposal is a major sanitation challenge as it can cause certain diseases and it also reduces the aesthetics of the environment. About 14% of the respondents dispose their wastes into flowing rivers and streams while 5% bury theirs. The state owned sanitation agency evacuates the wastes of only 7% of the respondents while 1% of the respondents dispose theirs through other methods.

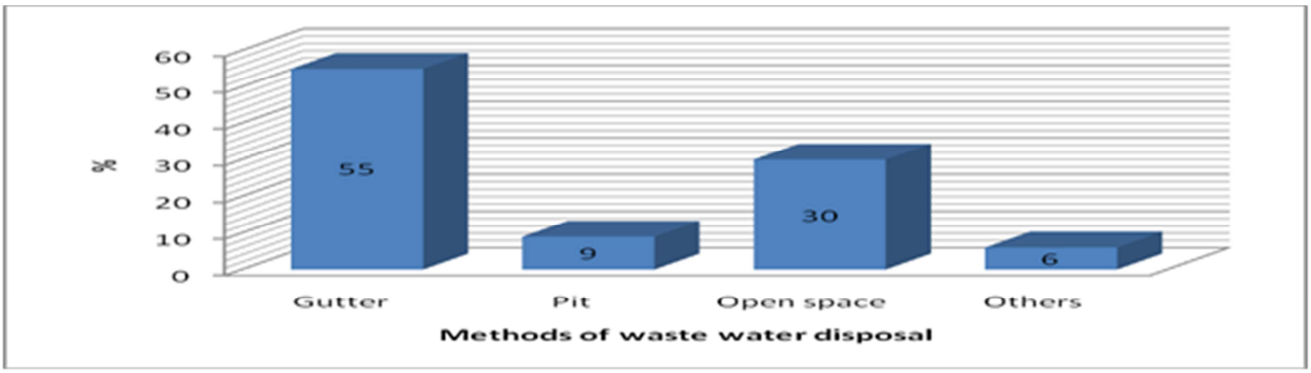


Fig 7: Methods of liquid waste disposal in the sampled areas

Source: Field work, 2012.

Figure 7 shows that 55% of the respondents make use of gutters as means of disposing their waste water, 30% of them dispose theirs in any available open spaces within their residence. Nine percent dispose their waste water into pits while just about 6% disposes theirs through other means which includes using the waste water on their gardens or to flush their toilets.

Table 3: Toilet facilities used by respondents

	Sampled Areas							
Facility	Ungwan Dosa	Ungwan Rimi	Barnawa	Kakuri	Ungwan Pama	Mararaban Rido	Total	Percentage
Pit latrine	20	5	31	20	9	13	98	30.2
Flush toilet (water closet)	72	5	43	25	13	29	187	57.7
Bucket latrine	0	0	0	0	0	0	0	0
Public toilet	6	5	6	10	7	5	39	12.1
Open field	0	0	0	0	0	0	0	0
Others	0	0	0	0	0	0	0	0
Total							324	100

Source: Field work, 2012.

Table 3 show that water closet system; pit latrine and public toilets are the toilet facilities in the study area. About 58% of the households use flush toilets. This could be attributed to the fact that the area of study is an urban setting while about 30% of the sampled households make use of pit latrines and the remaining 12% use public toilet facilities.

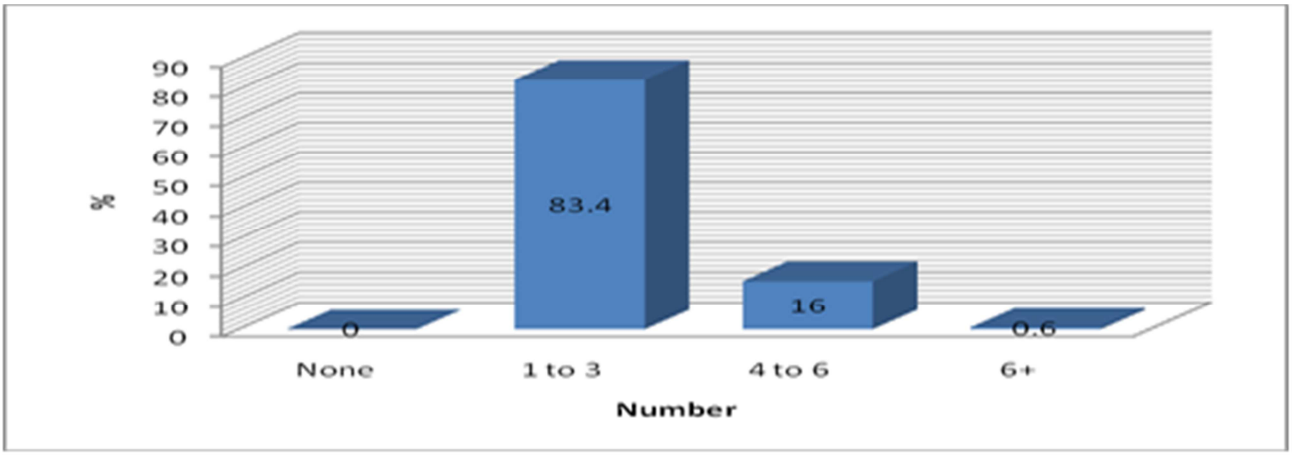


Fig 8: Number of toilet facility per household

Source: Field work, 2011.

The 2010 Joint Monitoring Program Report by the UNICEF and WHO on sharing of sanitation facilities indicated that sharing of sanitation facilities is more prevalent in urban areas of developing countries (WHO and UNICEF, 2010). This report is consistent with the results shown in Figure 8. The table shows that about 83% of the households have 1-3 toilet facilities, 16% have 4-6 toilet facilities while about 1% of the study sample have more than 6 toilet facilities in their households. This means that almost all the households in the study sample share their sanitation facilities.

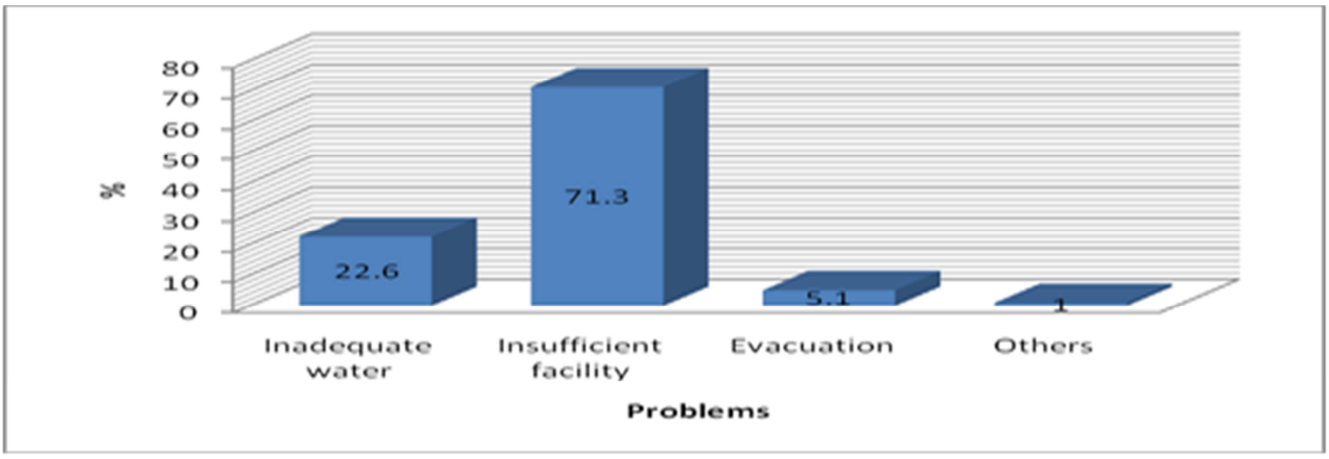


Fig 9: Problems associated with the use of toilet facilities

Source: Field work, 2012.

Figure 9 shows the problems associated with the use of the sanitation facilities in the sampled area. The major problem the people have is that of insufficient facilities in their households. Most of the people in the study area share their sanitation facilities. About 23% of the respondents face the problem of inadequate water supply during the use of their sanitation facilities while about 5% of the respondents have the problem of evacuating excreta from their households. Most of the households that have the problem of evacuating excreta are those in slum areas such as Mararaban Rido and Kakuri areas where the houses are not built according to the stipulated plans. This makes it very hard for evacuation vehicles to have access to these areas.

ASSESSMENT OF WATER SUPPLY AND SANITATION SITUATIONS BY THE RESPONDENTS

The respondents were asked to assess the present water supply and sanitation situation in their various areas. Their responses are presented and analyzed in the tables below.

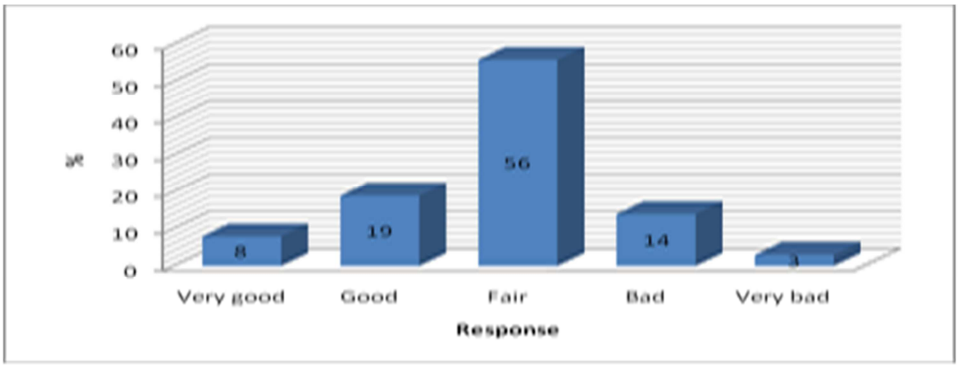


Fig 10: Assessment of water supply situation by the respondents

Source: Field work, 2012.

The result from Figure 10 shows that 8% of the respondents see the water supply situation in their areas as very good, 19% of the respondents see the situation as good while 56% of the respondents see the water supply situation as fair. In the views of 14% of the respondents, the water supply situation in their area is bad while 3% of the respondents see the situation as being very bad in their respective areas.

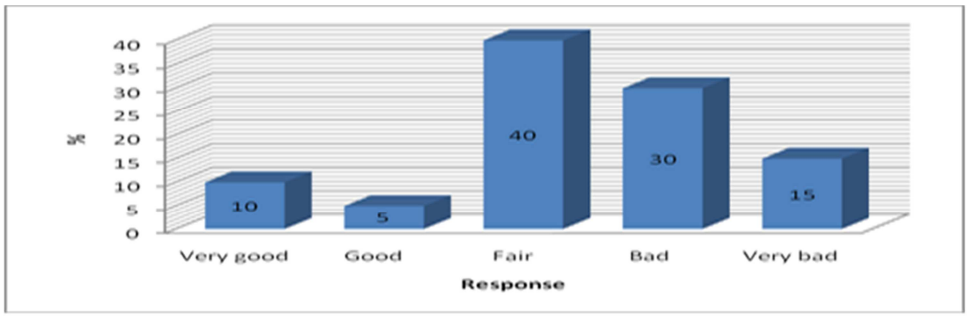


Fig 11: Assessment of sanitation situation by the respondents

Source: Field work, 2012.

Figure 11 shows that 10% of the respondents see the sanitation situation in their areas as very good, 5% of the respondents see the situation as good while 40% of the respondents see the sanitation situation as fair. In the views of 30% of the respondents, the sanitation situation in their area is bad while 15% of the respondents see the situation as being very bad in their respective areas. As per the laboratory report, the water test concluded that it was physic-chemically and bacteriologically unsafe for consumption.

4 SUMMARY AND CONCLUSION

4.1 SUMMARY

The results of findings show that majority of households in the study area use hand dug wells as their major source of water supply while privately owned boreholes, Kaduna State Water Board (KSWB), water vendors and streams are other main sources. This simply implies that a large proportion of households in the sample area get their water from untreated and sometimes unhealthy sources,

Analysis of the distance travelled to the source of water supply revealed some information about their situation. Majority of the respondents travel long distances to their respective sources of water supply.

The results obtained from the study also reveals that the major water supply problems faced by the households in the study area includes inadequate supply, distance to the source of water supply and irregularity in supply from the sources as well as water being supplied from various sources. The implication of this is that although the various sources of water supply in the study area include hand dug wells, boreholes, KSWB, water vendors and streams, differences in the sources vary significantly from area to area.

The risk of various sanitation related infections and diseases are high in the study area due to the poor methods of solid waste disposal. The implication of these poor solid waste disposal methods by the households in the study area is that; people who live close to waste dumps are exposed to various health risks such as malaria, bad odour, cholera, diarrhea, hepatitis B and dysentery. It also causes serious environmental problems such as water pollution, poor environmental quality and aesthetics, air pollution and water pollution, as this confirms a similar study carried in Ambo town Ethiopia carried out by Shanmugham and Solomon in 2011.

4.2 RECOMMENDATIONS

Based on the results and findings of this research work, it is necessary to get the private sector involved in water supply in the areas of fund mobilization for the construction, maintenance, rehabilitation and expansion of water supply and sanitation facilities in Kaduna metropolis. It is also recommended that the government agencies responsible for the provision of water supply and sanitation facilities should be adequately funded and equipped to carry out their services to the people in order to reach the goal 7 of the MDG 2015 target as reported by the Public Relations Officer of Kaduna State Water Board.

4.3 CONCLUSION

The water supply and sanitation situation in Kaduna metropolis illustrates the scenario in other urban and rural areas of Kaduna state in particular and Nigeria in general. To some extent, the poor sanitation and water supply situation in Kaduna metropolis is due to inadequacy of the state government and private sector participation in the provision of these basic facilities coupled with the rapid increase in the population of people in Kaduna metropolis. This explains why majority of the people in the study area resort to untreated sources of water supply such as hand dug wells, water vendors, streams. Also, the people employ various unhygienic ways of disposing their solid wastes and waste water.

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Proposition d'un modèle d'intégration des systèmes de management Qualité, Sécurité et Environnement

[Proposition a model for integrating management systems Quality, Safety and Environment]

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ABSTRACT: The quality management, safety and environment (QSE) is developing more in companies seeking to improve their economic and financial performance, taking into account the health and safety aspects and protection the natural environment.
Based on an extensive literature search and cross on the topic of integrated management, where different models, strategies and integration techniques were highlighted, we found limitations and constraints in the implementation of these tools on field. This work aims to fill this gap by proposing a generic model for the integration of management systems.

KEYWORDS: Quality, Safety, Environment, ISO 9001, ISO 14001, OHSAS 18001.

RESUME: Le management de la qualité, de la sécurité et de l'environnement (QSE) se développe de plus au sein des entreprises qui cherchent à améliorer leur performance économique et financière tout en prenant en compte l'aspect santé et sécurité au travail et la protection de l'environnement naturel.
D'après une recherche bibliographique transversale et approfondie sur le thème de management intégré, où les différents modèles, stratégies et techniques d'intégration ont été mis en relief, nous avons constaté des limites et des contraintes dans la mise en œuvre de ces outils sur le terrain. Ce travail vise à combler cette lacune en proposant un modèle générique d'intégration des systèmes de management.

MOTS-CLEFS: Management intégré, ISO 9001, ISO 14001, OHSAS 18001.

1 INTRODUCTION

Au cours de la dernière décennie, la révision des normes de système de management qualité sécurité et environnement (QSE) a été orientée vers des structures plus compatibles, en respectant le cycle de Deming PDCA (plan, do, check, act). Au travers de ce travail, nous essayerons dans un premier temps, d'apporter un regard sur la littérature en présentant les différentes stratégies et modèles d'intégration. Dans un second temps, une analyse critique des modèles d'intégration les plus cités dans la littérature sera réalisée. En fin, nous exposerons notre propre modèle adapté à tout type d'organisation et à n'importe quel référentiel normatif.

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2 MÉTHODOLOGIE

Pour répondre à notre objectif, une revue de la littérature a été réalisée pour cerner le concept du système de management intégré (SMI) et définir les différentes approches d'étude sur la thématique. Ensuite, une analyse critique des différents modèles d'intégration a été évoquée avant de proposer un nouveau modèle.

3 PRESENTATION DES RESULTAS OBTENUS

Dans cette partie, les résultats de l'étude bibliographique ont été présentés. Nous avons abordé le concept d'un SMI, les avantages que procure l'intégration des systèmes de management ainsi que les contraintes rencontrées par les entreprises. Ensuite, les résultats relatifs aux stratégies et modèles d'intégration ont été avancés et analysés pour aboutir finalement à un modèle d'intégration.

3.1 LE CONCEPT D'UN SYSTEME DE MANAGEMENT INTEGRE

Plusieurs approches ont été avancées pour cerner la définition d'un système intégré, Garvin, (1991) [1] identifie l'intégration comme étant l'harmonisation et l'alignement des politiques et des buts d'une organisation, l'ensemble des départements parlent le même langage et sont sur la même langueur d'onde. Selon Karapetrovic (2003) [2], un SMI est un ensemble de processus raccordés qui partagent les mêmes ressources (ressources humaines, renseignements, matières, infrastructures et ressources financières) pour accomplir un ensemble de buts rattachés à la satisfaction d'une variété de parties prenantes. D'après Pojasek (2006) [3] un système intégré est celui qui combine des systèmes de management séquentiels dans un système simple en adoptant l'approche processus et l'approche systémique afin de répondre aux exigences normatives. Beckmerhagen & al (2003) [4] définissent l'intégration comme un processus qui combine plusieurs systèmes de management dans un seul SMI plus simple et efficace.

Certes, l'efficacité est très demandée par les organisations, elle reflète l'ensemble des avantages et bénéfices que procure l'intégration des systèmes de management. Domingues & al (2011) [5] ont démontré que les actions sécurité permettent d'améliorer significativement les indicateurs qualité et donc la performance de l'entreprise.

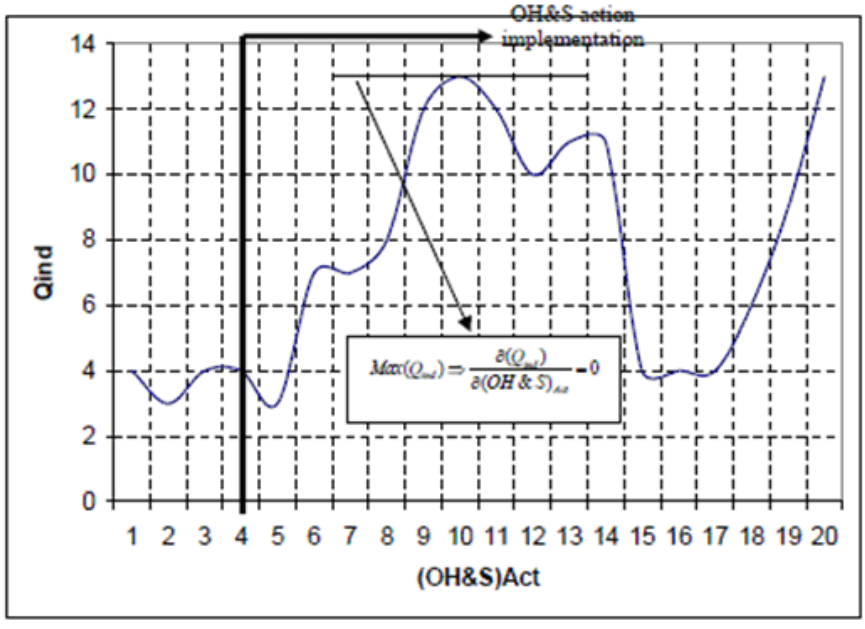


Fig. 1. Relation entre actions sécurité et indicateur qualité selon Domingues & al (2011)

Le SMI présente plusieurs avantages, Rocha & al (2007) [6] expliquent que la gestion intégrée crée une synergie entre les différents systèmes de management, Zeng & al (2007) [7] rejoignent la définition de karapetrovic (2003) [7] et parlent d'une meilleure optimisation des ressources disponibles et d'une réduction des coûts. McDonald & al (2003) [8] s'alignent avec Domingues & al (2011) [5] et évoquent l'amélioration des performances de l'organisation suite à l'implication et la motivation du personnel via l'adoption d'un système de management intégré.

3.2 CONTRAINTES RENCONTRÉES

Pour tirer profit des avantages de l'intégration, l'organisation doit surmonter plusieurs contraintes, selon (Karapetrovic, 2002) [9], le manque d'une norme de management intégré ISO constitue le premier obstacle lié à l'intégration, des lignes directrices ISO relatives à la qualité, à la sécurité et à l'environnement existent mais aucune norme ISO n'est prévue pour faciliter l'intégration des systèmes de management.

Le problème lié à l'intégration des trois référentiels ISO 9001, ISO14001 et OHSAS 18001 réside dans le fait de leurs champs d'application très différents (Wilkinson & Dale, 2001[10]; Zeng et al, 2007) [7]; la qualité s'intéresse à la satisfaction des clients, la sécurité vise le bien être du personnel tandis que l'environnement cherche à maîtriser l'impact indésirable des activités de l'entreprise sur son environnement externe. Wilkinson & Dale, 2001[10] parlent de l'absence d'un concept d'intégration et exigent une transformation culturelle de l'organisation afin de réussir le processus d'intégration. Zutshi & Sohal (2005) [11], Karapetrovic (2002) [9] avancent plutôt le manque d'expertise chez les organisations, l'insuffisance des ressources et la résistance des employés face au changement.

Certainement, l'intégration des systèmes de management séquentiels dans un seul système global constitue un processus de changement d'un état à un autre. D'après Pettigrew & whipp (1991) [12], tout changement doit prendre en considération trois dimensions : le contenu, le contexte et le processus de mise en œuvre.

a. Contenu :

En l'absence d'une norme ISO, aucune information spécifique n'est prévue pour définir le contenu d'un système de management intégré. Néanmoins, on peut se contenter des définitions avancées auparavant et des modèles cités dans cette publication.

b. Contexte :

Selon Asif et al (2009) [13], le contexte est une dimension qui touche l'environnement interne et externe de l'entreprise, en interne on inclut la politique de l'organisation, sa culture, ses capacités et ses ressources, en externe on évoque plutôt les politiques étatiques et les facteurs socioéconomiques. La culture d'une organisation fait partie intégrante de l'environnement interne de l'entreprise (Jorgensen, Remmen & Mellado, 2005) [14], elle est très influencée par l'entourage externe. Ce phénomène est rencontré souvent par les multinationales qui opèrent dans différents pays et font face à des cultures très variées Lagrosen (2003) [25].

c. Processus :

Le troisième élément d'écrit par Pettigrew & whipp (1991) [12] est le processus qui décrit la manière avec laquelle on aborde le changement, selon la norme ISO 9001 : 2000 un processus est un ensemble d'activités corrélées ou interactives qui transforment des éléments d'entrée en éléments de sortie, les intrants ici sont les systèmes de management séquentiels et les extrants représentent le système de management intégré.

En l'absence d'une norme ISO, Labodova (2004) [16] avance que l'échec rencontré par quelques organisations est lié étroitement à l'absence d'un modèle d'intégration. Pour faire face, quelques managers se basent sur leurs propres perceptions et expériences afin intégrer les systèmes (Asif et al, 2009) [13].

3.3 LES STRATÉGIES D'INTÉGRATION

Les stratégies d'intégration font généralement allusion à l'ordre d'implémentation des systèmes de management, elles conditionnent la morphologie d'un SMI.

Plusieurs stratégies d'intégration ont été évoquées dans la littérature, la plus citée est celle de karapetrovic :

Tableau 1. Ordre d'intégration des systèmes de management

Auteurs	Ordres d'intégration
Karapetrovic & Willborn (1998a) [17]	1. le SMQ d'abord, suivi du SME; 2. le SME suivi du SMQ ; 3. la mise en place d'une manière simultanée des deux systèmes SMQ et SME.
Karapetrovic (2002) [9]	1. le SMQ d'abord, suivi des autres SM. 2. le SME suivi des autres SM. 3. la mise en place simultanément des deux systèmes SMQ et SME suivi des autres SM. 4. l'intégration des éléments fondamentaux des SM suivi des éléments spécifique à chaque système.
Karapetrovic & Jonker (2003) [18]	1. l'intégration du SMQ avec d'autres SM en utilisant l'approche processus suggérée par la norme ISO 9001. 2. l'intégration du SME avec d'autres SM en se basant sur la roue de Deming (PDCA) proposée par la norme ISO 14001. 3. l'intégration par la suite des éléments spécifiques à chaque SM.
Labodova (2004) [16]	1. l'implémentation séquentielle des SMQ, SME et SMS puis assurer leur intégration dans un seul SMI. 2. la mise en place simultanément d'un SMI couvrant les domaines QSE

3.4 MODÈLES D'INTÉGRATION DES SMI

Selon Karapetrovic & Jonker (2004) [18], un modèle d'intégration doit être :

- capable d'intégrer tous les éléments communs des systèmes de management séquentiels.
- générique pour être adopté à toutes les organisations y compris leurs systèmes de management.
- flexible pour réponde aux exigences spécifiques de n'importe quel système de management.
- et entièrement compatible avec les normes.

a. Modèle Wilkinson & Dale (2001)

Wilkinson & Dale (2001) [10] proposent un modèle d'intégration des systèmes de management qualité, sécurité et environnement adapté à chaque type d'organisation et surtout celles qui sont engagées dans la voix du TQM. Les trois systèmes de management séquentiels perdent leur identité et leur indépendance pour être totalement imbriqués dans un seul et unique système.

Les processus ont pour objectifs la satisfaction des parties prenantes et la déclinaison de la politique de l'entreprise, ils font référence à des activités entièrement fusionnées qualité, sécurité et environnement. Les processus, les procédures et les ressources rentrent en interaction avec la culture et la structure de l'organisation pour donner un amalgame répondant parfaitement à la philosophie TQM.

Les activités de planification, de mise en œuvre, de contrôle et d'amélioration permettent de transformer des intrants en extrants. Ces derniers sont comparés à des objectifs préalablement définis et révisés au fur et à mesure.

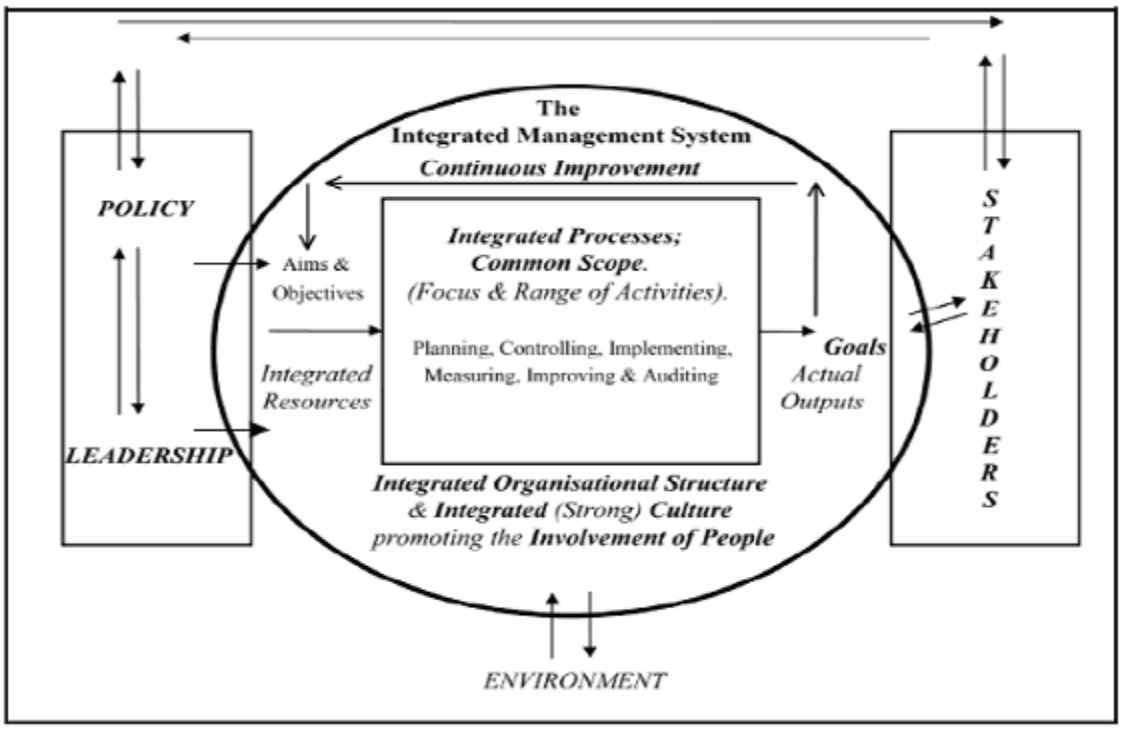


Fig. 2. Modèle (Wilkinson & Dale 2001)

b. Modèle Karapetrovic & Jonker, 2003) :

Karapetrovic & Jonker (2003) [19] suggère que le modèle devrait être basé sur l'approche systémique. Un système est un ensemble de processus interdépendants qui fonctionnent d'une manière harmonique, partagent les mêmes ressources et sont orientés vers la réalisation d'un ensemble de buts liés à la satisfaction des parties intéressées.

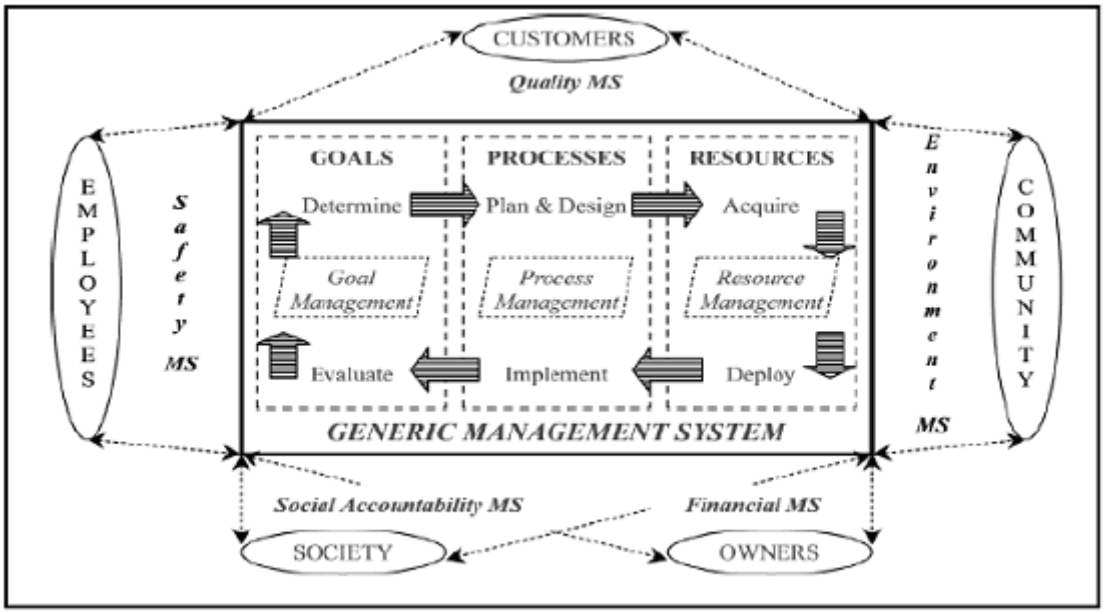


Fig. 3. Modèle (Karapetrovic & Jonker, 2003)

c. Modèle Zeng & al. (2007) :

Zeng et al. (2007) [7] proposent un modèle à trois niveaux, au premier niveau, il faut qu'il ait une synergie stratégique entre la qualité, la sécurité et l'environnement. Au deuxième niveau, trois piliers sont définis, l'organisationnel, le culturel et celui des ressources :

- La synergie structurelle ou organisationnelle est supportée par l'engagement du top management et l'implication du personnel.
- La synergie au niveau culturel est nécessaire pour assurer l'amélioration continue du système de management intégré.
- Tandis que la synergie liée à l'exploitation des ressources (humaines, financières, …) nécessite l'examen des similitudes et compatibilité entre les trois systèmes.

Au troisième niveau, la synergie documentaire (qualité, sécurité et environnement) permet de gérer toutes les procédures et instructions de travail d'une manière intégrée. Les normes ISO 9001, ISO 14001 et le référentiel OHSAS 18001 partagent le même principe d'amélioration continue basé sur le cycle de Deming PDCA.

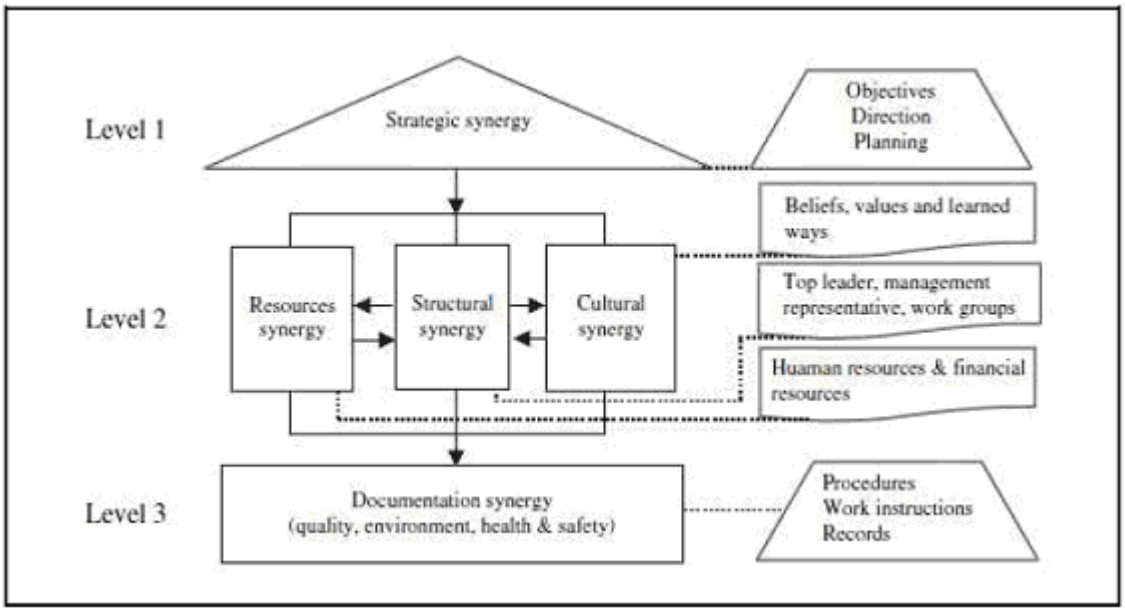


Fig. 4. Modèle (Zeng & al. 2007)

d. Modèle Rocha & al. (2007) :

Rocha et al. (2007) [6] présentent un modèle basé sur le développement durable qui intègre la qualité (ISO 9001), l'environnent (ISO 14001), la santé et la sécurité au travail (OHSAS 18001) et la responsabilité sociale des entreprises (AA1000). Le modèle se compose de sept éléments clés :

1. parties prenantes
2. ressources
3. leadership
4. valeurs
5. objectifs
6. processus
7. résultats

Tous ces éléments sont influencés par le contenu des quatre normes ci-dessus.

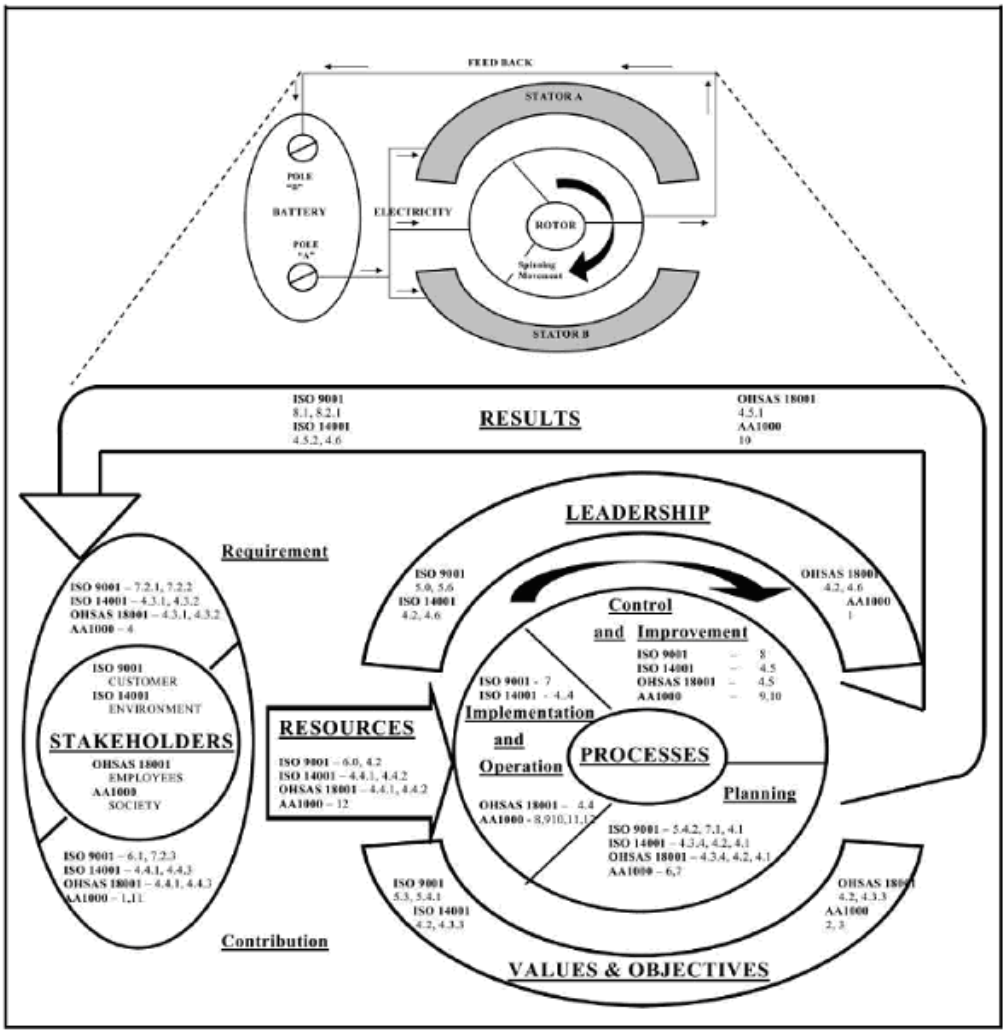


Fig. 5. Modèle Rocha & al. (2007)

e. Modèle Asif & al. (2010a) :

Asif et al. (2010a) [20] proposent un modèle d'intégration basé aussi sur l'approche systémique. Le processus d'intégration commence à partir de l'identification des parties prenantes et de leurs exigences, lesquelles sont prises en compte lors de l'élaboration de la stratégie.

Au niveau tactique et opérationnel, les processus et les procédures traitent d'une manière intégrée les exigences qualité, sécurité et environnement.

La mise en œuvre du SMI requiert une intégration verticale et horizontale à chaque niveau de l'organisation, avec l'intégration verticale, les plans stratégiques sont déclinés en processus puis en activités opérationnelles, tandis que l'intégration horizontale est matérialisée par l'intégration des éléments du système de ménagement séquentiels dans des activités composites à la fois qualité, sécurité et environnement.

Exemple : dans un procédé de peinture automobile, En plus des exigences normatives qualité à respecter (la résistance à la chaleur et le contrôle de l'épaisseur de la couche de peinture), l'aspect environnemental est aussi à prendre en compte (le gaspillage et le contrôle des émissions) en plus du volet santé et sécurité au travail (procédé de peinture en toute sécurité).

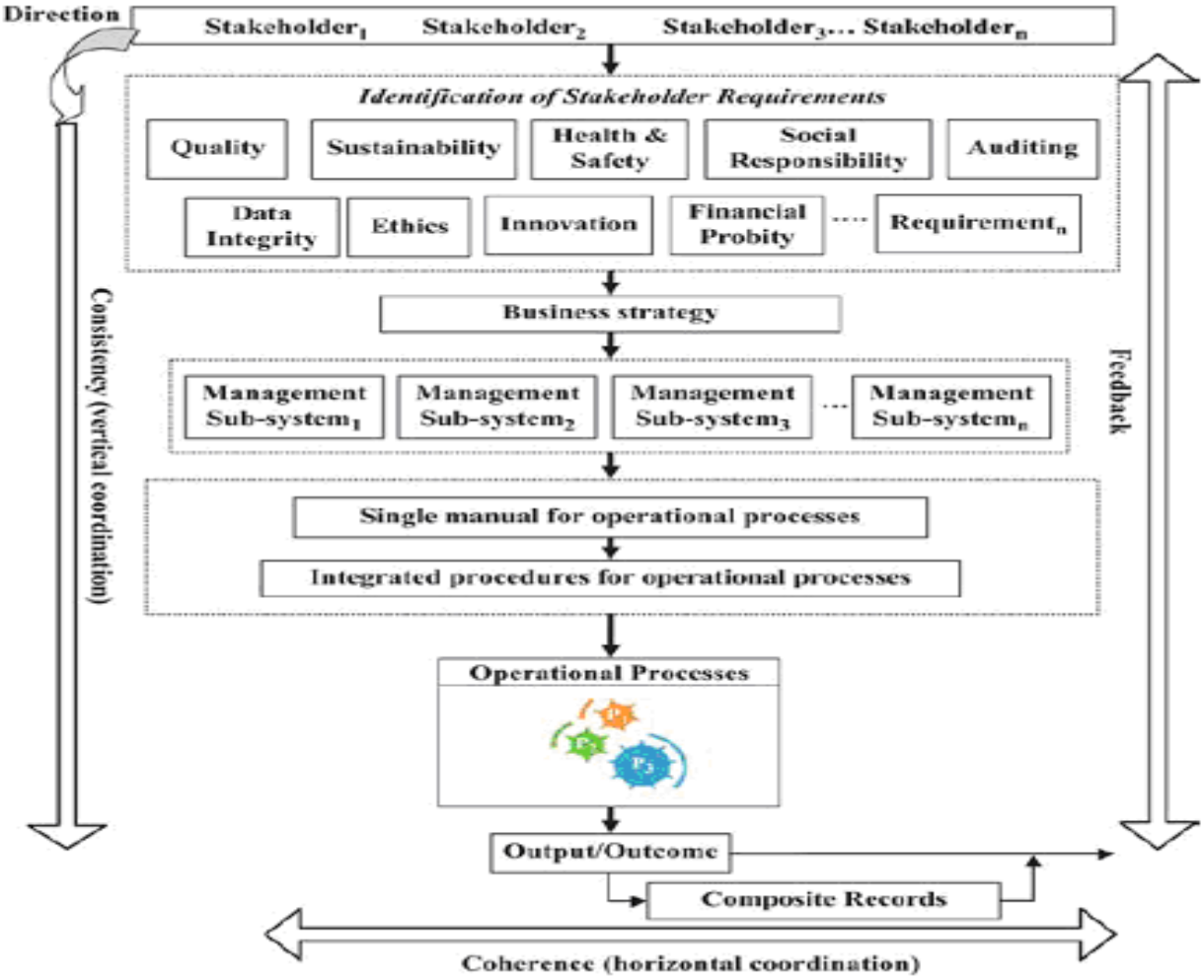


Fig. 6. Modèle (Asif & al. (2010a)

3.5 3.5 ANALYSE CRITIQUE DES MODÈLES D'INTÉGRATION

Le tableau suivant illustre une analyse critique des cinq modèles cités auparavant :

Tableau 2. Analyse critique des cinq modèles

	Les points forts du modèle	Les points faibles du modèle
Modèle Wilkinson & Dale (2001) [10]	- la politique est établie sur la base des attentes des parties intéressées - les objectifs sont déclinés à partir des orientations de la politique - les ressources sont allouées d'une manière intégrée pour soutenir l'atteinte des objectifs - le champ d'application des processus couvre le domaine QSE - les processus sont intégrés et se composent des activités de planification, de maîtrise, d'implémentation, de mesure, d'amélioration et d'audit - les éléments de sortie (résultats) permettent de satisfaire les exigences des parties intéressées, ils font l'objet d'un rapprochement par rapport aux objectifs préalablement définis - l'amélioration continue prend en considération l'intégration des systèmes de management - le retour d'informations des parties intéressées sont prises en compte lors du processus d'amélioration continue - La culture de l'organisation permet de promouvoir la participation des personnes envers le système de management QSE - le système rentre en interaction avec l'environnement externe de l'entreprise	- l'élaboration de la stratégie n'est pas prise en compte suite à la définition des attentes des parties intéressées. - les exigences des parties prenantes ne sont pas prises en considération au niveau des éléments d'entrée des processus
Modèle Karapetrovic & Jonker, 2003 [19]	- les cinq parties intéressées sont clairement définies, leurs intérêts sont identifiés - la qualité, la sécurité et l'environnement partagent les objectifs, les processus et les ressources. - une fois que les objectifs sont déterminés, les processus sont conçus, les ressources sont acquises et déployées pour permettre une bonne implémentation des processus, l'évaluation du système permet de vérifier l'atteint des objectifs préalablement définis.	- l'amélioration n'est pas bouclée selon la roue de Deming (PDCA), à partir de l'évaluation de l'atteinte des objectifs, le modèle évoque directement la détermination des nouveaux objectifs sans traiter l'aspect « action correctives préventive ». - les exigences des parties intéressées ne sont pas clairement définies. - la définition de la stratégie et politique ne sont pas prises en compte
Modèle Zeng & al. (2007) [7]	- trois niveaux sont définis, le stratégique, le tactique et l'opérationnel - la fixation des objectifs, la planification et le pilotage sont prises en compte au niveau stratégique - présence d'une synergie aux différents niveaux - le niveau tactique prend en considération les ressources, la structure et la culture de l'organisation - les ressources font référence aux ressources humaines et financières - la structure se compose du top management, des managers et des équipes de travail - les principes, les valeurs et la formation font partie intégrante de la culture de l'organisation. - A l'échelle opérationnelle, les documents y compris les procédures relatives au système de management qualité, sécurité et environnement sont établis.	- l'amélioration continue n'apparaît pas clairement au niveau du modèle - l'approche processus et systémique ne sont pas évoquées au niveau du modèle - l'implication des parties prenantes est ignorée par le modèle
Modèle Rocha & al. (2007) [6]	- Les exigences des parties prenantes sont identifiées et prises en compte - Les ressources sont allouées et constituent un support indispensable - Les activités de planification, de mise en œuvre, de vérification et d'amélioration sont prises compte au niveau des processus - L'engagement du leadership constitue un élément clé pour le fonctionnement de l'organisation - Les valeurs de l'organisation sont partagées par le personnel et représentent un élément de motivation important pour l'atteinte des objectifs - Les résultats de l'organisation permettent de satisfaire les exigences des parties prenantes - Les exigences normatives sont prises en compte d'une manière intégrée à chaque étape	- Le modèle est très compliqué - Les ressources sont représentées comme étant un élément d'entrée aux processus mais pas comme un support - le modèle fait références aux chapitres des normes et perd ainsi son caractère générique - la définition de la stratégie et politiques ne sont pas prévues par le modèle
Modèle Asif & al. (2010a) [20]	- Les parties prenantes sont clairement définies, leurs exigences sont prises en compte - La stratégie de l'organisation est basée sur les exigences des parties prenantes - Des sous systèmes de management sont définis pour décliner la stratégie de l'entreprise et satisfaire les exigences des parties prenantes - Un seul manuel pour les processus opérationnel est établi - Les procédures relatives aux processus opérationnels sont intégrées - Les processus opérationnels sont lancés en application - Les résultats des processus permettent de satisfaire les exigences des parties prenantes - La cohérence verticale et horizontale permet de créer une synergie à chaque niveau hiérarchique et entre les différentes activités d'un même niveau.	- L'amélioration continue n'est pas prise en considération au niveau du modèle - La mise à disposition des ressources n'est pas mentionnée par le modèle

3.6 COMPARAISON DES CINQ MODÈLES

Nous avons jugé nécessaire d'éviter les points faibles évoqués par les cinq modèles, c'est dans cet objectif qu'on a créé notre propre standard de comparaison.

Le standard, comprenant six critères, a pris en considération l'ensemble des points faibles à éviter :

- 1er critère : le modèle doit être générique afin qu'il soit adapté à tout type de système
- 2ème critère : la prise en compte des parties intéressées et de leurs exigences
- 3ème critère : la définition de stratégie, politique et objectifs
- 4ème critère : le mise à disposition des ressources
- 5ème critère : l'adoption de l'approche processus et de l'approche systémique
- 6ème critère : l'amélioration continue selon le cycle PDCA

Le tableau suivant illustre une comparaison des cinq modèles par rapport au standard :

Tableau 3. Comparaison des cinq modèles

	Critères du standard					
	Modèle générique	Prise en compte des exigences des PI	Stratégie et politiques	Mise à disposition des ressources	Approche processus /systémique	Amélioration continue
1er modèle	oui	oui	non	oui	oui	oui
2ème modèle	oui	oui	non	oui	oui	non
3ème modèle	oui	non	oui	oui	non	non
4ème modèle	non	oui	non	oui	oui	oui
5ème modèle	oui	oui	oui	non	oui	non

3.7 PROPOSITION D'UN MODELE DE MANAGEMENT INTEGRE

Chacun des modèles d'intégration cités ci-dessus présente des limites, ce qui nous a poussé à proposer notre propre modèle d'intégration.

Le modèle proposé se compose de cinq étapes :

- l'identification des exigences des parties intéressées
- l'identification des attentes de l'organisation
- la définition de stratégie et politique
- la mise à disposition des ressources
- le management des processus via l'approche systémique
- et la mesure, analyse et amélioration.

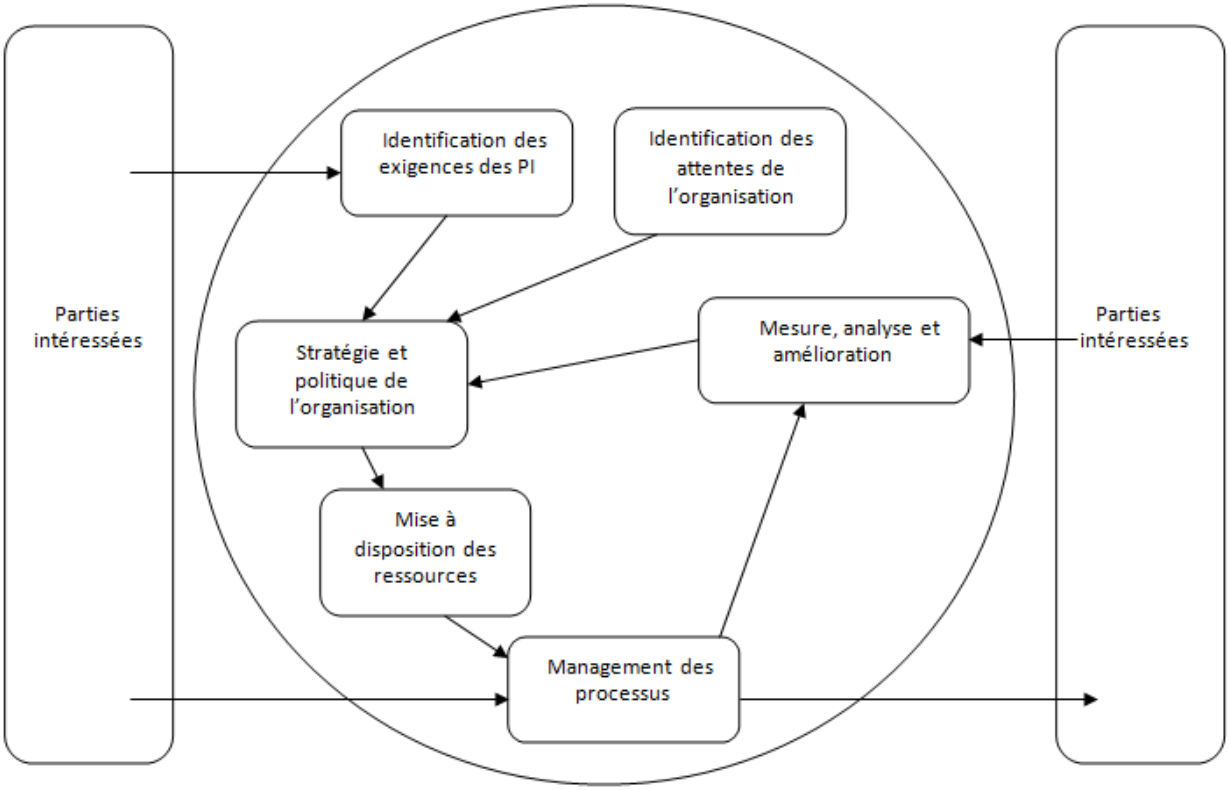


Fig. 7. Modèle proposé de management intégré

C'est un modèle adapté parfaitement au cycle de Deming (PDCA) et ayant comme valeur ajoutée la prise en compte des attentes de l'organisation en plus des exigences des parties intéressées, ces deux éléments d'entrée permettent de définir la stratégie et la politique de l'organisme. Lesquelles seront déclinées en système de management intégré plus efficace mais surtout rentable.

4 CONCLUSION

Ces dernières années, beaucoup d'entreprises ont mis en œuvre des systèmes de management pour améliorer leur mode de gestion, les normes les plus utilisées sont la norme ISO 9001 relative au système de management qualité, la norme ISO 14001 pour le management environnemental et le référentiel OHSAS 18001 pour le management de la santé et sécurité au travail. En l'absence d'une norme de management intégré (QSE), plusieurs recherches théoriques et empiriques ont été réalisées pour faciliter l'intégration des systèmes de management séquentiels dans un seul et unique système de management intégré.

Notre publication s'inscrit dans cette perspective, et essaye d'apporter un regard sur les stratégies et les modèles de management intégré. Nous avons essayé, par ce travail, de développer notre propre modèle en se basant sur une analyse critique des modèles qui sont très cités dans la littérature. Ce modèle est en phase de test dans une entreprise marocaine opérant dans le domaine de transformation des matières plastiques.

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Association of anthropometric indices of obesity and white blood cell count with arterial stiffness and blood pressure

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ABSTRACT: *Background:* Obesity induces oxidative stress and inflammation, which may lead to arterial stiffness and hypertension. The relationship of white blood cell count (WBC) and anthropometric indices with arterial stiffness index (ASI) and blood pressure was evaluated in this study.
Methods: Thirty male subjects aged between 35-55 years were selected in each of normotensive, prehypertensive and hypertensive groups. Their weight, height, waist circumference (WC) and hip circumference (HC) were measured according to the WHO guidelines. BMI, waist hip ratio (WHR), waist stature ratio (WSR) and conicity index (CI) were calculated. ASI was calculated from digital volume pulse recorded by photoplethysmography with iWorx-214 physiological interface system. The white blood cell count and differential was done. One way ANOVA followed by Post Hoc Tukey's Test was applied to determine the difference between the groups. Pearson's coefficient was calculated to study the correlation. Statistically, p value < 0.05 was considered significant.
Results: There was statistically significant difference in WHR (0.000), WC (0.003) and ASI (0.000) between the study groups but not BMI (0.223). Amongst the anthropometric measurements, WHR and WC had positive correlation with the systolic and diastolic blood pressure. The WBC and absolute neutrophil count correlated significantly with WHR and WC but not with ASI and blood pressure.
Conclusions: The central obesity is a more robust risk factor for arterial stiffness and blood pressure than BMI. The inflammation may be involved in pathogenesis of visceral obesity and arterial stiffness that may be determined by elevated white blood cell counts.

KEYWORDS: Prehypertension; hypertension; Arterial stiffness index; central obesity; inflammation; neutrophil-lymphocyte ratio; cardiovascular diseases.

1 INTRODUCTION

Hypertension is the boiling issue of the today's world. The prevalence of hypertension has been increasing all over the globe including Pakistan. In the United States, twenty-nine percent of the adults above nineteen years in age have hypertension and approximately thirty-seven percent are pre-hypertensive's [1]. In Pakistan, it has been estimated that one-third of population above forty-five years of age and twenty percent aged above fifteen years have hypertension [2].

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Hypertension is a multifactorial disorder caused by various environmental, physiological and genetic factors. The endothelial dysfunction, vascular stiffness, abnormal sympathetic outflow, alterations in renin-angiotensin system and increased plasma aldosterone levels are involved primarily in the increased arterial pressure [3].

The measurement of arterial stiffness index (ASI) has been proposed to be a useful non invasive tool for the cardiovascular risk assessment because of its ability to identify early target organ damage [4]. The stiffness of the arterial wall determined by analysis of digital volume pulse contour is a simple, reproducible and noninvasive method of assessing arterial stiffness. There has been a strong evidence that the stiffness index score derived by this technique is comparable to the arterial stiffness determined by pulse-wave velocity, which is the gold standard marker [5]. ASI may serve as a noninvasive tool for assessing the patients at risk of stroke, coronary artery disease and heart failure. It has been documented to be more sensitive tool in risk stratification for cardiovascular diseases (CVD) in comparison to plasma glucose, total cholesterol, and waist to hip ratio in apparently healthy population [6].

Obesity and hypertension have become swift growing worldwide epidemics [7]. There has been progressive increase in blood pressure with increasing obesity, which is result of sedentary life styles, urbanization, industrialization and behavioral adaptations. The rise in blood pressure is generally considered as an essential component of aging. However, this rise in blood pressure is by no means inevitable [8].

In various studies body mass index (BMI), waist-hip ratio (WHR), waist circumference (WC), waist-stature ratio (WSR) and Conicity index (CI) have been proposed as markers of obesity. However, it is not yet fully clear which anthropometric index of obesity has the strongest association with blood pressure in our population. Literature survey shows that BMI determines the overall obesity but not the central or visceral obesity, which is more closely associated with blood pressure and cardiovascular diseases [9], [10]. Obesity has been associated with oxidative stress, inflammation, and hypertension [11].

Arterial stiffness is determined by structural and functional intrinsic elastic properties of the vessel wall. The outer adventitial layer is composed of collagen fibers, fibroblasts, adipocytes, lymphocytes, macrophages and dendritic cells [12]. The adventitial cells are generally the first to be activated and recruited in response to the inflammation and oxidative stress leading to alterations in the tone and elasticity of the vessel wall. The cytokines and inflammatory signals from the adventitia play a critical role in alterations in the extracellular matrix (ECM). The modulation of ECM leads to the high elastin to collagen ratio, resulting in increased stiffness of the arterial wall [13]. The long term increased BP results in distension of the arterial wall, leading to greater and greater recruitment of the inelastic collagen fibers and thereby, reduction in its elasticity. The structural changes in the medial layer of the elastic arteries mainly result from the progressive elastic fibre degeneration [14].

Hypertension leads to increased stretch of the vessel wall by raised hydrostatic pressure or cyclic strain, which in turn influences endothelial cell gene expression and function [15]. The expression of intercellular adhesion molecule-1 (sICAM-1) increases in linear fashion in response to progressive rise in cyclic strain. The elevated sICAM-1 results in greater activation of WBCs and adhesion of monocytes to endothelial cells [16]. The activated WBCs release a variety of hydrolytic enzymes, cytokines, and growth factors, which can induce further vascular damage. Moreover, neutrophil aggregate along with platelets, to the vessel wall resulting in its narrowing and stiffening.

The literature review shows that WBC and neutrophil lymphocyte ratio (NLR) may predict inflammatory status in various cardiovascular pathologies. Increased white blood cell (WBC) count is related to cardiovascular disease in patients with type II diabetes mellitus and raised NLR is associated with metabolic syndrome and poor outcome after reperfusion procedures in acute coronary syndrome[17], [18].

In our research project, we evaluated the simplest markers of inflammation i.e. WBC, ANC, NLR and ESR, ASI and anthropometric markers of obesity (BMI, WHR, CI, WSR, WC) in equal number of normotensive, prehypertensive and hypertensive male subjects. Moreover, we have studied the correlation of these simple markers of inflammation and anthropometric indices of obesity with ASI and blood pressure.

2 MATERIAL AND METHODS

The study was carried out at Dept. of Physiology and Clinicopathalogical Lab, Army Medical College in collaboration with Military Hospital Rawalpindi, Pakistan. The duration of study was six months from Dec. 2013 to May 2014. It was case a control study and thirty male subjects aged between 35-55 years were selected in each of normotensive, prehypertensive and hypertensive group by non-probability, convenience sampling. The grouping was done in light of JNC-VII report [19]. Approximately, one thousand subjects were interviewed and subjects having any allergic disease, fever or taking any medications for at least last two weeks were excluded from the study. Those who had diabetes, chronic inflammatory disease or any prolonged illness were also excluded. The study was started after approval from Ethical Review Committee

Army Medical College and Centre for Research in Experimental and Applied Medicine. After informed consent, the subjects' particulars were recorded and detailed medical history was inquired.

2.1 BLOOD PRESSURE MEASUREMENT

Blood pressure was measured by auscultatory method with the mercury sphygmomanometer. First reading was taken at the time of filling the proforma, second during recording of pulse wave contour for recording the stiffness of the vessel wall and third just before drawing the blood. The average systolic (SBP), diastolic (DBP), pulse pressure (PP) and mean arterial pressure [MAP = DBP + 1/3 (SBP – DBP)] were recorded. In order to exclude diabetes mellitus blood sugar was checked by the glucometer.

2.2 ANTHROMETRIC MEASUREMENTS

Weight, height, waist and hip circumference were measured using standard protocols. Weight (Wt) was measured nearest to 0.1 kg with pointer spring balance, without shoes and wearing light clothing. Height (Ht) was recorded to the nearest 0.5 cm. WC was measured using a rubber measuring tape, horizontally halfway between the lower border of the rib cage and the iliac crest. Hip circumference (HC) was measured at the widest part over the buttocks. WC and HC were measured to the nearest 0.5 cm.The WHR was calculated by dividing the WC (cm) by the HC (cm). BMI was determined as weight (kg) divided by height in meters square. Waist-Stature Ratio [WSR=WC/Ht] and Conicity index [CI=WC (m)/$0.109\ \sqrt{\mathrm{Wt\ (kg)/Ht\ (m)}}$] were calculated.

2.3 ARTERIAL STIFFNESS INDEX

It was observed by placing plethesmograph on the volar surface of the distal segment of middle finger and digital volume pulse (DVP) recorded by Human/Animal Physiology interface system iWorx-214. The recorded data was analyzed, using LabScribe software and reflection time was calculated by placing cursor on the two peaks of DVP. The arterial stiffness index was calculated as [ASI = Height (meters)/ Reflection time (seconds)].

2.4 WHITE BLOOD CELL COUNT

The blood cell count and differential leucocytes count (DLC) was done by KX-21 automated hematology analyzer and confirmed by microscopy of Leishman stained peripheral smear in the supervision of hematologist. The DLC was also done by technician of the Clinicopathalogical lab and observer difference was less than 2%. ESR was done by Westergren's method.

2.5 STATISTICAL ANALYSIS

Statistical analysis was performed using, IBM-SPSS version 20. ANOVA was applied followed by Post-Hoc Tukey test to compare the means of obesity indices (BMI, WHR, CI, WSR, and WC), blood pressure variables, blood cell counts (WBC, ANC, NLR, ESR) and arterial stiffness index (ASI) in normotensive, prehypertensive and hypertensive subjects. In order to determine the correlation between different variables; Pearson's correlation coefficient was calculated. The p value <0.05 was considered statistically significant.

3 RESULTS

The comparison of age, blood pressure variables, proposed inflammatory markers and obesity indices by one way ANOVA followed by Post Hoc Tukey's test is given in normotensive, prehypertensive and hypertensive subjects in Table-1 and Table-2. There has been significant difference in WC and WHR (determinants of central obesity) and ASI amongst the three groups.

The Pearson's coefficient was calculated to study the correlation between different variables. There was statistically significant relationship between blood pressure variables and WHR and WC. There was a weak association between CI and WSR. However, the BMI was not related to the blood pressure (Table-3). There has been strong relationship between ASI and blood pressure as Pearson correlation coefficient was 0.808 [p value: 0.0001] and 0.739 [p value 0.0001] for systolic and diastolic blood pressure respectively. Moreover, a significant correlation was seen between ASI, WHR and WC. There was no relationship seen between the proposed markers of inflammation with systolic and diastolic blood pressure. Interestingly, the WBC and ANC were correlated to WC, WHR and CI (Table 3). The correlation orders of anthropometric indices of obesity with SBP and DBP are given in Table-4.

4 DISCUSSION

Years ago in 1967, Framingham Heart Study indicated, that obesity is a principal risk factor in arterial hypertension [20]. In our study, we have taken the equal number of normotensive, prehypertensive and hypertensive male subjects in middle age group (35 to 55 years) to study the correlation of obesity indices and white cell counts (WBC) with arterial stiffness (ASI) and blood pressure. It was found that markers of central obesity (WHR>WC>WSR>CI) are better correlated with hypertension than indices of whole obesity i.e. BMI. These results were similar to the findings by Gus *et al.*(2009) that waist to hip ratio and waist-stature ratio were better predictors of the incidence of hypertension than BMI, especially in male gender [21]. Our results supported the findings of the study by Zhou *et al.*(2003) that in male gender hypertension depends mainly on the visceral/central obesity [22]. Mark *et al.*(1999) found that the prevalence of elevated blood pressure was positively correlated with increasing adipose tissue [23]. It had been proposed that substantial compression of the kidneys by visceral fat deposits and the activation of renin-angiotensin system might be important factors in elevation of blood pressure with increasing body weight [24].

The visceral fat has been proposed to contribute in increasing the blood pressure by enhancing sympathetic activity [25]. The BMI was comparable in three groups in our study, which was similar to the findings of a study conducted in male and female population of Peshawar, Pakistan. It was observed that large percentage of males in the normal BMI category had signs of hypertension [26]. The studies by Sakurai *et al.* (2006) and Mufunda *et al.* (2006) also supported our observation that BMI does not have significant association with blood pressure especialy in male gender [27], [28]. The correlation orders of obesity indices with systolic and diastolic blood pressure in various studies and the present one are given in Table-4.

The white blood cell count, ANC, ESR and NLR were found comparable in normotensive, prehypertensive and hypertensive subjects. These results were similar to the findings of the study conducted by Acar *et al.* (2013) and Julius *et al.* (2014), but contrary to the findings of two other studies (Pusuroglu *et al.*, 2014, Rajkumari *et al.*, 2013). These contrary findings could be due to the difference in the duration of hypertension in subjects who participated in various studies. The hypertension over long period of time has been associated with elastin fiber fatigue and fracture due to continuous stretching of arterial tree which may lead to systemic inflammation in the long standing hypertension [3], [4], [29], [30].

In our study, there was a rise in NLR with increasing ASI but this relationship was not statistically significant. These results were similar to the findings of Blann *et.al*, in patients with stable coronary artery disease. In their study, ASI was strongly related with age and blood pressure but not with the markers of systemic inflammation [31].

When correlation between NLR and ASI was analyzed separately in each group, there was modest positive correlation (r=0.432) in normotensive subjects but no correlation was observed in prehypertensive and hypertensive subjects. It may be inferred from these findings that inflammatory processes play important role in the vascular stiffening in subclinical stage before any other manifestation. Our results supported the findings by Malahfji *et al.* (2014) that WBC and NLR were associated with ASI in asymptomatic individuals free of CVD [32]. In a study, conducted by Park *et al.* (2011) NLR was independently associated with arterial stiffness, irrespective of blood pressure variations which was contrary to our findings [33]. This conflict in the findings of the two studies may be due to the difference in the study design. In that study, the grouping was based on NLR and NLR was studied as a qualitative or categorical variable. The NLR had been divided into four quartiles and it was revealed that the mean blood pressure and arterial stiffness was higher in the highest quartile of NLR and blood pressure was associated with the increasing quartile of NLR. However, in our study, NLR was studied as a numerical or quantitative variable and its association with arterial stiffness index in equal number of normotensive, prehypertensive and hypertensive subjects was investigated. Statistically, the results of co-relational studies are more reliable when both the variables are quantitative while, the categorization of numerical data may yield misleading results [34].

The initial stiffening in the vessel wall may involve inflammatory process and inflammation could precede the development of hypertension. This observation is supported by the findings of various studies, in which elevated WBC count and especially raised neutrophil count were associated with higher incidence of hypertension [3], [35]. However, continuous stretching of the vessel wall over a prolonged period of time due to sustained hypertension may lead to the mechanical injury and inflammation that may be responsible for the strong association of inflammatory cells in hypertensive subjects. Therefore, a vicious cycle develops which leads to further stiffening of the vessel wall. These inflammatory processes may play a pivotal role in cardiovascular complications and end organ damage as a consequence of continuously high blood pressure.

Our study had certain limitations that only one time blood sampling was done and inflammatory markers like high-sensitivity C-reactive protein (hs-CRP), interleukins, adhesion molecules, selectins, TNF-α were not measured to confirm the inflammatory status in the subjects participating in the study. Therefore, further evaluation in a crossectional study with multiple sampling may help in assessing the relevance of NLR with arterial stiffness in cardiovascular diseases.

Table-1: Comparison of anthropometric indices, white cell count and arterial stiffness index amongst the groups.

Variables	Group 1 Normotensive Mean ± SD (n=30)	Group 2 Prehypertensive Mean ± SD (n=30)	Group 3 Hypertensive Mean ± SD (n=30)	p-value (sig.)
Age	40.10 ± 4.29	43.17 ± 5.17	47.90 ± 5.30	**0.000**
SBP	110.17 ± 5.89	129.93 ± 4.46	164.03 ± 11.63	**0.000**
DBP	72.90 ± 5.87	86.20 ± 2.25	104.97 ± 11.17	**0.000**
MAP	37.26 ± 4.88	43.73 ± 4.26	59.07 ± 7.71	**0.000**
PP	85.32 ± 5.40	100.78 ±2.45	124.66 ± 10.73	**0.000**
BMI	25.47 ± 2.78	25.77 ± 3.16	26.76 ± 3.01	0.223
WC	0.90 ± 0.08	0.95 ± 0.09	0.98 ± 0.08	**0.003**
CI	1.28 ± 0.07	1.32 ± 0.08	1.32 ± 0.08	0.051
WHR	0.94 ± 0.56	0.999 ± 0.08	1.03 ±.09	**0.000**
WSR	0.54 ± 0.05	0.54 ± 0.11	0.57 ± 0.05	0.102
WBC (k/µL)	6.86 ± 1.45	7.57 ± 1.64	6.96 ± 1.67	0.185
ANC (k/µL)	3.93 ± 0.83	4.59 ± 1.35	4.17 ± 1.22	0.094
ALC (k/µL)	2.41 ± 0.65	2.43 ± 0.6	2.38 ± 0.7	0.729
NLR	1.72 ± 0.52	1.74 ± 0.37	1.94 ± 0.63	0.161
ASI	6.67 ± 0.52	7.85 ± 0.62	12.19 ± 2.62	**0.000**

All values are expressed as mean plus/minus standard deviation.

[SBP: systolic blood pressure; DBP: diastolic blood pressure; PP: pulse pressure; MAP: mean arterial pressure; BMI: body mass index; WC: waist circumference; CI: conicity index; WHR: waist to hip ratio; WSR: waist stature ratio; WBC: white blood cell count; ANC: absolute neutrophil count; ALC: absolute lymphocyte count; NLR: neutrophil-lymphocyte ratio; ASI: arterial stiffness index; Kg: kilogram; m: meters; s: seconds]

Table-2: Comparison of anthropometric indices, white cell count and arterial stiffness index between the groups

Variables	Normotensive vs Prehypertensive	Normotensive vs Hypertensive	Prehypertensive vs hypertensive
Age	**0.048**	**0.0001**	**0.001**
SBP	**0.0001**	**0.0001**	**0.0001**
DBP	**0.0001**	**0.0001**	**0.0001**
MAP	**0.0001**	**0.0001**	**0.0001**
PP	**0.0001**	**0.0001**	**0.0001**
WC	**0.057**	**0.003**	0.523
WHR	**0.011**	**0.0001**	0.371
ASI	**0.014**	**0.0001**	**0.0001**

[SBP: systolic blood pressure; DBP: diastolic blood pressure; PP: pulse pressure; MAP: mean arterial pressure; WC: waist circumference; WHR: waist to hip ratio; ASI: arterial stiffness index]

Table-3: Relationship of anthropometric indices and white cell counts with arterial stiffness index and blood pressure variables

VARIABLES		BMI	WC	WHR	CI	WSR	WBC	ANC	ESR	NLR
ASI	R	0.107	**0.218**	**0.269**	0.136	0.098	.041	0.068	0.082	0.183
	P	0.316	**0.038**	**0.010**	0.201	0.357	.703	0.523	0.441	0.085
SBP	R	0.177	**0.323**	**0.372**	0.192	0.167	0.055	0.125	0.157	**0.271**
	P	0.095	**0.002**	**0.0001**	0.070	0.116	0.605	0.239	0.140	**0.010**
DBP	R	0.181	**0.346**	**0.362**	**0.250**	0.186	0.023	0.122	0.082	**0.314**
	P	0.088	**0.001**	**0.0001**	**0.017**	0.080	0.830	0.253	0.440	**0.003**
MAP	R	0.182	**0.341**	**0.372**	**0.228**	0.180	0.038	0.125	0.117	**0.299**
	P	0.086	**0.001**	**0.0001**	**0.031**	0.089	0.724	0.240	0.273	**0.004**
PP	R	0.135	**0.323**	**0.209**	0.070	0.167	0.089	0.105	0.198	0.155
	P	0.204	**0.002**	**0.003**	0.051	0.116	0.405	0.325	0.080	0.144

[BMI: Body Mass Index; WC: waist circumference; WHR: waist to hip ratio; CI: conicity index; WSR: waist stature ratio; WBC: white blood cell count; ANC: absolute neutrophil count; NLR: neutrophil-lymphocyte ratio; ASI: arterial stiffness index; SBP: systolic blood pressure; DBP: diastolic blood pressure; MAP: mean arterial pressure; PP: pulse pressure]

Table 04: Correlation orders of anthropometric indices with systolic and diastolic blood pressure in various studies.

Studies	Systolic Blood Pressure	Diastolic Blood Pressure
Zhou Z et al. [10] (n 29079)	BMI>WC>WSR>WHR>CI	BMI>WC>WSR>WHR>CI
Yalcin et al.[36] (n 267)	WSR>BMI>WC>WHR>CI	BMI>WC>WSR>WHR>CI
Ghosh & Bandyopadhyay [37] (n180)	WSR>BMI>WC>WHR>CI	BM>WC>WSR>WHR>CI
Ghosh JR, Bandyopadhyay AR[38](n=179)	WC > CI > WSR > BMI (0.01) (0.01) (0.62) (0.70)	WC > CI > WSR > BMI (0.01) (0.01) (0.05) (0.53)
Present study (n 90)	WHR > WC > WSR > CI >BMI (0.000)(0.002)(0.04)(0.07)(0.09)	WHR > WC > CI > WSR >BMI (0.000)(0.001)(0.01)(0.06)(0.09)

[BMI: Body Mass Index; WC: waist circumference; WHR: waist to hip ratio; CI: conicity index; WSR: waist stature ratio].

5 CONCLUSIONS

The central obesity is a more robust risk factor for arterial stiffness and blood pressure. The inflammation may be involved in pathogenesis of visceral obesity and arterial stiffness that may be determined by elevated white blood cell counts. However, the white blood cell count and differential white cell count may not give information about the inflammatory status in hypertension, which may be due to its complex pathophysiology.

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Traitement des Lixiviats de la décharge non contrôlée de la ville de Taza par électrocoagulation- filtration et leur réutilisation dans la germination du Sorgho et de la luzerne

[Treatments by electrocoagulation- filtration of uncontrolled Leachate discharge from the city of Taza and re-use in the germination of sorghum and alfalfa]

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ABSTRACT: The leachate is a source of contamination of surface water and groundwater if not pretreated. Indeed, its complex structure and pollutant load makes treatment very difficult to meet the limits required by the standards. The study presented in this work aimed to develop techniques for treatment of leachate. Two techniques were studied. The first involves treatment by electrocoagulation with aluminum electrode, the second is a sand filter with a diameter between 0.44 and 0.55 mm. Initially, we characterized the sample in the rough. Thereafter, we followed the evolution of abatement of chemical oxygen demand (COD) levels, biological oxygen demand (BOD5), suspended solids (TSS). Secondly, we performed a comparative study on the germination of seeds of sorghum and Lucernes by use of leachate unprocessed or processed and at different concentrations. Treatment of leachate by electrocoagulation-filtration significantly reduced the intensity of their color that resulted in a decrease in pollution load of mineral and organic matter, especially in color, BOD5 and COD. This, allowed him to act favorably on the germination of seeds of sorghum and Lucernes. Leachate treated at different concentrations has no effect on the germination of Sorghum and Lucernes. The application of the raw leachate to inhibit germination of the total grain examined.

KEYWORDS: Leachate, treatment, electrocoagulation, filtration, germination.

RESUME: Le Lixiviat est une source de contamination des eaux de surface et des eaux souterraines s'il n'a pas subi un traitement préalable. En effet, sa structure complexe et sa charge polluante rendent son traitement très difficile pour atteindre les limites exigées par les normes. L'étude présentée dans ce travail avait pour objectif la mise au point des techniques de traitement des Lixiviats. Deux techniques ont été étudiées. La première consiste à un traitement par électrocoagulation avec l'électrode d'aluminium, la deuxième consiste à une filtration à sable ayant un diamètre variant entre 0,44 et 0,55 mm. Dans un premier temps, nous avons caractérisé l'échantillon à l'état brut. Par la suite, nous avons suivi l'évolution du taux d'abattement de la demande chimique en oxygène (DCO), de la demande biologique en oxygène (DBO_5), Matières en suspension (MES). Dans un deuxième temps, nous avons réalisé une étude comparative sur la germination des graines des Sorgho et des Luzernes par utilisation des Lixiviats à l'état brut ou traité et à différentes concentrations. Le traitement des Lixiviats par électrocoagulation-filtration a nettement réduit l'intensité de leur couleur qui s'est traduit par une diminution de leur charge polluante en matière minérale et organique, notamment en couleur , DBO_5 et DCO. Ceci, lui ont permis d'agir très favorablement sur la germination des graines des Sorgho et des Luzernes. Les lixiviats traités à différente concentration n'ont pas d'effet sur la germination des Sorgho et des Luzernes. L'application des lixiviats à l'état brut inhibe la germination totale des grains étudiés.

MOTS-CLEFS: Lixiviats, traitement, électrocoagulation, filtration, germination.

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1 INTRODUCTION

Actuellement, la question des déchets devient alarmante au Maroc comme dans les pays en voie de développement. En effet, l'augmentation du volume des déchets solides municipaux pose de sérieux problèmes dans les zones urbaines. La croissance démographique, l'amélioration du niveau de revenu par tête et du niveau de l'activité économique, ont eu pour conséquence l'augmentation de la production des déchets solides [1]. Cette grande production des déchets et par conséquence la production des lixiviats constitue une menace pour la qualité de l'environnement [2] et particulièrement les ressources hydriques [3] et du cadre de vie. En fait, le problème de gestion des déchets solides devient le souci majeur des collectivités.

La ville de Taza n'a pas échappé à la problématique du mode de gestion des déchets solides qui correspond à la mise en décharge. Il s'agit principalement de décharge non contrôlée et à ciel ouvert, où tous les types de déchets sont rejetés à l'état brut et mélangés : urbains, industriels, hospitaliers et agricoles. Cette dernière est installée sur une plaine alluviale s'étendant sur une superficie de 4 hectares et n'ayant bénéficié d'aucune étude préliminaire géologique, hydrogéologique ou d'impact. Le site de la décharge est situé à 1,2 Km du centre de l'agglomération et au cœur de l'Oued Larbâa ce qui pourrait générer de sérieux problèmes de pollution [4]. En effet, dès la phase de dépôt, les déchets sont soumis à des processus de dégradation liés à des réactions biologiques et physico-chimiques complexes; avec production des lixiviats et du biogaz chargés de substances organiques et minérales qui engendrent une pollution essentiellement de type organique et métallique [5]. Leur rejet à l'état brut et sans aucun traitement préalable engendre des impacts environnementaux (pollution des sols, contamination des eaux souterraines et de surface) [6, 7, 8] et sanitaires [9].

La ville de Taza, est malheureusement, considérée une ville en voie de développement du point de vue de la protection de l'environnement par rapport aux grandes villes marocaines qui ont réalisé beaucoup de progrès dans ce domaine, mais qui reste loin des mécanismes de développement que connaît le secteur de la gestion des déchets ménagers dans les pays développés.

La population de Taza, estimée à environ 154 496 habitants, produit 18 000 tonnes par jour des déchets solides [1], et ceci malgré la faible activité industrielle de cette région. Ces déchets sont essentiellement domestiques (0,85 kg/ jours/ habitant) et sont acheminés vers la décharge publique de Taza au cœur de l'Oued Larbâa (Figure 1), ce qui pourrait être à l'origine de sérieux problèmes de pollution.

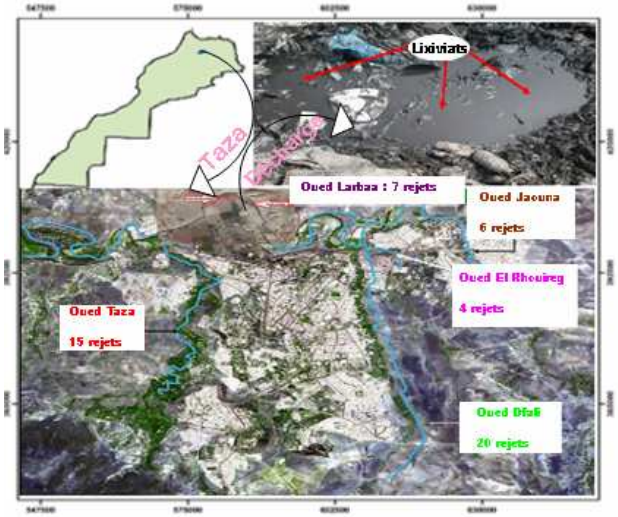


Fig. 1. Situation géographique de la décharge sauvage de la ville de Taza

L'objectif du présent travail est de caractériser les lixiviats de la décharge non contrôlée de la ville de Taza, en estimant les risques qu'ils présentent et de proposer un procédé de traitement de ces lixiviats. Le procédé recherché vise à obtenir un abattement très significatif de la charge organique du lixiviat qui s'adapte au contexte socio-économique du Maroc. Cette investigation consiste à étudier l'effet des lixiviats brutes ou traitées, par la méthode d'électrocoagulation-filtration, à différentes concentrations sur la germination et le développement des graines de Sorgho et de Luzerne.

L'électrocoagulation-filtration est une méthode simple, efficiente, sécurisée [10, 11], moins coûteuse et plus rentable que les méthodes physico-chimiques utilisant des coagulants chimiques [12, 13]. La filtration gravitaire à sable lavé, de

dimension 0,5 mm est considérée comme de simples tamis destinés à retenir des particules ayant un diamètre supérieur à l'ouverture de ses pores.

2 MATÉRIEL ET MÉTHODES

2.1 COMPOSITION PHYSICO-CHIMIQUE DES LIXIVIATS

Pour un échantillonnage plus représentatif des lixiviats, même il est difficile de déterminer avec précision les propriétés des lixiviats vu que ces derniers évoluent dans le temps et dans l'espace [14] ; et vu que ces lixiviats s'enrichissent au cours du temps, nous avons retenu trois missions en trois points de prélèvement bien déterminés dans la décharge « Julien » vue le manque d'un système de drainage des lixiviats de cette décharge sauvage. Les échantillons des lixiviats analysés ont été prélevés soigneusement dans des flacons en polyéthylène à différents volumes, conservés dans une glacière et transportés immédiatement au laboratoire [15, 16, 17]. Pour la caractérisation physico-chimique des lixiviats étudiés, plusieurs types d'analyses ont été réalisés. Certaines mesures ont été réalisées sur place, au moment du prélèvement, pour éviter le changement et l'évolution des échantillons; c'est le cas de la température, la conductivité électrique et le pH (multi-paramètre Type CONSORT – Modèle C535). D'autres ont été effectuées au laboratoire à savoir : DBO_5, DCO, MES, Nitrate, ions Nitrite et Ammonium (tableau 1). Tous les échantillons et les paramètres physico-chimiques des lixiviats ont été déterminés par une personne habilitée dans le domaine de la qualité de l'eau et selon les méthodes standards d'analyse des eaux usées [16, 18]. La teneur de matières en suspension (MES) a été déterminée par la méthode de centrifugation. La Demande Chimique en Oxygène (DCO) est déterminée selon la méthode de Dichromate de potassium à une température de 148°C, et la demande biologique en oxygène (DBO_5) est mesurée à l'aide d'un Oxymeter 538(WTW) / DBOmèter : TS606/2. Les ions nitrites, nitrates et ammoniums ont été déterminés avec un spectrophotomètre dans le visible type G BOYER/ANACHEM 320.

Table 1. Méthodes d'analyses des composantes physicochimiques

Paramètres	Méthodes d'analyses	Unité
Conductivité	Conductivimètre Type CONSORT – Modèle C535	µs / cm
pH	pH-mètre Type CONSORT – Modèle C535	1 - 4
Température	Thermomètre à mercure / multi-paramètre analyser Type CONSORT – Modèle C535	° C
Oxygène dissous	Méthode de titrage de Winkler.	mg / l
Nitrates	Salicylate de sodium	mg / l
Nitrites	Méthode au réactif de Zamballi	mg / l
Ammoniums	Nitroprussiate de sodium et de phénol et solution chlorée	mg / l
Orthophosphates	Tartrate de l'antimoine de potassium et une solution de molybdate d'ammonium	mg / l
MES	Membrane de 0,45 µm	mg / l
DBO_5	OXITOP	Mg d'O_2 / l
DCO	Dichromate de potassium à la température de 148°C	Mg d'O_2 / l
Azote total Kjeldahl	Minéralisation de l'échantillon par l'acide sulfurique concentré à chaud en présence d'un catalyseur le sélénium.	mg / l

Après la détermination du taux d'abattement des paramètres indicateurs de pollution des lixiviats bruts et ceux traités, nous vous déterminer du paramètre ??? à la fin de germination des graines de Sorgho et des luzernes pour des lixiviats traités et ceux bruts. Un volume de 5 ml de chaque échantillon est pipeté dans une boîte de Pétri stérile, tapissée par un papier filtre Whatman support absorbant les échantillons à comparer, dix graines des variétés testées sont distribuées sur le papier filtre ; les boîtes de Pétri sont incubées à 25 °C pendant trois jours. Après incubation, les effets des traitements sont évalués par comptage du nombre des graines germées. Comme témoin, 5 ml d'eau distillée sont utilisées à la place des lixiviats traités ou bruts. L'indice de germination "IG" est calculé selon la formule suivante :

$$IG=\frac{\text{(Nombre de graines germées) x (Longueur des racines des plantules traitées)}}{\text{(Nombre de graines germées) x (Longueur des racines des plants témoins)}}$$

La longueur des racines est exprimée en cm.

On a calculé, aussi, le pourcentage final de germination qui présente le pourcentage de germination après cinq jours et le pourcentage d'inhibition de la germination [19]:

$$\%IG=\frac{PGTE - PGTR}{PGTE}*100$$

Avec : PGte: pourcentage de germination du témoin.

PGtr : pourcentage de germination du lot traité par les lixiviats.

L'indice de vigueur [20] :

$$IVG=\frac{[\%\ DE\ GERMINATION \times MOYENNE\ (LONGUEUR\ DES\ RACINES + LONGUEUR\ DES\ TIGES)]}{100}$$

3 RÉSULTATS ET DISCUSSION

Les lixiviats d'un lieu d'enfouissement sont particulièrement caractérisés par de très fortes valeurs des paramètres indicateurs des pollutions : DBO, de MES, de l'azote ammoniacal, quelques métaux [6]

L'analyse physic-chimique des lixiviats de la décharge de la ville de Taza, montre que les concentrations moyennes en DBO_5 et en DCO au cours des trois dernières années d'étude (2011-2014), varient entre 5060,28 mg d'O_2/l et 7902,70 mg d'O_2/l. Le rapport DBO/DCO se situe à environ 0,64. Ces lixiviats présentent, aussi, une forte charge minérale et organique dépassant les limites marocaines des rejets (VLMR) des eaux usées dans les eaux superficielles ou souterraines (tableau 2) [21, 22].

Les lixiviats étudiés ont une conductivité électrique élevée de l'ordre de 4,26 mS/cm, due aux apports des déchets solides et liquides par la décharge, sous l'effet de la température élevée de l'ordre de 32,7 °C, correspondant à la période entre les mois Mai et Août d'échantillonnage ce qui favorise le développement bactérien 420000 N des coliformes fécaux /100 ml [6], et de la diminution de la pluviosité engendrant une augmentation de la concentration du lixiviat [23]. Les concentrations en azote ammoniacal, nitrate, nitrite, Azote total Kjeldahl sont respectivement de 32,76 mg/l, 29,14 mg/l, 26,3 mg/l et 210,15 mg/l

La moyenne des matières en suspension retrouvée dans les Lixiviats étudiés est de l'ordre de 5480 mg/l qui donnent au lixiviats une apparence trouble, un mauvais goût et une mauvaise odeur [29] ??. Cependant le pH enregistré est de l'ordre de 6,20 qui prouve que les déchets ne s'accumulent pas sur le site, le pH basique caractérise les décharges anciennes avec des lixiviats âgés ou stabilisés [24]. Cela est probablement dû au mode d'exploitation de ce site, basé sur le brûlage des déchets et l'élevage intense des bétails.

Table 2. Caractérisation physico-chimique des lixiviats bruts.

Paramètre	T°C	pH	Couleur	CE (mS/cm)	DBO_5 (mg d'O_2/L)	DCO (mg d'O_2/L)
Valeur	33± 0,1	6,20± 0,19	Très intense	4,26	5060,28	7902,70
VLRM*	-	5,5-8,5	-	2,7	40	120

Paramètre	MES (mg/L)	NH_4^+(mg/L)	NO_3^-(mg/L)	NO_2^- (mg/L)	PO_4^{3-} (mg/L)	(NTK) (mg/l)
Valeur	5480,00	32,76 ± 0,76	29,14± 0,36	26,3 ± 0,12	16± 0,09	210,15

Le traitement des lixiviats par électrocoagulation-filtration dans les conditions suscitées signale l'apparition des bulles formant une mousse à la surface de l'échantillon. Après 2 h de traitement, les lixiviats deviennent neutres, de couleur moins intense, et de très faible conductivité; soit un abattement de 73,9 %, de la charge organique.



Fig. 2. Aspect visuel des Lixiviats bruts et traités par électrocoagulation-filtration

Table 3. Caractérisation physico-chimique des lixiviats traités

Paramètre	**pH**	Couleur	**CE (mS/cm)**	**DBO_5 (mg d'O_2/L)**	**DCO (mg d'O_2/L)**
Valeur	7,3 ± 0,15	Moins intense	1450 ± 50	36± 5,77	100± 25,16
VLMR*	5,5-8,5	-	2,7	40	120

Au cours de la réaction, les électrodes anodiques s'oxydent en générant des bulles d'oxygène et en libérant un ion trivalent et trois électrons. Les électrons libérés réagissent avec les hydroxydes, provenant de la cathode, pour former les ions hydroxydes et de l'hydrogène qui va migrer vers la surface. Les ions provenant de l'anode et les hydroxydes de la cathode s'unissent pour donner des hydroxydes de métaux qui peuvent se lier avec des substances chargées négativement pour les éliminer. Les polluants sont éliminés par flottation ou par décantation.

La Filtration à sable qui consiste à faire passer les Lixiviats traités par EC à travers une colonne poreuse, afin d'éliminer les matières en suspension restantes et les flocs non éliminés par le procédé EC.

Ceci prouve que la matière restante dans les Lixiviats traités s'est transformée en matière biodégradable. Nous avons ainsi enregistré une réduction de 98,7 % de la DCO, de 98,4 % de la DBO_5 et de 94,22 % de la MES (figure 3).

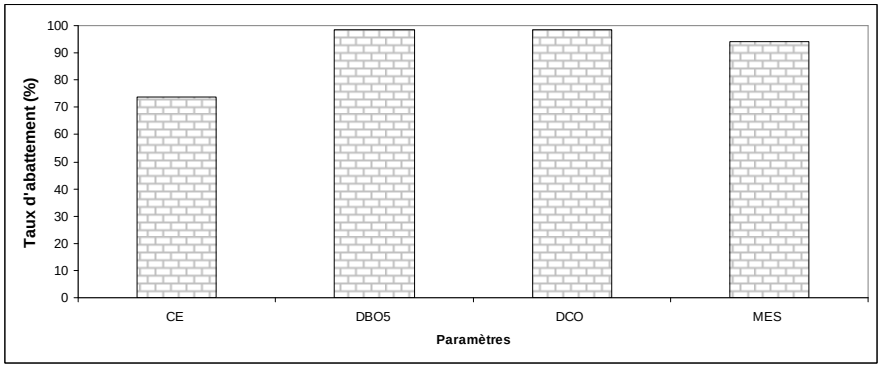


Fig. 3. Taux d'abattement de la charge polluante des lixiviats après leur traitement

La réduction de la couleur est due, fort probablement, à la disparition totale de la matière organique biodégradable et non biodégradable, de la MES et de la matière colloïdale par filtration à sable. L'augmentation du pH justifie la disparition des protons, et la diminution de la conductivité de 73,9 % prouve l'élimination des sels dissous suite à leur liaison avec les hydroxydes d'aluminium lors de l'électrocoagulation.

3.1 APPLICATION DES LIXIVIATS TRAITES ET NON TRAITES SUR LA GERMINATION DES PLANTES FOURRAGERES (SORGHO ET LUZERNE)

L'application des lixiviats non traités a un effet totalement négatif sur la germination des deux plantes, aucun des grains n'a germé chez les deux plantes et pour les différentes dilutions. Ceci montre l'effet totalement néfaste des lixiviats bruts sur la culture de sorgho et de luzerne. Cet effet peut être expliqué par les fortes charges polluantes des lixiviats (DBO, DCO, MES et NTK),

Chez Les deux variétés sous l'effet des lixiviats traités à des dilutions différentes, la germination débute dès le premier jour et se termine au cinquième jour. On observe que la majorité des grains de sorgho germent en premier jour et atteint 100% de germination dans le 4eme jour pour toutes les dilutions. Dans le troisième jour, une germination de 100% est observée pour le témoin et la dilution ½, de 96.67% pour les lixiviats traités bruts et 93.33% pour la dilution ¼.

Chez la luzerne le pourcentage de germination atteint jusqu'à 90% pour les lixiviats traités bruts, 80% pour le témoin, 76% pour la dilution ½ et 70% pour la dilution ¼.

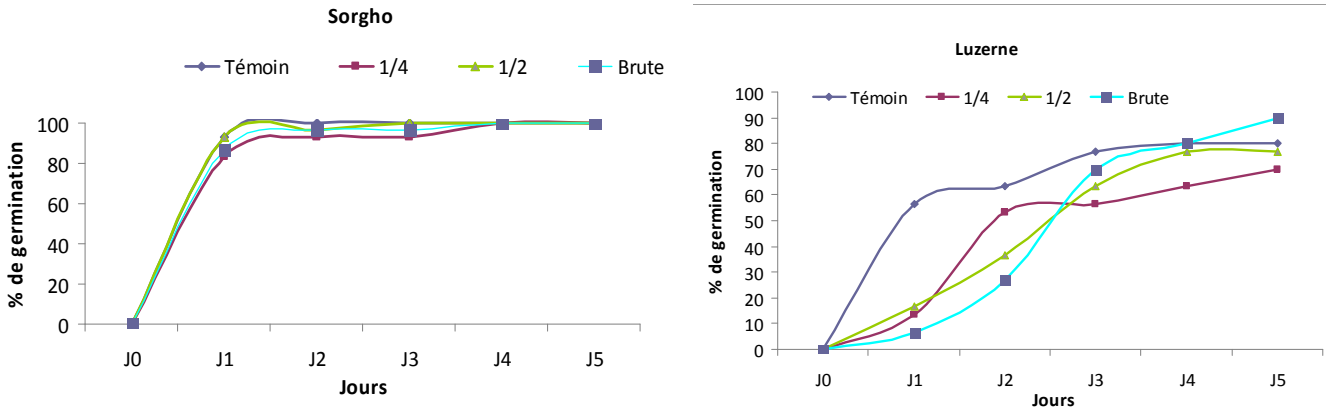


Fig. 4. Effet des lixiviats traités à différentes dilutions sur la germination des graines de luzerne et de sorgho en fonctions du temps (Les valeurs correspondent aux moyennes ± SE pour n = 3).

D'après la figure. 4; pour le sorgho, l'utilisation de lixiviats traités et à différentes dilutions donne des résultats comparables à ceux du témoin. Pour la luzerne le pourcentage de germination le plus satisfaisant est obtenu avec les lixiviats bruts par rapport aux autres dilutions.

Pour les deux plantes, C'est le sorgho qui présente les valeurs du pourcentage de germination les plus élevées dans chaque dilution et qui dépasse largement celles obtenues chez la luzerne.

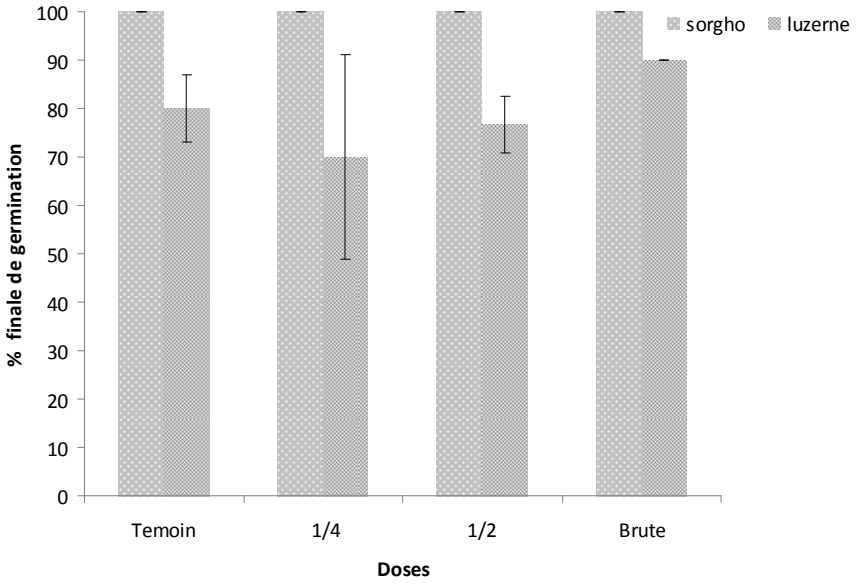


Fig. 5. ***Effet des lixiviats traités à différentes dilutions sur le taux de germination de luzerne et de sorgho après 5 jours de germination (Les valeurs correspondent aux moyennes ± SE pour n = 3).***

Les résultats concernant le pourcentage d'inhibition de la germination chez les deux variétés (Figure.6), montrent que les graines de sorgho possèdent des pourcentages plus faibles que ceux des graines de luzerne. Les dilutions ¼ et ½ des lixiviats traités ont un effet inhibiteur sur la germination de la luzerne avec des pourcentages respectivement de 12.5% et 4.12%, par contre aux lixiviats bruts qui ont un effet positif comparativement au témoin, avec un pourcentage d'inhibition de -12.5%.

Le pourcentage d'inhibition de la germination chez le sorgho est nul, la germination du sorgho aux différentes dilutions est similaire au témoin. Les lixiviats traités n'ont aucun effet sur l'inhibition de la germination de cette plante fourragère.

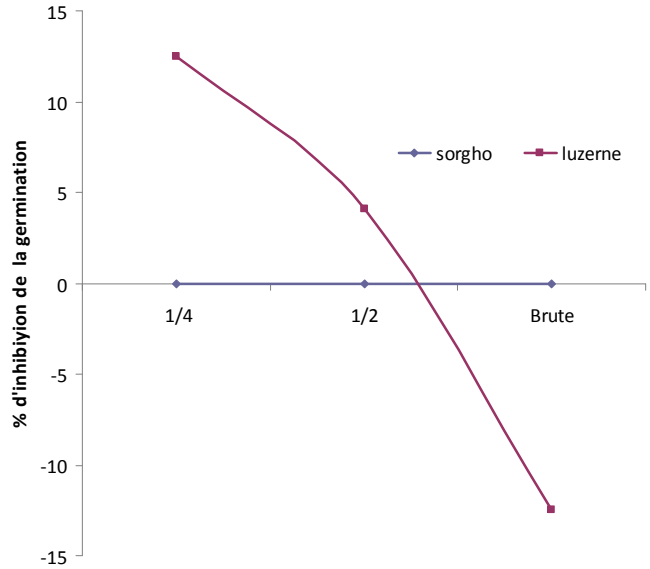


Fig. 6. ***Pourcentage d'inhibition de la germination des graines des deux variétés en fonction de la concentration des lixiviats traités (Les valeurs correspondent aux moyennes ± SE pour n = 3).***

En se rapportant à la figure ci-dessous (Figure.7), les valeurs de l'indice de vigueur chez la luzerne subissent une augmentation avec l'augmentation de la concentration des lixiviats traités en allant de 3.64% pour le témoin à 5.23% pour les lixiviats bruts. Cette augmentation peut être le résultat de l'augmentation du pourcentage de germination aux différentes concentrations, ou des racines et des hypocotyles. En revanche, le sorgho présente des valeurs variables, dont la plus importante est celle obtenue pour la dilution ¼ qui est de 19.21%.

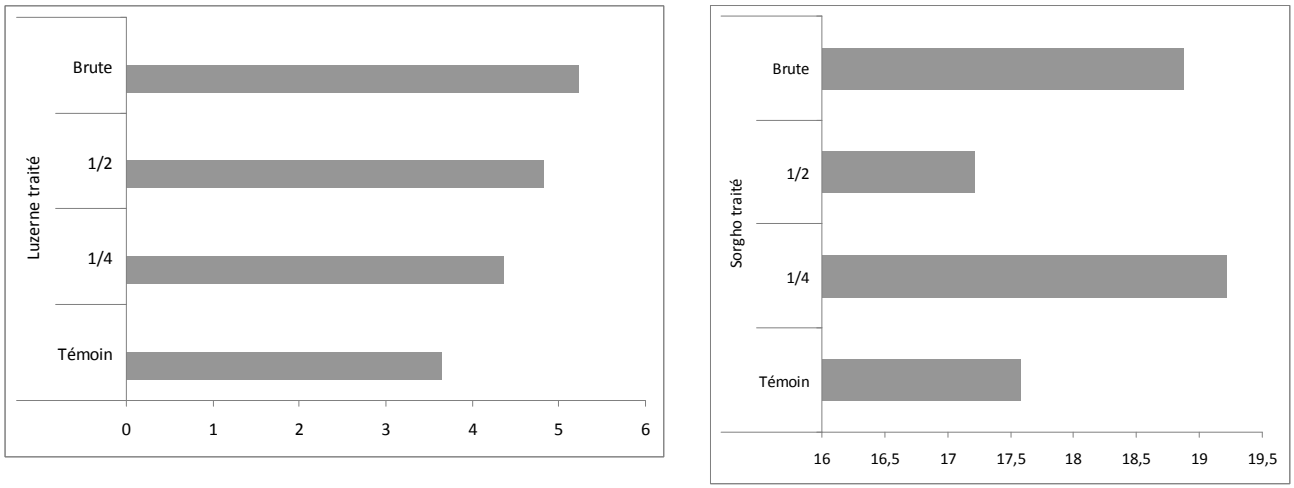


Fig. 7. ***les valeurs de l'indice de vigueur en fonction des différentes concentrations des lixiviats traités (Les valeurs correspondent aux moyennes ± SE pour n = 3).***

Les résultats d'étude du système radiculaire sous différentes doses des lixiviats, sont représentés dans le tableau ci-dessous (Tableau.4) :

Table 4. Comparaison de la longueur (cm) de la racine pour les deux variétés en fonction des différentes doses des lixiviats traités.

		Témoin	1/4	1/2	Brute
Luzerne	Moyenne	2.04	3,7	3,54	3,53
	Ecart type	0	0,38	0,15	0,16
Sorgho	Moyenne	12,92	12,87	10,86	13,32
	Ecart type	1,01	0,76	0,71	0,97

D'après le tableau.4 et la figure.8, les deux plantes présentent des longueurs des racines très variables. Chez la luzerne la longueur de ces parties est généralement élevée par rapport au témoin principalement à la dilution ¼ avec 3.7cm. Alors que chez le sorgho, on trouve la valeur la plus importante pour les lixiviats bruts (13.32cm) puis 12.9cm pour le témoin, 12.8 cm pour la dilution ¼, et enfin 10.8 cm pour la dilution ½.

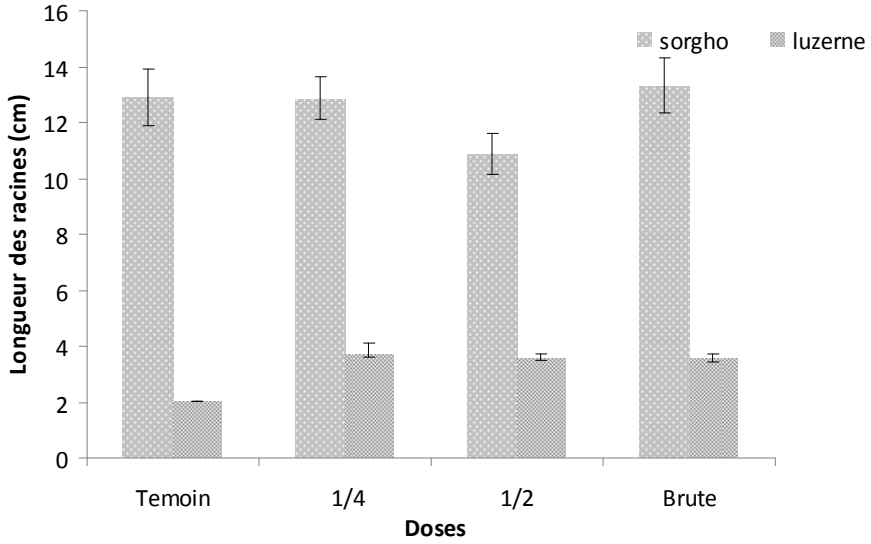


Fig. 8. ***Effet des lixiviats traités à différentes dilutions sur la longueur de racine de sorgho et la luzerne après 5 jours.***

Les résultats d'étude de la partie aérienne sous différentes doses des lixiviats traités, sont représentés dans le tableau ci-dessous (tableau.5) :

Table 5. Comparaison de la longueur des hypocotyles pour les deux variétés en fonction de différentes doses des lixiviats traités.

		Témoin	¼	1/2	Brute
Luzerne	Moyenne	2,52	2,91	2,75	2,28
	Ecart type	0	0,11	0,02	0,12
Sorgho	Moyenne	6,31	7,56	6,55	5,78
	Ecart type	0,19	0,99	0,77	0,7

Pour la croissance de la partie aérienne, les résultats ont montré que les deux dilutions ¼ et ½ des lixiviats traités présentent les valeurs les plus importantes chez les deux plantes fourragères, mais c'est la dilution de ¼ qui donne la valeur la plus élevée, avec 2.9cm chez la luzerne et 7.56cm chez le sorgho. On comparant entre ces deux variétés on trouve que la le sorgho présente des longueurs qui dépassent largement celles de la luzerne.

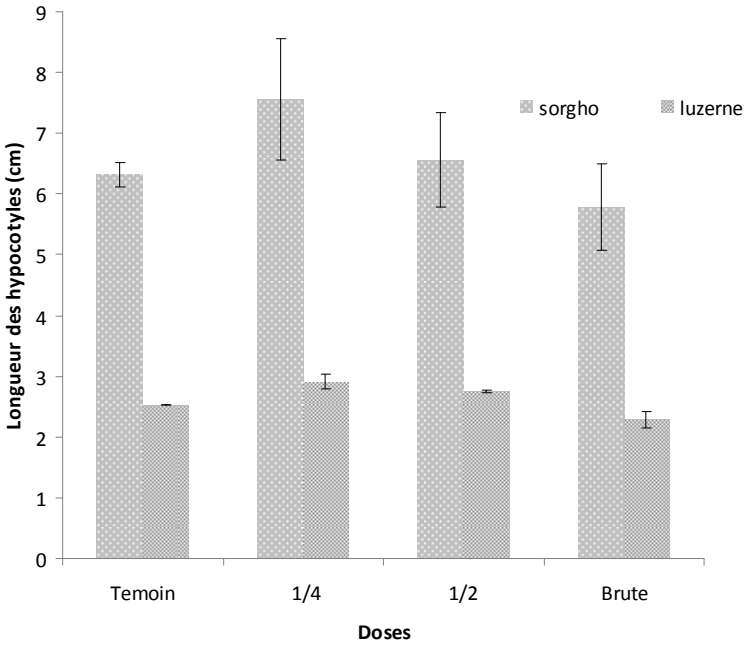


Fig. 9. Effet des lixiviats traités à différentes dilutions sur la longueur des hypocotyles de Sorgho et Luzerne après 5 jours.

Les résultats montrent que la réponse des deux variétés à la concentration des lixiviats traités, est variable en fonction des différentes dilutions, l'organe étudié et en fonction de la plante elle-même. En effet, pour une concentration plus sévère des lixiviats traités, les deux variétés ont pu maintenir une augmentation de la longueur des racines et des hypocotyles par rapport aux témoins.

Les résultats de la mesure des poids frais et secs de l'ensemble des parties de la plante pour les différentes dilutions des lixiviats traités chez la variété du sorgho, sont présentés dans le tableau ci-dessous (tableau.6) :

Table 6. les quantités de PS, et PF en différentes concentrations des lixiviats traités du sorgho.

	PF (mg)			PS (mg)		
	Racine	**Hypocotyle**	**Cotylédon**	**Racine**	**Hypocotyle**	**Cotylédon**
témoin	17,81	33,02	28,81	14,93	17,16	23,86
1/4	27,22	45,51	35,36	24,85	25,99	25,44
1/2	27,77	40,10	55,88	23,91	26,21	31,86
¾ ??	25,48	36,87	38,88	22,06	22,96	26,07

La figure représentative des quantités du PF (Figure.10), en fonction des traitements appliqués, montre que chez la variété étudiée, toutes les parties de la plante étudiées subissent une augmentation du poids frais comparativement aux témoins.

La même observation pour le PS, les valeurs sont généralement élevées comparativement au témoin. Pour le PS, des différentes parties en différentes dilutions, présente des valeurs rapprochées. On peut noter dans les racines 15.11mg, et 15.69mg ?? dans les hypocotyles pour les lixiviats traités bruts, les cotylédons présentent la valeur la plus satisfaisante à la dilution de ¾ de 17.97mg ???.

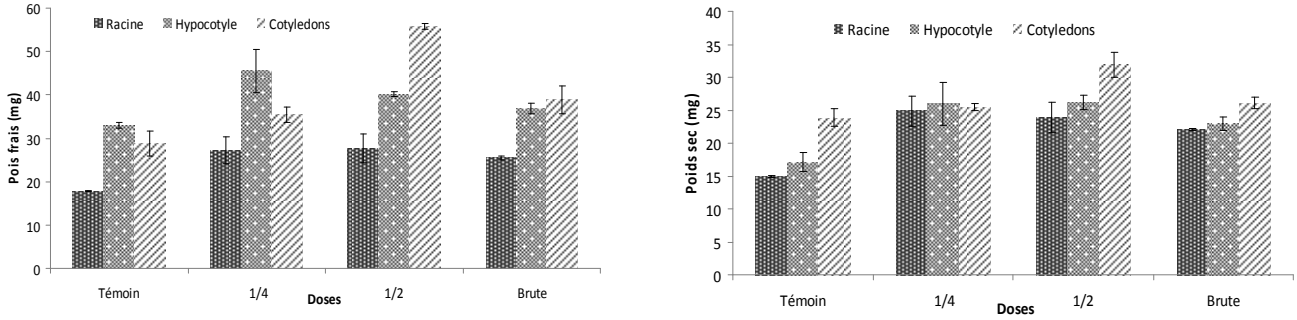


Fig. 10. Effet des lixiviats traités à différentes dilutions sur PF et PS de sorgho (Les valeurs correspondent aux moyennes ± SE pour n = 3).

En générale, les PF et PS à différentes dilutions des lixiviats traités sont plus élevés que ceux obtenus pour les lixiviats traités non dilués. En plus, Les apports de 35 et de 70 t/ha de compost entraînent des augmentations statistiquement significatives de la production de fruits de 28.7% et de 31.5% respectivement par rapport au témoin. Par ailleurs, il n'existe pas de différence significative entre les traitements de 70 et de 35 tonnes à l'hectare. (**Paino VANAI** 25 octobre 1995) :

Les valeurs des poids frais et secs de l'ensemble des parties de la plante, pour les différentes dilutions des lixiviats traités chez la variété de la luzerne, sont représentées dans le tableau ci-dessous (Tableau.7) :

Table 7. Les quantités de PS, et PF en différentes concentrations des lixiviats traités de la luzerne.

	PF (mg)			PS (mg)		
	Racine	**Hypocotyle**	**Cotylédon**	**Racine**	**Hypocotyle**	**Cotylédon**
Témoin	21,20	26,80	24,40	18,60	22,60	20,80
¼	18,77	26,94	23,94	17,64	20,50	19,38
½	15,30	16,52	13,96	13,67	11,39	11,51
Brute	12,85	16,30	14,11	11,36	12,03	12,39

D'après, Les valeurs du PF de la luzerne (Figure. 11), en tenant compte des différentes concentrations, on observe que les poids des racines sont généralement faibles que ceux du témoin, par contre pour les hypocotyles, ses poids sont plus élevées surtout à la dilution ¼ qui est de 26.94mg. Les poids des cotylédons sont toujours variables et c'est le ¼ qui est principalement important avec 34.81mg après le témoin.

Les valeurs des PS sont en général différentes, ou on peut apprécier 17.6mg pour les racines, 20.5mg pour les hypocotyles, et 19.3mg qu'on l'a trouve pour les cotylédons à la dilution de ¼.

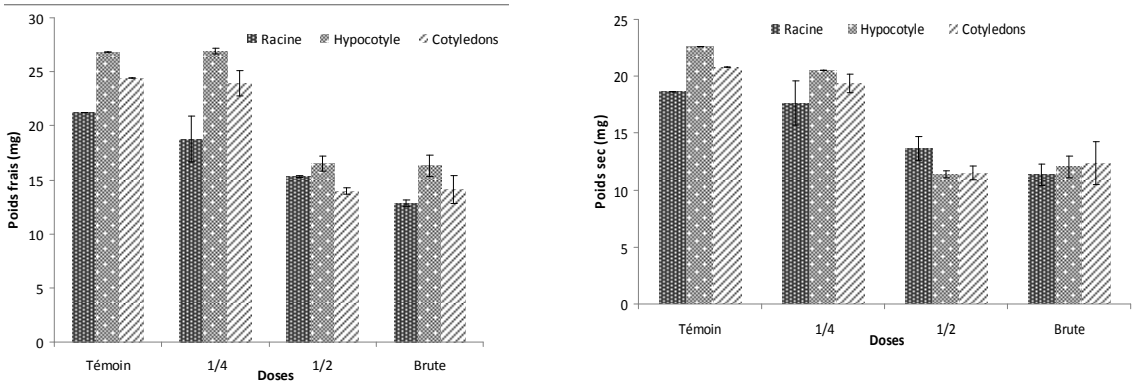


Fig. 11. Effet des lixiviats traités à différentes dilutions sur PF et PS de luzerne (Les valeurs correspondent aux moyennes ± SE pour n = 3).

Après cette analyse**,** la plante subisse toujours une diminution de poids, comparativement au témoin.

4 CONCLUSION

Le traitement des lixiviats par électrocoagulation-filtration, a entrainé une réduction de la charge polluante de ce percolat qui s'est traduit par une diminution des paramètres indicateurs de pollution (DBO5, DCO, MES), de la CE, du pH et une réduction de l'intensité de la couleur….

La réutilisation de ce liquide résiduel, en l'appliquant pour la germination des graines de deux variétés différentes le Sorgho et la Luzerne a montré que les lixiviats bruts n'ont aucun effets sur la germination de ces graines; par contre, un effet positif a été marqué avec les lixiviats traités à différentes dilution.

Finalement, Le traitement des lixiviats par électrocoagulation-filtration fait partie des innovations intéressantes pour l'avenir. En effet, cela permet de donner une seconde vie à des déchets auparavant jetés.

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L'impact de l'efficience de R&D sur l'innovation technologique dans les pays émergents

[The impact of the R&D efficiency on technological innovation in developing countries]

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ABSTRACT: Innovation is a key success factor for enterprises and a factor in creating wealth for the country. Hence, it's very important to study its determinants. Although the financial and human resources in research and development (R&D) have been the subject of several empirical studies, the efficient use of these resources has been ignored and has not been recognized as a determinant of innovation. The present study attempts to fill this gap in the literature. Its purpose is to test the effect of R&D efficiency on technological innovation in 14 developing countries during the period (2000-2010). After estimating the R&D efficiency scores by the stochastic frontier approach, we estimated a linear regression model where innovation is explained by these efficiency scores. The results show that R&D efficiency levels have a significant positive impact on the international rate of innovation. The main conclusion from this study is that to innovate, countries need to increase not only the amount of resources for innovation activity, but also the quality of management of existing resources.

KEYWORDS: innovation, R&D expenditure, human resources for R&D, R&D efficiency, developing countries.

RESUME: L'innovation est un facteur clé de succès pour les entreprises et un facteur de création de richesse pour les pays. D'où la nécessité d'étudier ses déterminants. Bien que les ressources financières et humaines de recherche et développement (R&D) aient fait l'objet de plusieurs travaux empiriques, l'utilisation efficiente de ces ressources a été ignorée et n'a pas été reconnue comme un déterminant de l'innovation. La présente étude essaie de combler ce vide dans la littérature. Son objectif consiste à tester l'effet de l'efficience des dépenses de R&D sur l'innovation technologique dans 14 pays émergents pendant la période (2000-2010). Après avoir estimé les scores d'efficience de R&D par l'approche de frontière stochastique, nous avons estimé un modèle de régression linéaire où l'innovation est expliquée par ces scores d'efficience. Les résultats montrent que les niveaux d'efficience de R&D ont un impact positif et significatif sur le taux international d'innovation. La principale conclusion tirée de cette étude est que pour innover, les pays ont besoin d'accroitre non seulement la quantité des ressources relatives à l'activité d'innovation, mais aussi la qualité de gestion des ressources existantes.

MOTS-CLEFS: innovation, dépenses de R&D, personnel de R&D, efficience de R&D, pays émergents.

1 INTRODUCTION

L'innovation est la source d'avantage compétitif pour les entreprises et de prospérité et croissance pour les pays. D'où la nécessité d'étudier ses déterminants. Le capital financier et le capital humain ont souvent constitué les principaux déterminants de l'innovation. Ce qui laisse entendre que plus on consacre des ressources de recherche et développement

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(R&D), plus on est innovant. Or, le monde économique se caractérise par la rareté des ressources, quelle que soit leur nature. On ne peut pas accroître indéfiniment les dépenses de R&D. Par contre, il faut penser à bien exploiter les ressources existantes et les utiliser d'une manière efficiente. C'est dans ce contexte que s'inscrit notre problématique qui peut être énoncée comme suit : Quel est l'impact de l'efficience de R&D sur l'innovation dans les pays émergents ?

Notre concentration sur les pays émergents se justifie par l'obligation de ces derniers d'innover pour rattraper les pays développés.

La méthodologie de recherche suivie dans ce travail consiste à estimer dans un premier temps les scores d'efficience de R&D grâce à l'approche de frontière stochastique (SFA) et régresser dans un second temps le niveau d'innovation sur ces scores. La conclusion principale de cette étude est que l'utilisation efficiente des ressources de R&D constitue un déterminant clé de l'innovation technologique.

Le papier sera composé de quatre sections. Nous présenterons dans une première section le modèle de notre étude. Ensuite, nous citerons une revue de littérature portant sur notre problématique. Dans une troisième section, nous entamerons la méthodologie de recherche. Et dans une quatrième section, nous présenterons et interprèterons les résultats trouvés.

2 MODÈLE

Dans les premiers modèles économiques, l'output (Q) était exprimé en fonction du capital (K) et du travail (L), et la technologie était ignorée :

$$Q = f(K, L). \quad (2.1)$$

En 1957, la référence [1] devient fameuse pour avoir souligné que les accroissements du capital et travail ne tiennent pas complètement en compte de la croissance économique. Il existe un autre facteur (A) qui représente le changement technique et améliore la productivité du capital et du travail. Donc, la technologie a été insérée comme un facteur séparé (A) qui accroit la productivité du capital et du travail comme dans l'équation (2.2) :

$$Q = A\, f(K, L). \quad (2.2)$$

A: mesure le niveau de productivité totale des facteurs (PTF) (une mesure du niveau actuel de technologie).

La technologie a été supposée toutefois exogène. Il fallait attendre trois décennies pour qu'en 1986 la référence [2] a modélisé la technologie non pas comme une manne du ciel exogène mais comme le résultat d'un effort explicite.

Donc, la nouvelle théorie de croissance modélise la technologie (T) comme le résultat d'inputs explicites, notamment, la recherche et le développement (R&D) et le capital humain (CH), comme dans l'équation (2.3) :

$$A = f(R\&D, CH). \quad (2.3)$$

Cependant, et à notre égard, l'accumulation des ressources de R&D n'est pas suffisante pour créer l'innovation. Encore faut-il assurer l'utilisation efficiente de ces ressources rares. Ainsi, le sous développement scientifique et économique peut résulter non seulement de la quantité insuffisante des ressources utilisées mais aussi de la mauvaise gestion de ces ressources. Sur ça, nous supposons que l'efficience de R&D est un déterminant essentiel de l'innovation. D'où, l'équation (2.3) devient :

$$A = f(R\&D, CH, EFF) \quad (2.4)$$

Avec EFF est l'efficience des ressources de R&D.

3 REVUE DE LITTÉRATURE

Selon le modèle développé dans la section précédente, il s'avère que l'innovation est expliquée par trois facteurs principaux : le capital physique, le capital humain et l'efficience de ces deux ressources.

D'après [3], l'innovation se base d'une part sur les connaissances résultant du volume cumulatif de R&D et contribue d'autre part à ce stock de connaissances. Les dépenses cumulatives de R&D sont un déterminant important de la productivité [4] et [5].

La référence [3] a estimé l'impact des stocks de R&D domestiques et étrangers sur la productivité totale des facteurs dans 22 pays dont certains appartiennent à l'UE pendant la période 1971-1990. Les auteurs ont trouvé que le stock de R&D

domestique permet un taux marginal de rendement social égal à 123% pour les grandes économies de l'OCDE et 85% pour les autres pays.

La disponibilité de ressources humaines suffisantes en recherche et développement est indéniablement un facteur important pour que les activités d'innovation soient mises en œuvre. Le travail empirique de [6] confirme que les différences dans les activités d'innovation nationale mesurée par le nombre de brevets par habitant sont attribuables aux différences au niveau du nombre des scientifiques et des ingénieurs employés. La référence [7] montre aussi que les différences entre les pays au niveau de la part des scientifiques et ingénieurs dans l'emploi total causent dans une proportion considérable les différences entre les pays au niveau de R&D effectuée par le secteur des entreprises.

Concernant l'efficience de R&D, bien qu'elle ait fait l'objet de plusieurs travaux, nous constatons que ce facteur a été très rarement considéré comme une variable expliquant l'innovation. En fait, certains travaux antérieurs se sont intéressés à étudier les différences entre les pays des niveaux d'efficience [8] et [9]. D'autres, ont étudié les déterminants de l'efficience [10], [11], [12], [13] et [14]. A notre connaissance, l'étude de [15] est la seule à tester l'impact de l'efficience de R&D sur la performance économique. L'auteur a mené une étude sur 30 pays dont 23 sont membres de l'OCDE pendant les années 1998-1999-2000. Il a trouvé que l'effet de l'efficience des dépenses de R&D sur le PNB par habitant est positif.

4 MÉTHODOLOGIE

Notre démarche méthodologique suit deux étapes. Elle consiste à estimer les scores d'efficience dans une première étape. Dans une seconde étape, nous allons estimer un modèle de régression linéaire où les scores d'efficience sont utilisés comme variable explicative de l'innovation.

4.1 ESTIMATION DES SCORES D'EFFICIENCE DE R&D

Cette étude considère un cadre de production des activités de R&D basé sur la théorie de production. Chaque pays est considéré comme une unité de décision qui emploie des ressources humaines et physiques de R&D comme inputs pour produire des outputs tels que les brevets. L'approche de frontière stochastique (SFA) avec une spécification translog est appliquée pour estimer l'efficience relative de R&D de chaque pays.

4.1.1 LA FONCTION DE PRODUCTION DE R&D

Comme l'ont établi [16] et [17], cette étude considère l'activité internationale de recherche et développement dans le contexte d'une fonction de production dans les différents pays.

La fonction de production de R&D des différents pays a la forme générale suivante :

$Y_{kt} = f(x_{kit})$ k = 1,….., k (pays), i = 1,…., N (inputs) (3.1)

Où Y_{kt} est l'output de R&D du pays k à l'instant t

x_{kit} est l'input i du pays k à l'instant t.

La grande variété des inputs qui résulte de l'utilisation des données de différents pays nécessite l'utilisation d'une forme fonctionnelle flexible. La plus utilisée est la forme translog. Une fonction de production translog à l'instant t peut être écrite comme :

$$\ln y = \beta_0 + \sum \beta_i (\ln x_i) + \sum \beta_{ii} (\ln x_i)^2 + \sum \sum \beta_{ij} (\ln x_i) (\ln x_j) \quad (3.2)$$

y représente le volume de l'output, x_i et x_j sont les inputs i et j, respectivement. ln est le logarithme népérien. β_i β_{ii} et β_{ij} sont des paramètres à estimer et ne dépendent d'aucun pays particulier.

4.1.2 L'APPROCHE DE FRONTIERE STOCHASTIQUE POUR L'EFFICIENCE DE R&D

La référence [18] a proposé un modèle variant dans le temps pour évaluer l'efficience technique qui prend la forme d'une fonction de production frontière aléatoire pour des données de panel, et qui a des effets relatifs à l'unité de décision qui sont supposés être des variables aléatoires normales tronquées.

Le modèle peut être exprimé comme :

$Y_{kt} = f(x_{kt}) + (v_{kt} - u_{kt})$, k = 1,…., k pays ; t = 1,….., T (année) (3.3)

Où :

Y_{kt} est le logarithme de production du $k^{ème}$ pays dans l'année t.

x_{kt} est le vecteur des inputs du $k^{ème}$ pays dans l'année t.

$f(x_{kt})$ est une fonction flexible comme la fonction translog spécifiée ci-dessus.

v_{kt} représentent des termes d'erreur aléatoires, distribués identiquement et indépendamment selon la loi normale N(0, σ^2_v) et indépendants de u_{kt}.

$u_{kt} = \{\exp[-\eta (t - T)]\}u_k$ (3.4)

où u_{kt} sont des variables aléatoires non négatives, qui sont supposées tenir compte de l'inefficience technique dans la production et sont supposées être indépendamment et identiquement distribuées selon la loi normale tronquée à zéro de moyenne μ et de variance σ^2_u, $N(\mu,\sigma^2_u)$.

η est un scalaire inconnu à estimer.

Dans l'objectif d'estimation, les paramètres σ^2_v et σ^2_u sont remplacés par $\sigma^2 = \sigma^2_v + \sigma^2_u$ et $\gamma = \sigma^2_u / \sigma^2_v + \sigma^2_u$ pour pouvoir effectuer l'estimation par la méthode maximum de vraisemblance.

4.2 ESTIMATION DU MODELE DE REGRESSION LINEAIRE

Lorsqu'on travaille sur un échantillon de données de panel, il convient de vérifier dans un premier temps la spécification homogène ou hétérogène du « processus générateur des données ». Si le test réalisé (test de présence d'effet individuel) montre qu'il existe des spécificités propres à chaque individu, la méthode des moindres carrés ordinaires (MCO) n'est pas convenable et il faut dans ce cas appliquer le test d'Hausman afin de connaître si les coefficients des deux estimations (fixe et aléatoire) sont statistiquement différents.

4.3 CHOIX DE L'ECHANTILLON ET BASES DE DONNEES UTILISEES

La présente étude porte sur un échantillon de 14 pays émergents[1] pendant la période 2000-2010. Les bases de données utilisées dans cette étude sont UNESCO, USPTO, Penn World Table et Banque Mondiale.

4.4 CHOIX DES VARIABLES ET INSTRUMENTS DE MESURE

Nous présenterons ci après les variables ainsi que leurs mesures utilisées. Il s'agit de préciser les variables représentatives de l'output et des inputs de la fonction de production de R&D ainsi que les variables dépendante et indépendantes du modèle linéaire à estimer.

4.4.1 L'OUTPUT ET LES INPUTS DE LA FONCTION DE PRODUCTION DE R&D

Alors que nous ne pouvons pas mesurer exactement l'innovation, les brevets sont généralement acceptés comme des indicateurs du processus d'innovation technologique et de R&D en absence d'indicateurs plus robustes.

Dans le cadre de cette étude, l'output des dépenses de recherche et développement est mesuré par le nombre des brevets accordés par le bureau américain des brevets et des marques de commerce (**BREV**).

A l'instar de la majorité des études [15], [8] et [11], nous allons introduire le capital financier et le capital humain dans la fonction de production des connaissances.

La première variable introduite reflète les dépenses cumulatives de R&D. Pour chaque pays de notre échantillon, nous calculons le stock de recherche et développement en utilisant la méthode de l'inventaire perpétuel [19] et en se basant sur les dépenses intérieures de R&D (DIRD).

[1] *Les pays de notre échantillon sont : l'Argentine, la Bulgarie, la Chine, l'Estonie, l'Hongrie, la Lettonie, la Lituanie, le Mexique, la Pologne, la République tchèque, la Roumanie, la Russie, la Slovaquie et la Turquie.*

Le stock de capital de R&D domestique est calculé comme suit :

$S_t = (1-\delta)*S_{t-1} + R_{t-1}$, t = 0, 1, 2,…..n. L'année 0 est la première année pour laquelle les données sont disponibles. L'année n est l'année 2010.

δ = 15%, c'est le taux de dépréciation.

R = dépenses intérieures de recherche et développement.

$S_0 = R_0 / (g + \delta)$, g c'est la moyenne annuelle de croissance des dépenses de R&D durant la période pour laquelle les données des dépenses de R&D sont disponibles.

Cette méthode de calcul a été suivie par [12].

La deuxième variable que nous employons reflète la disponibilité des ressources humaines en R&D.

Donc, cette étude emploie le stock des dépenses de R&D (**DRD**) et le personnel de R&D en équivalent plein temps (**PRD**) pour mesurer les deux principaux déterminants de la frontière de production des nouvelles connaissances.

Le problème qui se pose lors de l'évaluation de l'efficience de R&D est la présence d'un décalage temporel entre la fourniture d'inputs et la prévision des outputs. Dans ce travail, nous prenons 2 années de différence entre les données d'inputs et d'output. Ainsi, les données relatives aux brevets sont prises pour la période 2002-2012 alors que les données relatives au stock de connaissances et au personnel de R&D concernent la période 2000-2010.

4.4.2 LES VARIABLES DU MODÈLE LINÉAIRE

La variable dépendante sera mesurée par le nombre des brevets accordés au pays i à l'instant t+2 par le bureau américain des brevets et des marques de commerce (**BREV**).

Pour les variables explicatives de l'innovation, nous allons introduire le stock des dépenses de R&D (**DRD**), le personnel de R&D en équivalent plein temps (**PRD**) et les scores d'efficience (**EFF**) estimés dans la première étape. Nous allons introduire en plus deux variables de contrôle. La première mesure le niveau de développement économique et sera représentée par le PIB par habitant (**PIB**). La deuxième variable tient compte de la spécificité du contexte de notre étude : un contexte de pays émergents où l'innovation dépend non seulement de la création de nouvelles connaissances mais aussi de l'acquisition et de l'absorption des connaissances étrangères. Il s'agit de la part du commerce extérieur (Importations + Exportations) dans le PIB traduisant le degré d'ouverture commerciale (**OUV**).

Tableau 1: Définition des variables, signes prévus et sources utilisées

Code	Définition	Calcul	Signe prévu	Source
BREV	Nombre de brevets accordés aux pays par l'USPTO)	Log (nombre de brevets accordés aux pays par l'USPTO)		USPTO
DRD	Stock des dépenses intérieures de R&D	Log (stock DIRD) basé sur les DIRD mesurées en milliers de dollars PPA, (prix constant 2005).	+	UNESCO
PRD	Personnel total de R&D (en équivalent plein temps)	Log (personnel de R&D)	+	UNESCO
EFF	Scores d'efficience	Log (score d'efficience estimé par l'approche SFA)	+	Calcul personnel
PIB	Produit intérieur brut par habitant	Log ((PIB/habitant) calculé en PPA au prix constant 2005))	+	Penn World Table 7.1
OUV	Degré d'ouverture commerciale	Log [(Importations + Exportations)/PIB]	+	Banque Mondiale

5 PRESENTATION ET INTERPRETATION DES RESULTATS

5.1 SCORES D'EFFICIENCE

Pour estimer l'efficience relative de R&D de chaque pays, nous avons appliqué l'approche de frontière stochastique avec la spécification translog suivante :

$\ln BREV_{it+2} = \beta_0 + \beta_1 \ln DRD_{it} + \beta_2 \ln PRD_{it} + \beta_3 (\ln DRD_{it})^2 + \beta_4 (\ln PRD_{it})^2 + \beta_5 (\ln DRD_{it}) (\ln PRD_{it})$ (4.1)

ln est le logarithme népérien ; i = 1,2,….14 pays ; t = 2000, 2001,…….2010.

Pour vérifier si l'une des deux formes de la fonction de production (Translog ou Cobb-Douglas) est la plus adéquate, nous testons l'hypothèse H0 : β3 = β4 = β5 = 0. Si l'hypothèse nulle est acceptée, alors la spécification Cobb-Douglas sera la plus adaptée. Le LR test est basé sur la statistique suivante :

LR = -2 {ln [L(H0) / L(H1)]}

L(H0) et L(H1) correspondent aux fonctions de vraisemblance de H0 (forme Cobb-Douglas) et H1 (forme translog) respectivement.

La statistique LR suit une loi de Khi2 mixte χ^2 (df, α), df correspond au nombre de restrictions (3 dans notre cas) et α le seuil de tolérance (1%).

Nous trouvons que LR test = 135.670[2] qui est supérieur à χ^2 (3, 0.01) = 10.501 (d'après le table Kodde et Palm).

Ainsi, l'hypothèse nulle H0 : β3 = β4 = β5 = 0, est rejetée, ce qui implique que la fonction de production translog est adéquate.

Donc, nous allons nous baser sur le modèle de la fonction translog pour interpréter les résultats.

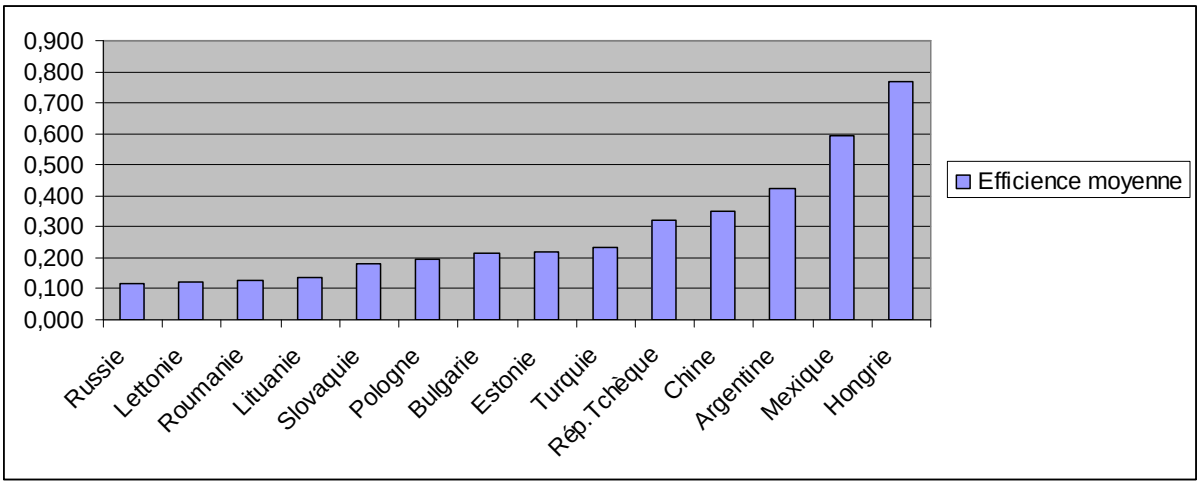
Les valeurs estimées pour les paramètres de la fonction de production permettent de calculer la distance de chaque observation par rapport à la frontière efficiente. Le score d'efficience est compris entre 0 (inefficience totale) et 1 (efficience parfaite).

Tableau 2 : Les efficiences annuelles moyennes de R&D

Année	Efficience moyenne	Ecart type	Efficience minimale	Efficience maximale
2000	0,204	0,192	0,053	0,709
2001	0,219	0,193	0,063	0,723
2002	0,234	0,195	0,073	0,735
2003	0,250	0,195	0,085	0,748
2004	0,267	0,196	0,097	0,760
2005	0,284	0,196	0,111	0,771
2006	0,302	0,195	0,125	0,782
2007	0,319	0,194	0,140	0,793
2008	0,338	0,193	0,157	0,803
2009	0,356	0,191	0,174	0,812
2010	0,378	0,196	0,192	0,822
Score moyen d'efficience		**0,29**		

D'après le tableau n°2, l'efficience moyenne durant les 11 périodes étudiées est de l'ordre de 29%. Ce niveau faible d'efficience implique que les pays de notre échantillon peuvent améliorer leurs résultats d'innovation de 71% avec les mêmes niveaux de ressources.

[2] *Le modèle est estimé à l'aide du logiciel FRONTIER 4.1.*



Graphique 1 : Efficience moyenne des dépenses de R&D dans 14 pays émergents (2000-2010)

D'après le graphique suivant, les scores d'efficience les plus élevés sont pour la Hongrie (77%), le Mexique (59%) et l'Argentine (42%). La Lettonie et la Russie se caractérisent par les niveaux les plus faibles d'efficience (12% et 11%, respectivement).

5.2 MODÈLES DE RÉGRESSION

Pour étudier l'effet de l'efficience des dépenses de R&D sur l'innovation dans les pays émergents, nous avons estimé le modèle suivant :

$$\ln BREV_{it+2} = \beta_0 + \beta_1 \ln DRD_{it} + \beta_2 \ln PRD_{it} + \beta_3 \ln EFF_{it} + \beta_4 \ln PIB_{it} + \beta_5 \ln OUV_{it} + \varepsilon_{it} \quad (4.2)$$

$i = 1,2,\ldots.14$; $t = 2000, 2001,\ldots.2010$, ε_{it} est un terme d'erreur, ln est le logarithme népérien.

Avant de présenter les modèles de régressions, nous procédons à l'analyse de l'indépendance des variables explicatives (condition préalable à l'utilisation des modèles de régression).

La matrice de corrélation simple nous permet de détecter une forte corrélation entre les variables DRD et PRD (0,82). Donc, ces deux variables ne doivent pas appartenir au même modèle afin de s'assurer de l'efficacité d'interprétation des résultats. C'est pourquoi nous décidons d'estimer les deux modèles suivants[3] :

Modèle (1) : $\ln BREV_{it+2} = \beta_0 + \beta_1 \ln DRD_{it} + \beta_2 \ln EFF_{it} + \beta_3 \ln PIB_{it} + \beta_4 \ln OUV_{it} + \varepsilon_{it}$

Modèle (2) : $\ln BREV_{it+2} = \beta_0 + \beta_1 \ln PRD_{it} + \beta_2 \ln EFF_{it} + \beta_3 \ln PIB_{it} + \beta_4 \ln OUV_{it} + \varepsilon_{it}$

5.2.1 TEST DE PRÉSENCE D'EFFETS INDIVIDUELS

Dans les modèles (1) et (2), le test de multiplicateur de Lagrange donne des valeurs de 232,73 et 1,74 respectivement et les p-values y associées sont inférieures au seuil de 1 %. Nous rejetons alors l'hypothèse nulle d'absence d'effets spécifiques, il est donc nécessaire d'introduire des effets individuels.

5.2.2 TEST D'HAUSMAN

Les modèles à effets fixes et à effets aléatoires autorisent la prise en compte de l'hétérogénéité des données. Néanmoins, les hypothèses sur la nature des effets spécifiques sont différentes d'un modèle à l'autre. En effet, dans le premier modèle, on suppose que les effets spécifiques peuvent être corrélés avec les variables explicatives. Sous l'hypothèse nulle d'absence

[3] *Les modèles sont estimés à l'aide du logiciel STATA 10.*

de corrélation entre les effets spécifiques et les variables explicatives, le test d'Hausman permet de choisir entre les deux modèles.

Si le risque de rejeter H0 sachant qu'elle est vraie est faible (p-value < α % ; avec α : niveau de confiance), nous rejetons H0 d'absence de corrélation et nous privilégions l'adoption d'effets individuels fixes et l'utilisation de l'estimateur Within. Cependant, lorsque la probabilité du test est supérieure à α %, alors le test d'Hausman ne permet pas de distinguer le modèle à effets fixes du modèle à effets aléatoires. Dans ce cas, le choix de l'un ou l'autre modèle doit être justifié rigoureusement.

La probabilité du test dans les deux cas est inférieure à 1% (0,0051 dans modèle (1) et 0,0071 dans modèle 2) donc le test d'Hausman nous permet de choisir le modèle à effets fixes pour les deux modèles.

5.2.3 TEST D'HÉTÉROSCÉDASTICITÉ

Le test de Breush-Pagan nous permet de détecter l'hétéroscédasticité. Dans les modèles (1) et (2), les probabilités du test sont égales respectivement à 0,0000 et 0.0055 < 1 %. Nous rejetons donc H0 et nous concluons la présence d'un problème d'hétéroscédasticité.

5.2.4 TEST D'AUTO CORRÉLATION DES ERREURS

Le test de Wooldridge nous permet de détecter l'auto-corrélation dont l'hypothèse nulle est l'absence d'auto-corrélation des erreurs.

Dans les modèles (1) et (2), les probabilités du test sont égales respectivement à 0,0083 et 0.0032 confirmant la présence d'un problème d'auto-corrélation des erreurs.

Dans ce qui suit, nous présentons les résultats des régressions linéaires en corrigeant les deux problèmes d'hétéroscédasticité et d'auto-corrélation des erreurs.

5.2.5 RÉSULTATS DES RÉGRESSIONS LINÉAIRES

Tableau 3 : Résultats des estimations des modèles (1) et (2)

	Signe prédit	Coefficients (Modèle 1)	Coefficients (Modèle 2)
Constante		3,641	- 5,441***
DRD	+	0,591***	
PRD	+		0,912***
EFF	+	0,889***	0,991***
PIB	+	- 0,927***	- 0,044
OUV	+	0,079	0,235**
N		153	153
Chi2		272,45***	1112,06***

****, ** et * : significatifs à 1%, 5% et 10% respectivement.*

D'après le tableau ci-dessus, la statistique de Chi2 testant la significativité conjointe des variables explicatives est significative à 1 % dans les deux modèles permettant de rejeter l'hypothèse nulle stipulant que les coefficients de régression β sont nuls. Par conséquent, nos modèles sont globalement significatifs.

Les résultats montrent que le stock des dépenses intérieures de R&D a un effet positif et significatif (à 1%) sur l'innovation. Ils montrent qu'un accroissement de 1% des dépenses cumulatives de R&D fait augmenter le nombre de brevets de 0,59%. Ce résultat est cohérent avec celui trouvé par [3]. Il montre la présence des économies d'échelle et des externalités positives dans les activités de recherche et développement.

Le personnel de R&D a un effet positif et significatif à 1%. Ce qui implique que la production des nouvelles connaissances augmente, toutes choses égales par ailleurs, avec le nombre de chercheurs et techniciens de R&D. Ce résultat est cohérent avec les travaux précédents tels que [6] et [7]. Il montre qu'un accroissement de 1% du personnel de R&D fait augmenter le nombre de brevets de 0,91%.

Le troisième résultat trouvé est très intéressant pour notre étude dans la mesure où il montre l'importance de la bonne gestion des ressources de R&D. En fait, l'efficience de R&D a un impact positif et significatif à 1% sur l'innovation technologique. Ce résultat est conforme avec celui trouvé par [15]. Il implique qu'une amélioration du niveau d'efficience de 1% entraîne une augmentation dans le nombre de brevets internationaux de 0,89% dans le modèle (1) et 0,99% dans le modèle (2). Remarquons que l'effet de l'efficience des ressources de R&D est plus intense que celui des ressources mêmes, d'où l'intérêt extrême de cette variable.

Ainsi, nos résultats montrent que les innovations dans les pays émergents sont créées grâce aux ressources financières et humaines de R&D, d'où la nécessité d'accroitre le volume des ressources consacrées aux activités d'innovation. Un tel accroissement doit être accompagné par une utilisation efficiente des ressources existantes.

Pour les variables de contrôle, les résultats trouvés montrent que le PIB par habitant a un effet négatif sur l'innovation. Ceci implique que les conditions macroéconomiques dans les pays de notre échantillon ne sont pas favorables à la création d'innovation.

L'effet positif de la variable relative au degré d'ouverture commerciale montre que les entreprises des pays de notre échantillon bénéficient suffisamment de leurs contacts avec les fournisseurs et les consommateurs étrangers. Ces derniers les aident à acquérir les connaissances étrangères pour innover.

6 CONCLUSION

L'objectif de ce papier était d'étudier l'impact de l'efficience des dépenses de R&D sur l'innovation. Pour ce faire, nous avons mené une étude empirique portant sur 14 pays émergents pendant la période 2000-2010. Nous avons estimé dans une première étape les scores d'efficience à l'aide de l'approche SFA. Puis, dans une deuxième étape nous avons régressé le nombre de brevets sur les scores calculés dans la première étape. Les résultats trouvés confirment le rôle important joué par l'efficience de R&D dans l'innovation technologique. Notre étude a des implications pour les pays qui souffrent d'un faible niveau d'efficience de R&D (que ce soient les pays de notre échantillon tels que la Russie, la Lettonie, la Lituanie et la Roumanie ou autres n'en faisant pas partie). Ces derniers doivent utiliser leurs ressources de recherche et développement d'une manière plus efficiente pour augmenter leurs taux de brevetage international.

La présente étude révèle aussi l'intérêt d'étudier les déterminants de l'efficience de R&D.

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Implementing Process Safety Management (PSM) in Battery Manufacturing Industry: A case study

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ABSTRACT: Process safety management (PSM) is the analytical tool which is used to prevent the unexpected release of toxic, reactive, or flammable liquids and gasses in various processes in industries worldwide. This regulation is promulgated by the U.S. Occupational Safety and Health Administration (OSHA). In this paper, the challenges and necessities are investigated in implementing the PSM process in the battery industries of Bangladesh. This paper shows that implementing the PSM tool in this area would result in a safer work environment and will assure environmental safety as well as increased productivity. The basic problems that occur in the process of storage, manufacturing and handling of highly hazardous chemicals in battery industries are also discussed. A case study was made in Hamko Batteries Company Ltd. Khulna, Bangladesh to observe the effects of implementing process safety management. The observed result showed a significant reduction in the number of accident frequency and increased productivity of the company. The three basic relationship between man, machine and environment are discussed in an industrial situation to ensure safety. The main aim of this paper is to identify the obstacles and challenges that would take place in implementing the PSM method and the requirements of practicing PSM method in the battery industries of Bangladesh.

KEYWORDS: Process Safety management, Safety Management, Industrial waste Management, Process Risk Reduction PSM implementation.

1 INTRODUCTION

Numerous facilities process and store highly hazardous materials, both toxic and flammable, below the PSM regulatory threshold. While these facilities are not required to comply with the rigorous requirements of PSM, because these facilities process highly hazardous materials they still have a responsibility to identify hazards associated with the process and ensure the facilities are designed, operated, and maintained to minimize hazards [1]. To meet this objective, many industries in Bangladesh have elected to implement PSM elements at the unregulated industries. For example, battery industries in Bangladesh process and transfer lead-acid battery which meet the definition of toxic and hazardous materials are subject to the OSHA PSM standard. In battery industries in Bangladesh like every other process industries, raw materials (lead and sulfuric acid) are converted into intermediate or final products using physical and/or chemical processes [2]. In these industries, production, storage, transportation, use and disposal of chemicals are inherently dangerous and the potential for catastrophic accidents is very high [3-4]. As accidents in these industries may lead to loss of life and damage to equipment, economic losses and environmental pollution [5-6], great efforts should be made to improve safety. This should be promoted by traditional safety measures and a passive approach toward developing preventive laws and regulations, such as the introduction of process safety management (PSM) [7].PSM was introduced in 1990 by the U.S. Occupational Safety and Health Administration (OSHA) and its final, complete version was published in 1992 [8, 9]. Process industries have since used this management system to limit and control chemical risks [10-11]. OSHA estimated that 6 to 10 years after the implementation of PSM, the risk of accidents had decreased 80% and nearly 264 deaths and 1,534 injuries or illnesses had been prevented each year [12].Considering the benefits which result from the establishment of good PSM in process

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industries, this study was conducted in order to evaluate the requirements and Challenges of Implementing Process Safety Management (PSM) in Battery Manufacturing Industries in Bangladesh. All the information mentioned in this paper was taken from case studies in leading Battery manufacturer industries in Bangladesh.

2 PROCESS SAFETY INFORMATION

2.1 PROCESS FLOW DIAGRAM

All the lead-acid battery industries in Bangladesh follows almost similar process in their production process, transportation & storing. The process starts from gathering raw materials such as round lead (Pb) and concentrated H_2SO_4 and finishes the production process by making the final product as complete cell lead-acid Battery. Then the products are stored in inventory and thus transported to the dealers via various vehicles. As in this paper we focus on the PSM, the process flow diagram shows the production process only.

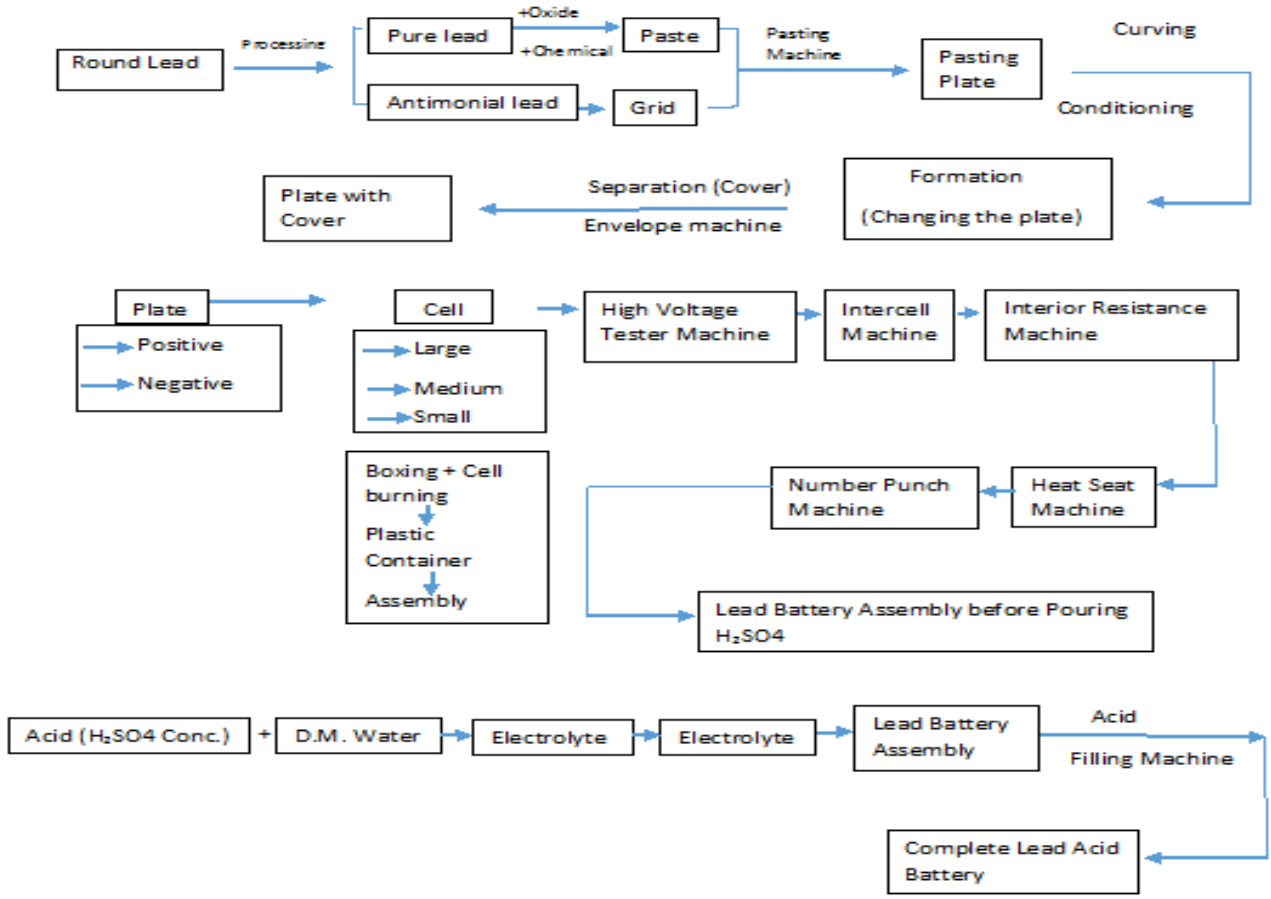


Fig. 1. Process Flow diagram of Hamko Batteries Company Ltd.

Fig. 1 shows the Process Flow diagram of Hamko Batteries Company Ltd.

2.2 PROCESS CHEMISTRY & ITS PROPERTIES

During the process of lead acid battery the following basic reactions are taken places particularly in cathode and anode [16].

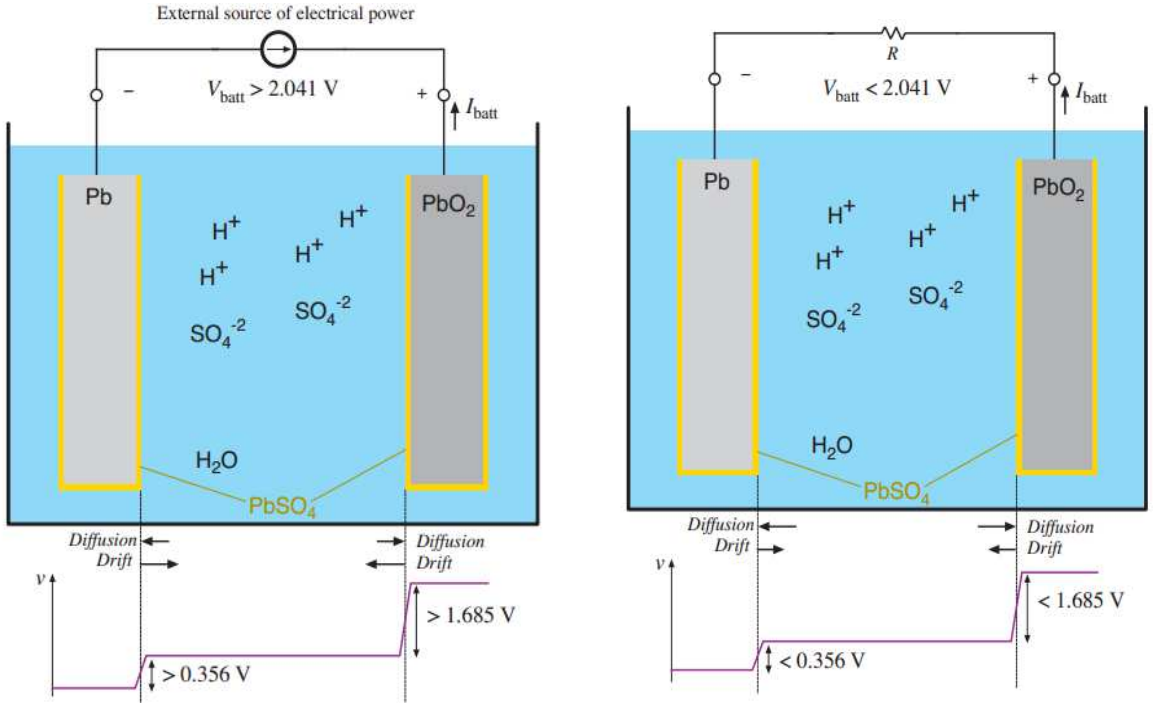
Anode: Pb + H2SO4 ↔ PbSO4 + 2H+ + 2e-

Cathode: PbO2 + H2SO4 + 2e-↔PbSO4 + 2OH-

→ Discharge

Pb + PbO2 + 2H2SO4 2PbSO4 + 2H2O

←charge



Discharging Charging

Fig. 2. Charging and discharging of lead-acid battery [17]

Fig.2 shows the charging and discharging mechanism of lead acid battery.

The aging mechanism of batteries are the actual chemical or mechanical events that cause battery's degradation. The battery will be affected in different ways depending on the conditions which is operated. All types of lead batteries will suffer from the same damage mechanism but in different degrees. The major aging process leading to [17]

- Gradual loss of performance and eventually to the end of service life
- Stratification of electrolyte
- Sulfating of electrodes
- Corrosion of electrodes
- Non cohesion of active mass

2.3 MAXIMUM INTENDED INVENTORY: (A CASE STUDY BASED ON HAMKO BATTERIES COMPANY LTD.)

The total demand of battery per month = 70,000 pcs
So the daily demand of battery = 2500 pcs
The minimum level of inventory is 10 times of daily inventory = 2500*10=25,000 pcs
The maximum level of inventory is 3 times of minimum level inventory= 25000*3=75,000 pcs

2.4 TOXICITY INFORMATION

A chemical or material is said to be toxic when it produce injury if it reaches a susceptible site or sites on or within the body. Other way of Toxicity may be defined as the inherent ability that all substances have to harm to body. [15]

The major type of toxic compounds/chemicals are classified as follows:

1. METALS - Lead
2. ACIDS - H2SO4

Table 1. Occupation exposure limits for inorganic lead

Inorganic Lead	Exposure units $\mu g/m^3$
OSHA PEL TWA	50
NIOSH REL TWA	100*
ACGIH TLVR TWA	150

*Air level to be maintained such that worker blood lead remains ≤ 60µ /100g

The degree of the toxic effect is not the same in all organs. Usually there are one or two organs which show the major toxic effect. These are referred as target organs of toxicity of the particular substance. The central nervous system is the target organs of toxicity most frequently involved in systemic effects. The blood circulation system, liver, kidneys, lungs, and skin follow in frequency of systemic effects. Muscle and bones are the target organs for a few substances. The male and female reproduction systems are vulnerable to many substances. [15]The major uses of lead is in lead-acid storage batteries. The majority of the lead used in batteries are recycled and during the melting process PbO is produced and released in the environment. [15] Sulfuric acid mist severely irritates the eyes, respiratory tract, and skin. Concentrated sulfuric acid destroys tissue due to its severe dehydrating action, whereas the dilute from acts as milder irritant due to acid properties. A worker sprayed in the face with liquid fuming sulfuric acid suffered skin burns of the face and body, as well as pulmonary edema from inhalation. Sequelae were pulmonary fibrosis, residual bronchitis, and pulmonary emphysema; in addition, necrosis of the skin resulted in marked scarring. In human subjects, concentrations of about 5 mg/m3 were objectionable, usually causing cough, an increase in respiratory rate, and impairment of ventilator capacity. Workers exposed to concentrations of 12.6 to 35 mg/m3 had a markedly higher incidence of erosion and discoloration of teeth than was noted in unexposed individuals. Splashed in the eye, the concentrated acid causes extremely severe damage, often leading to blindness, whereas dilute acid produces more transient effects from which recovery may be complete. Repeated exposure of workers to the mist causes chronic conjunctivitis, tracheobronchities, stomatitis, and dermatitis, as well as dental erosion. While ingestion of the liquid is unlikely in ordinary use, the highly corrosive nature of the substance may be expected to produce serious mucous membrane burns of the mouth and esophagus. [19]

3 CHALLENGES IN IMPLEMENTING PSM

In a developing country like Bangladesh, implementing any new practice or feature which is not mandatory for the production and doesn't earn extra profit for the industry are not welcome if it's not a must to do. So implementing PSM which is not directly involved with earning extra profit for the industry, could be subjected to the unwillingness of the managerial levels. The board of directors of the industry should realize their responsibility to identify hazards associated with the process and ensure the facilities are designed, operated, and maintained to minimize hazards. Though the practice of PSM method has not been well established till now, the top line of the battery industries should realize the importance and advantages of implementing PSM. Although PSM implementation costs are estimated to be high, most companies implemented it have achieved equal or higher benefits and are generally happy with it [13]. A study of chemical industries of South Korea found that seven years after the implementation of PSM, the number of deaths, injuries and "near misses" had been reduced by 62%, 58% and 82%, respectively. Additionally, quality and productivity had improved, and the number of emergency process shutdowns had decreased, as had damage to equipment [14].The unawareness of the worker in the battery industry is also one of the big challenges in the process of implementing PSM. They are not provided with any specific training program as the upper level of the industry think of the training program as an extra cost. If the safety regulations, provided by OSHA PSM is practiced in the industry, the number of accident will reduce dramatically as most of the accidents

happen due the unawareness and disobedience of the safety procedure. If the necessity of the PSM method can be realized by both the top line and bottom line of the industry, the challenges of implementing PSM can be resolved.

4 NECESSITY OF PSM IN BATTERY INDUSTRIES

4.1 TO PREVENT OPERATIONAL & TRANSPORTATION PROBLEMS

Both the raw materials used to produce battery in a lead-acid battery industry are toxic and reactive. Lead is a poisonous metal which has a deadly effect on human body. Lead binds strongly to a large number of molecules; such as: amino acids, hemoglobin, many enzymes, RNA and DNA, it thus disrupts many metabolic pathways. The effects of lead toxicity are wide ranging include impaired blood synthesis, hypertension, hyperactivity and brain damage.[15] Similarly, sulfuric acid is a very reactive agent which is deadly to human body. So safety precautions must be taken to handle these material in the production, transportation and storing process.

4.2 TO ENSURE PROPER RELATIONSHIP BETWEEN MAN, MACHINE & ENVIRONMENT

In an industrial situation there exists three basic relationship and any lagging or imbalance in the relations will result in accident. If these relationships are properly harmonized then accident can be reduced appreciably. [15] The three relationships are:

a) Man to Man (human) relationship.
b) Man and Machine relationship.
c) Man and Environment relationship.

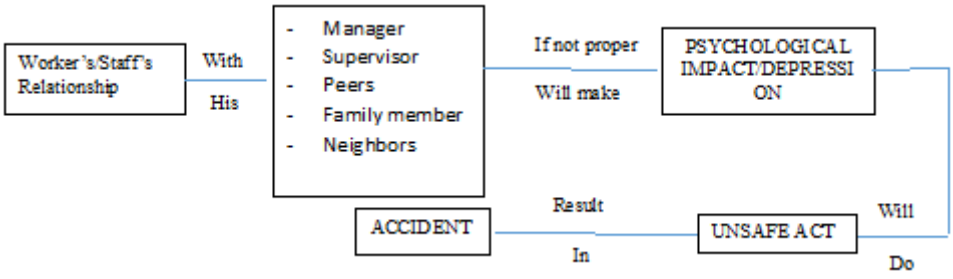


Fig. 3. Man to Man (human) relationship.

Fig. 3 shows the man to man relationship in an industrial situation.

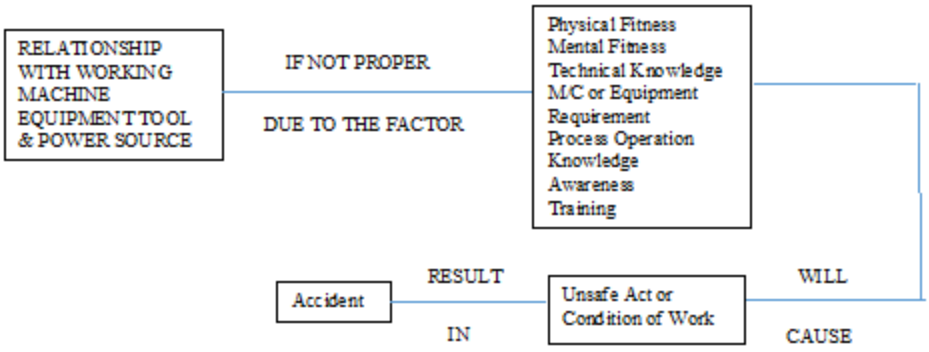


Fig. 4. Man and Machine relationship.

Fig. 4 shows the man and machine relationship in an industrial situation.

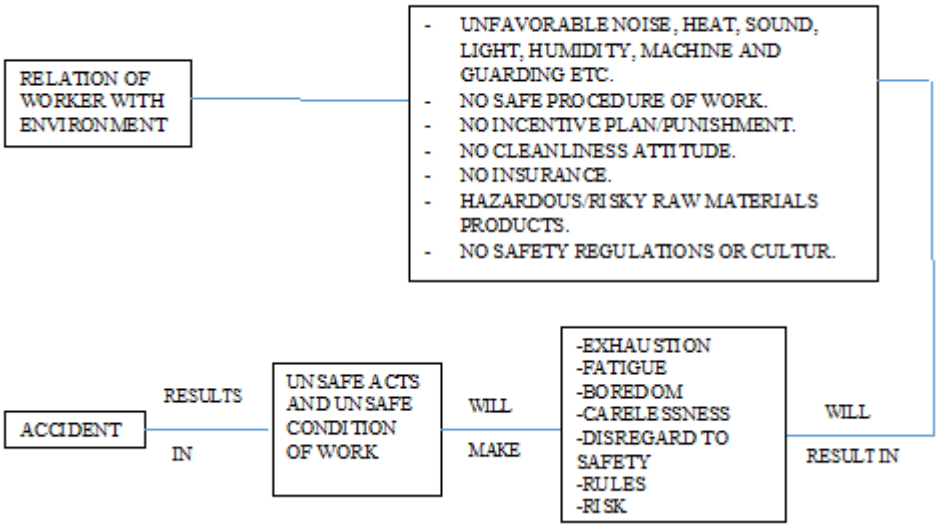


Fig. 5. Man and Environment relationship.

Fig. 5 shows the man and machine relationship in an industrial situation.

4.3 TO ENSURE BETTER WORK ENVIRONMENT FOR WORKERS

The work environment has a great effect on the worker's performance and dedication to work. A healthy and safer work environment will motivate the worker and increase his/her performance. This increased amount of motivation will lead to greater productivity of the industry. So implementing PSM is necessary to increase the work safety and sound environment in the industry area. Because PSM focuses not only on the safety issue but also on the sanitation system, medical treatments, emergency plan, workers training and much more.

4.4 SAFETY INCREASES PRODUCTIVITY

Safety is an important criterion increasing productivity. [16] Safety promotes productivity because of

- Uninterrupted production
- Keep people moral high
- No unplanned shut-down & production loss
- Better labor-management relationship

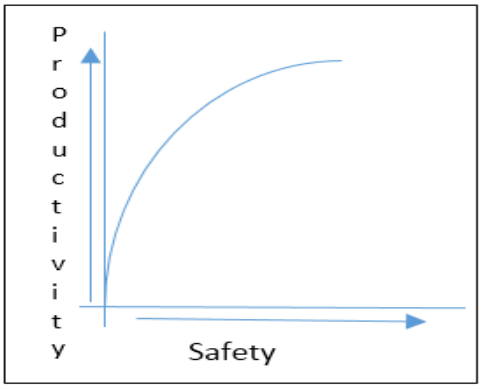


Fig. 6. Relationship between safety and productivity

Fig. 6 shows the relationship between safety and productivity in an industry.

4.5 PROMOTE COMPANY STANDARD

Successful implementation of process safety management secure the standard of any company. Because most accident and inequalities cause when any process is operated. When a process runs well, then the output of that process will be better. This will result in an increased reliability of the product as well as the company standard. This also secures better working condition and proper safety for workers that help to promote a company's standard.

4.6 REDUCE ACCIDENT RATE

"Accident does not happen-it is caused". Mr.Heinrich a U.S. safety expert in the year 1928 made an analysis with 75000 accident event and found that [16]

- 88% accidents were caused by unsafe acts.
- 10% accidents were caused due to unsafe work condition.
- 2% accidents were beyond human control.

To reduce the accident rate in the industry and to increase the occupational safety, PSM is very effective.

5 REQUIREMENTS FOR IMPLEMENTATION OF PSM IN BATTERY INDUSTRIES

To be eligible for the membership of OSHA organization and to implement PSM in the industry the battery industries must provide the following information about their process, raw materials and process technology: [9]

Information on the hazards of the highly hazardous chemicals in the process shall consist of at least the following:

- Toxicity,
- Permissible exposure limits,
- Physical data,
- Reactivity data,
- Corrosivity data, and
- Thermal and chemical stability data, and hazardous effects of inadvertent mixing of different materials.

Information on the technology of the process must include at least the following:

- A block flow diagram or simplified process flow diagram,
- Process chemistry,
- Maximum intended inventory,
- Safe upper and lower limits for such items as temperatures, pressures, flows or compositions, and
- An evaluation of the consequences of deviations, including those affecting the safety and health of employees.

Some of these required data has been discussed in this paper from a case industry in Hamko batteries, one of the largest battery manufacturer in Bangladesh.

5.1 ETP PLANT

When Lead Acid Batteries are replaced, they contain spent acid with some lead dissolved in it. These used batteries are sold in the open market to lead recyclers where they are drained before being put into the process of recycling. Further in many units, plastic containers of the batteries, after cutting and opening, are washed to remove any lead in them. The drained acid along with any washing effluent of the plastic scrap comprises of the effluent that needs treatment at the Effluent Treatment Plant (ETP). This ETP is also commonly called Acid Neutralization System.

If unchecked, these untreated effluent will sweep in to land and would lead to soil contamination, pollution in ground water table and their runoff may also lead to pollution of nearby eater sources. Hence, their proper treatment before disposal is necessary. [18]

Characteristics of Effluent before and after Treatment can be shown as the table below. The approved range of lead is 0.1 mg/l whereas before treatment it could be up to 30-40 mg/l.

Table 2. Characteristics of Effluent before and after Treatment

Parameter	Before Treatment	Approved Range
pH	3.0 - 4.0	6.5 - 8.5
Suspended Solids	600 - 800 mg/l	50 mg/l
Lead	30 - 40 mg/l	0.1 mg/l

5.2 EPP PLANT

A carefully Emergency Preparedness Plan (EPP) is vital for any plan that handles hazardous chemicals. The aim of EPP is to enable a quick and effective response to contain and minimize the effect if a catastrophic event to restore normality as soon as possible. [15]

In short, the objective of this plan:

- To provide essential information about the hazard any accident even because of certain equipment or process failure. Also to provide implication and remedial procedure.
- To form action group, for specific task during accident emergency.
- To provide information about emergency handling equipment, their functions and uses.
- To define procedure for evacuation of accident victims and their treatment.

5.3 SANITATION SYSTEM

Clothing which is contaminated with inorganic lead should be removed immediately and placed in closed contains for storage until it can be discard or until provision is made for the removal of inorganic lead from the clothing. If the clothing is to be laundered or cleaned, the person performing the operation should be informed of inorganic lead's hazardous properties. Change and shower rooms should be provided with separate locker facilities for street and work cloths. Skin that becomes contaminated with inorganic lead should be promptly washed with soap and water. [18] Skin that becomes contaminated with sulfuric acid should be immediately washed or showered to remove any sulfuric acid. [19]

5.4 APPROPRIATE MEDICAL FACILITIES

Medical facilities should be ensured for every worker. One or more specialized medical officer should be appointed according to the size of the total human resource. A regular checkup should be done for the identification of percentage of lead in the worker's body. Other medical tests like HIV test and blood test should be done periodically. A specific position of the industry should be allotted for the medical room and necessary fast aid instruments should be available all the time. Emergency transportation system like Ambulance should be available 24 hours a day in case of an emergency.

5.5 SAFETY COMMITTEE

In large organization, there may be safety committee for each department and a central committee for the whole undertaking. Safety committee should consist of representatives of both employers (management) and workers. The employer's representative should include staff members such as the Manager, Safety Engineer, Foreman, Factory Doctor and Personnel officer. The workers representatives should be as many as possible, preferably of different department and should be appointed for certain tenure of time, so as to allow other workers to become members. The workers members should be elected by them or nominated by the labor union, but sometimes nominated by the management also. It is expected always that educated, intelligent, logical, sincere and generally acceptable person from co-workers should be nominated or selected for the safety committee.

5.6 WASTE REMOVAL AND DISPOSAL

Bangladesh Environment Protection Agency, Department of Transportation, and state regulations should be followed to assure that removal, transport, and disposal are in accordance with existing regulations.

Other issues like emergency evacuation system, air cleaning, dust cleaning, providing clean and cold water, providing standard training should be also taken care of to implement PSM in battery industries or battery manufacturing facilities.

6 CONCLUSIONS

Effectively applying PSM at battery manufacturing industries in Bangladesh presents numerous challenges due to unwillingness of managerial level to bear additional expenses associated with PSM implementation and geographic extent of facilities. If the top level of industries are informed with the advantages of implementing PSM in the industry. It will result in both occupational safety for the workers and environmental safety and productivity for the company. Recently, Hamko Batteries Company Ltd. has been a member of OSHA and started implementing Process Safety Management Procedure in their lead-acid battery manufacturing facility. This implementation of PSM has shown a significant effect in reducing the accident rate in various operation of battery manufacturing and assembling process. The occupational safety of the workers has increased, the productivity has increased due to less interruption in the manufacturing and assembling process. These results can be shown in the chart below:

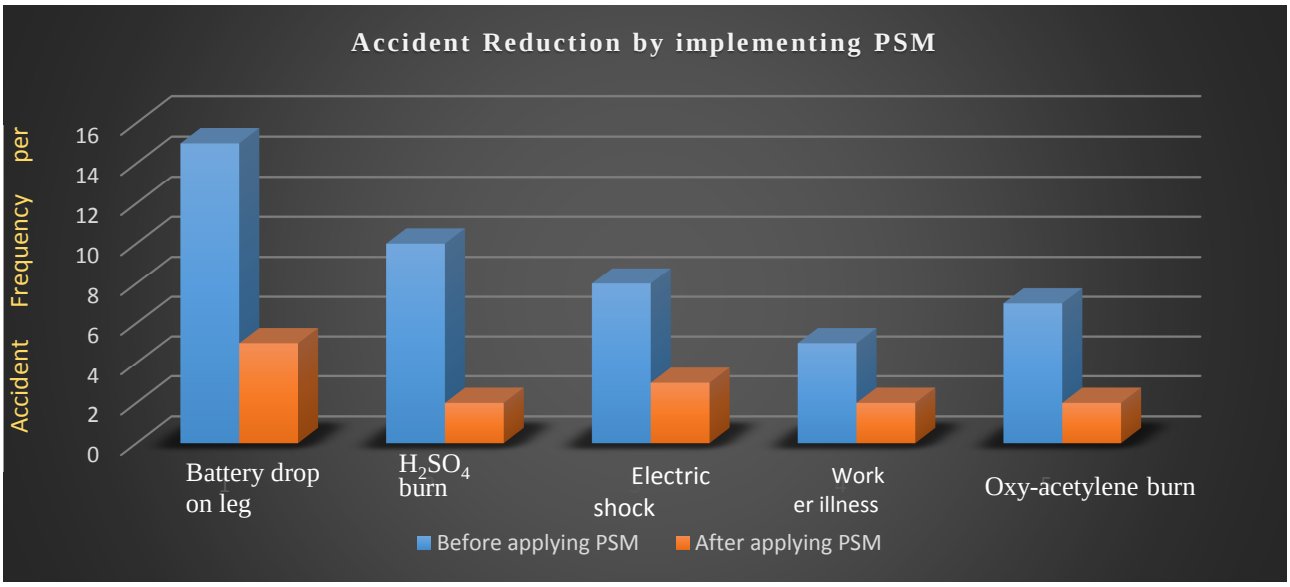


Fig. 7. Implementation of PSM in Hamko Batteries Company Ltd.

Fig. 7 shows the average number of accident happened in the industry due to various reasons before the implementation of PSM and after implementation of PSM.

Implementation of PSM not only protects workers but also protect the co-workers, family members, employers, customers, suppliers, nearby communities, and other members of the public who are impacted by the working place environment.

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Correlates between Levels of Education in Relation to Marital Satisfaction in KISII Township of KISII County, Kenya

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ABSTRACT: *Marital satisfaction* is a pertinent ingredient to the stability of any nation, given that the family is the basic unit of any nation. Too much marital dissatisfaction leads to family members being unstable socially which trickles down to societal problems hence to the nation. A higher level of satisfaction is seen as a measure of marital success. It is, therefore, important to study correlates of marital satisfaction in order to determine what variables could potentially predict the outcome of marital satisfaction. The purpose of this study therefore seeks to establish the correlates between levels of education in relation to marital satisfaction. Literature on the objective above was reviewed. The researcher employed a cross sectional survey design to examine the theme of study. The descriptive study was conducted among 4,019 spouses by using a questionnaire. Content and construct validity was ascertained by a pilot study of applying 20 questionnaires outside the area of study. Analysis was done using a chi square to understand the level of satisfaction, manual calculation of the means, manual thematic analysis of the qualitative data by mail using mean and percentages.

KEYWORDS: Level of Education, marital satisfaction.

1 INTRODUCTION

1.1 BACKGROUND

Marital satisfaction is a pertinent ingredient to the stability of any nation given that the family is the basic unit of any nation. A study by infotrak in 2010 showed that only 40 % of Kenyans report being happily married and 3 in 10 said they will marry their current spouse if given a chance to remarry Mcsheffrey (2014). Too much marital dissatisfaction leads to family members being unstable socially which trickles down to societal problems hence to the nation. A higher level of satisfaction is seen as a measure of marital success. It is, therefore, important to study correlates of marital satisfaction in order to determine what variables could potentially predict the outcome of marital success. Spanier (2002) argued that, although the concept of marital satisfaction may seem ambiguous, the growing field of research in this area demands attention. There is a strong interest in the continued study of how couples form successful marriages, to which the profusion of existing research can attest to some level. In this study, the potential correlates of marital satisfaction are explored in an effort to better understand the marital dyad, especially variables that contribute to its success. The variables of study are outlined, and past literature regarding their relationships to marital satisfaction are explored. This has followed an explanation of the

methodology of the current study, a discussion of the findings, and directions for future research in the area of marital satisfaction.

Some research done in the area of marital satisfaction has focused on level of education at time of marriage Heaton (2002). Some of the generalizations of research done agree that there exists virtually unanimous agreement of the association between the age at first marriage and the probability of divorce. And they go further to assert that the younger one is when married, the higher the likelihood of divorce Bumpass (2007). The researcher has explored that assertion and also queried whether people who marry early are at a higher risk of marital instability than those who marry later in life. One major reason for addressing age is that factors which are negatively related to marital "success" (i.e. whether one divorces or remains married) also include many which are related to age at time of marriage, such as low education, , short premarital acquaintance (knowledge and education) . In addition the researcher finds it worth to research and correlate whether personality maladjustment like financial problems, conflicts , social media, absentee spouses, among other variables as researched by Burchinal (1965).

Bumpass (2007) studied whether the inverse correlation between level of education at time of marriage and marital instability was attributable to the participant's education, religious affiliation, parental marital stability, or husband's marital history. They performed a multivariate analysis on a large sample of married, White women under the age of 45, and found that marital instability was not attributable to the aforementioned factors. Their data showed that age at marriage was the strongest single predictor of marital instability in their analysis. This means that, absent of all other seemingly relevant variables, age at time of marriage was the strongest predictor of marital stability. The researcher believes that given the research was done at a global level there needs to correlate age , level of education, gender and courtship and find the strongest predictor of marital satisfaction which might additionally predict marital stability.

Gorchof (2008) studied the relationship between marital satisfaction, age at marriage, and marital role performance. "Role performance" was defined as the extent to which a person acts out what is perceived to be their role socioeconomically and interpersonally in marriage. This study used data from a non - random sample of 394 married couples, including spouses' evaluations of role performance in order to gain a more accurate response. All respondents were in their first marriage, had been married six years or less at the time of the study, and were under 35 years of age. Through use of multivariate analysis, Lee found a positive correlation between age at time of marriage and marital satisfaction after studying variables of length of marriage, education, socioeconomic background, and religious importance. This means that as the age at marriage increased, marital satisfaction increased as well. This positive correlation finding was true for both males and females. Lee concluded, however, that the strength of the correlation was moderate at best, and may be related to an unmeasured third variable—potential for remarriage. He hypothesized that those who marry young may be cognizant of their better potential to remarry in the event of a divorce, and may then be less willing to tolerate dissatisfaction.

Booth (1985) expanded on the research done by Bumpass (2007) and also found that age at marriage was positively correlated with marital satisfaction due to inadequate marriage education in preparation. They hypothesized that this situation likely stemmed from inadequate role models or from lack of exposure length to these role models because of early termination of their "marriage apprenticeship" as a result of early marriage. They felt that people who married at an early age were more likely to experience deficiencies in their marital role performance, which then led to marital dissatisfaction. Data for this study came from a national sample of men and women under 55 years of age who were interviewed by telephone in 1980. Researchers used random digit dialing procedures to locate eligible participants. In total, the analysis involved 1,715 men and women currently in their first marriage. To test their hypothesis they used the MII by Johnson (1985) as well as multiple items to assess role performance, alternatives to the present marriage, and external pressure for marriage. They found that marital instability is the highest for those who married early (before age 20). Those who married in late twenties scored the lowest on marital instability. They found that those who married later than their twenties scored similarly to those that married earlier, which suggested that marital stability may have a curvilinear relationship with age. Beach (2000) continued in this similar study of marital satisfaction in relation to age. Their research indicated that both society and the individual benefit when couples form strong marriages, as those unions frequently lead to less involvement in crime and other detrimental activities by spouses and/or offspring. Slowly declining divorce rates over the last eight years may be related to a sharp increase in the average age of brides and grooms during that same span of time Alfons (2007). However, overall martial satisfaction had dropped significantly over those past four decades. They further concluded that positive and negative factors that led increased marital satisfaction and marital dissatisfaction, respectively, may not be mutually exclusive (i.e. satisfaction in marriage is a judgment based on criteria that changed both with the age of each partner and that of the marriage).

Alfons (2007) also examined the effects of age, number of children, employment status, and length of marriage on marital satisfaction. They found that those who married later were more likely to remain married, but also that those who married

younger and get divorced are more likely to remarry. Contrary to previously stated results, these researchers found that age had a significant negative effect on the sexual adjustment and marital adjustment of first-married adults. In other words, the older one was at the time of first marriage, the less adjusted the individual would be toward the marriage and, consequently, the less satisfaction one would express. Middle-aged adults seemed to have greater adjustment problems than both young and elderly participants involved in the study.

In Africa there are also some researches done on marital satisfaction. But interestingly Owuamanam (2000) reports that the most single variable that pointed on marital satisfaction is the aspect of religious inclination. He pointed out that the major reason for revelation above is the non tolerance and diverse thinking between Muslims and Christians religious philosophy. Given that on the local scene there are no major contrasts between religious communities, the researcher may not consider religion as a major variable.

2 METHODOLOGY

2.1 INTRODUCTION

This section contains Locale of the Study, Research Design, Population of the Study, Validity of Instruments and their reliability and validity, sampling techniques and methods of data collection**.**

2.2 AREA OF THE STUDY

Kisii township is a town located to the south east of Lake Victoria and is bordered by six counties with Narok to the south, Migori to the west, Homa Bay to the north west, Kisumu to the north, Bomet to the south east and Nyamira to the east.

2.3 RESEARCH DESIGN

The researcher employed a cross sectional descriptive survey design to examine the phenomenon under investigation.

Cross sectional survey design was be used since unlike longitudinal survey design where we have a long experience with the field , the researcher had limited period to accomplish the study .

And although cross sectional survey design was used conclusions were only made at only one time. The researcher utilized both qualitative and qualitative approaches approximately where descriptive, statistical and exploratory styles were be used.

All in all the design used was triangulation which enriched the information received.

2.4 POPULATION OF THE STUDY

The target population comprised of all the married spouses in Kisii Township in Kisii County. There are approximately 4019 spouses according to 2009 census in Kisii Township of Kisii County.

2.5 SAMPLING TECHNIQUES

There are approximately **4,019 spouses (source 2009 census)**. According to Gay (2006), a sample of 5% of the total population is a good representative of the target population for populations that are between 4001 to 10, 000 to ensure homogeneity, size and accuracy. Therefore the study utilized 200 respondents as per the principle above.

2.6 RESEARCH INSTRUMENTS

The Study obtained data from the field using a questionnaire as the main instrument. Self -administered questionnaires were used to collect information from spouses on personal data under study. Closed ended questions were be used because they were faster to code and score for analysis thus consistency of responses across the respondents. Open ended questions were be used to give respondents an open room to give their views of the phenomenon under study.

2.6.1 RELIABILITY OF INSTRUMENTS

The researcher administered the instruments of data collection to 50 respondents outside the locale of the study. This administration of the questionnaires at this level ensured that the questionnaires were understood. Vague questions were rectified.

2.6.2 VALIDITY OF INSTRUMENTS

Content validity was maintained by re- examining the questions to ensured they capture the needed data. The research peers, research experts evaluated all aspects such that the instruments focused on the required information . Construct validity ensured that the instruments obtained the anticipated view , attitudes and perceptions on the subject under research. The researcher administered the instruments to 20 respondents outside the locale of the study. This was done to ensure that the instruments are understood. Administering them outside the of the study will ensure that Hawthorne effect does not occur. After the administration of the instruments vague statements will be discarded. Also those statements that did not capture the right constructs of the study were discarded. The exercise was be supervised all through by the research peers and research experts.

2.7 DATA ANALYSIS AND PRESENTATION

Data analysis was done by both qualitative and quantitative approaches appropriately

The following data analysis procedure was used.

a) Edit of the data on a regular basis which sorted out anomalies in the data in regard to completeness , coherence and checking of contradiction.
b) Coding the data into themes and sub themes where similar responses were grouped together.
c) Availing the similarities and differences within the coded data was done by the researcher.
d) Interpretation of the data and deducting of meaning of the data.
e) Summary, discussion, conclusions and recommendations from the data.

Statistical calculation was done to establish percentages and the mean using the formula.

$$\frac{\text{Frequency}}{\text{M}} \times 10 = \%$$

3 DATA ANALYSIS AND DISCUSSION OF FINDINGS

The researcher carried out pre data analysis as follows; total questionnaires were 200, the return rate was 100%, response rate was substantial, then the researcher transcribed common responses into common themes and manually calculated percentages of similar themes. He used excel to draw graphs and pie charts and in some cases used manual coding and analysis. He also used spps to calculate a chi square.

The objectives of the study were; to find out if demographic variables influence marital satisfaction, to compare various levels of education in relation to marital satisfaction and to find out underlying factors that influence marital satisfaction

Table 1. Comparison of educational levels of spouses in relation to marital satisfaction

Levels of education		F	%	Level of marital satisfaction	
				Satisfied	Not satisfied
1.	Same level	64	32	39 (60.9%)	25 (39.1%)
2.	Husband higher level	104	52	85 (81.7%)	29 (19.3%)
3.	Wife higher level	32	16	07 (21.8%)	25 (78.2%)
Total		200	100	111	89

The research also correlated various educational levels l.e primary, secondary, certificate, diploma, degree, and post graduate. After classification it was evident that highly satisfied spouses are where husbands have higher levels 81.7%, then same level with 60.9% and lastly 21.8% where wives had higher education.

The findings are consistent with Tucker (2001) who generalized that married couples with differing education levels may be less satisfied with their marriages especially if the woman is woman is the one with a higher level of education in that dyad.

Table 2. Frequency of marital education /information and marital satisfaction

	Strongly satisfied	Satisfied	No opinion	dissatisfied	Strongly dissatisfied	Mean	Total	Rank
Very Frequent	**06**	**22**	**2**	**10**	**08**	**3.1**	48	**1**
Frequent	**12**	**14**	**5**	**20**	**09**	**2.7**	60	**3**
Less Frequent	**02**	**08**	**06**	**30**	**06**	**2.4**	52	**5**
Seldom	**00**	**04**	**03**	**05**	**05**	**2.6**	15	**4**
Never	**03**	**07**	**04**	**07**	**04**	**2.9**	25	**2**
Total	**23**	**55**	**18**	**71**	**31**		**200**	

From the table it was evident that married individuals who received marital education information very frequently were the most satisfied with a mean of 3.1. On the other hand those who never received the information were the 2nd in the satisfaction with a mean of 2.9.

The findings above are in line with Humoud (2010) who reported that the higher the frequency of marital education the higher the satisfaction.

Table 3. Satisfaction in relation with the frequency of marital education

	Very satisfied	Satisfied	No idea	Dissatisfied	Very Dissatisfied	Mean	Rank
Rural	45	25	1	58	71	2.5	2
Urban	89	47	2	40	22	3.7	1

Majority of spouses who stay in the urban areas were satisfied on the frequency with which they received marital information with a mean of 3.7 compared to the rural spouses who had a mean of 2.5.

This statistics concurs with Bradbury (2000) who researched and generalized that marriage in enrichment education magnitude is curvilinear to MS and that however that relationship does not always guarantee MS. That assertion is clearly shown on table 4.2 above.

4 CONCLUSION

- Majority of those who advanced their education were more satisfied i.e. 41.5%, those who remained the same had 33.0%.
- On ambition and MS majority of those who had it were more satisfied i.e. 69.0%
- On L.O.E and MS, more satisfaction was if husbands had a higher education level.
- The quality of MS information education was not always a predictor of MS as urban married people but were less satisfied.
- The married people who received marital education very frequently were the most satisfied.

5 RECOMMENDATIONS

1. Marital experts should counsel spouses on implication of education advancement and vice versa on marital satisfaction.
2. Counseling stake holders should device ways to counsel spouses who did not advance their education and find reasons why they are not satisfied.
3. Marital therapists, parents, friends, religious leaders and relevant stakeholders should counsel on marital hegemony due to education.
4. Marital therapists and related stakeholders should query all the information, procedures that influence the quality of marital information as perceived by couples.
5. Therapists, religious leaders, parents, friends, counseling agencies and counseling stakeholders should incorporate more frequent sessions to make marriages more stable.

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Obstacles of innovation among the entrepreneur: An empirical study

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ABSTRACT: Research on the innovation has traditionally focused on the determinants promoting innovation and R&D in SMEs. However, an approach to study the barriers and the decision to innovation among entrepreneurs, seems it never been studied before. Our goal is to focus on this approach. Thus, through a qualitative study using focus groups with entrepreneurs, researchers, and government actors, we were able to identify the main barriers faced by entrepreneurs to innovation. A quantitative study was subsequently possible to draw up an inventory of the situation and generate results to conclude that the main obstacles studied vary according to the type of creation and the phase in the creative process. Finally some managerial implications were discussed towards the end.

KEYWORDS: obstacles to innovation, innovation décisions, entrepreneur.

1 INTRODUCTION

Since Schumpeter has made his first work on innovation, the latter is considered as a complex phenomenon that requires the involvement of all actors. It is the main source of the pulse of the economic system and the assurance of a long life for the company. Innovation potential of an economy depends heavily on the company; therefore the OECD has published manuals standardizing the definition of innovation and methods of investigation appropriate to innovation studies. This had used to triggere a series of studies analyzing the determinants and the drawbacks of many industrialized countries.

And if developed countries exploit the results of their innovations thanks to a combination of experiences, studies and empirical research yet, in several developing countries, studies on innovation is still relatively rare, either because of the weak capacity of innovation in their companies, of the lack of information and statistical surveys to conduct research, or because of the very lack of a national strategy of innovation.

In newly industrialized countries, such as Turkey (Pamukçu and Cincera, 2001 Singapore Wan et al., 2005) countries have sought to understand the phenomenon of innovation in their countries, through case studies, and raise similarities and field action through comparative studies. In other developing countries, Morocco for example, strategic orientation has begun to give importance to innovation through the implementation of various programs and legislative actions to promote innovation both in the public or private sector. With the joint establishment of a program to upgrade the company, several units have joined the project to promote innovation. However, more than a decade of experience, the results of these measures have remained unknown due to lack of availability of detailed and reliable statistical information.

On the academic side, the concepts of the innovation system (Edquist 1997, Lundvall 1992, Nelson 1993), the national innovation capacity (Furman et al. 2002), barriers to innovation (Ben Moussa et Zaiem, 2013) are actively studied to provide a mapping innovation policies in developing countries.

In this context, and while these countries have not stopped enjoying the benefits of technological innovation over the centuries, can we hope to expect that Morocco will be growing as fast as developed countries? To achieve this aim, in my case that they will overcomes a number of pitfalls among them the barriers of innovation.

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This article argues fill this gap and provide an analysis of the barriers to innovation among entrepreneurs, a supposed to be the main driver of innovation in a country according to the writings of Schumpeter population. Thus, the objective of this paper is to define and analyze the determinants and the constraints of innovation decisions in a sample of entrepreneurs.

To this end, a first paragraph introduces a synthesis of the literature on barriers of innovation. The second paragraph explains the methodological choices. The third section focuses on the results of the survey and the last paragraph discusses the results and presents the decisional implications.

2 LITERATURE REVIEW RELATED TO CONSTRAINTS OF INNOVATION

Research on innovation have studied in detail the drivers and sources of innovation, paying particular attention to technological and organizational capabilities that companies need to develop to become innovators (Schumpeter 1950, Von Hippel 1988 Dosi et Al 2000).

However, this literature has dealt with less obstacles that hinder innovation. The previous research made on innovation, were mainly interested in the study of economic and strategic value and its impact on the performance business of the company (Savignac, 2008).

Economists, who are interested in innovation, have tended to concentrate their analysis on the determinants of innovative activities and their impacts on economic and technological performance of companies. Others are concerned whit understanding the process by which an innovation emerges. Opportunities and modes of innovation are the result of motivations and interactions in economic system stimulating or constraining the ability of the process of innovation in a company (Silva et al., 2008 Hewitt-Dundas 2006 Foxon & Pearson 2008). Chaminade et al. (2008) define the factors that hamper innovation and reduce the opportunities for firms to engage in interactive learning and innovation at the systemic level (see also Chaminade & Edquist 2006). Hewitt-Dundas (2006) shows that differences in innovation may be due to differences in the background resources.

The most investigated factors are firm size, degree of competition, the technological opportunity and the capacity to appropriate the benefits of innovation (Cohen 1995, Kleinknecht 1996)

Hadjimanolis (1999), Dalkey and Helmer (1993) distinguish between internal barriers (endogenous) and external barriers (exogenous). Indeed, Hewitt-Dundas (2006) shows that differences in innovation may be due to differences in the background resources. Maurer (2006) distinguishes four categories of barriers to innovation: cost factors (cost of funding and availability of funds), knowledge factors (lack of qualified staff, lack of technological and commercial information), market factors (competition and demand) and regulatory factors (government regulations and European regulations). In addition to these barriers to innovation, SMEs are faced with the problems of incompatibility of internal resources and lack of expertise (Hadjimanolis, 1999). Freel (2005) suggests four categories of constraints related to the ability of small companies to innovate: finance, management and marketing, the work factor, and information. D'Este et al. (2007, 2008, 2009) studied the factors that reduce barriers to innovation by distinguishing between companies which face daunting barriers to innovation (non-innovative companies) and companies which face revealed innovative barriers to proven innovation (innovative companies). The results found support the conclusion against-intuitive (in much of the literature on barriers to innovation based on innovation surveys) indicating the positive and significant impact of constraints and obstacles on the likelihood of innovation Sophie Reboud et Tim Mazzarol, Mohnen & Röller 2005 Savignac 2008).Thus, the pieces of research that has dealt with the issue of barriers to innovation and innovation behavior were mainly directed towards the determination of the relative importance of these barriers and measuring their impact on SMEs in developed countries developed. (Freel 2005; March-Chorda et al., 2002; Hewitt-Dundas, 2006).

However, for Schumpeter, the central actor of innovation is the entrepreneur. He highlights the important role of innovation in the impulsion, the prosperity of the economy under the action of the entrepreneur. He is with this in mind, we chose to focus our study on the behavior of the people, whose innovation directly affects the dynamics of innovation of Moroccan SMEs.

3 METHODOLOGY

The perception of obstacles depends on the conditions and business characteristics and varies according to socio-economic and institutional context in which these are located (Rahmouni,2011) research often evoke variables such as the size the sector and the firm age as determinants factors of innovation (Maurer 2006 Lim and Shyamala 2007).

Jesper Sorensen B, Toby Stuart (2000) and Sylvie Laforet (2008) state that organizational skills acquired over the years, facilitate its orientation towards innovation. Thus a nascent company finds more obstacles in innovation than an older one. But does a new-born firm find less obstacles than a firm in the start-up phase or the pre-start-up one. Hence our first hypothesis:

H1: Barriers to innovation are influenced by the stage in the entrepreneurial process, depending on whether the contractor is in pre-startup or growth

Thus, Vega Jaider Jurado (2008), Sylvie Laforet (2013) showed that the internal factors of innovation vary in accordance with the firm sector of activity. As well Similarly Larson and Lewis (2007) showed that organizational innovation is related to the industry of the company. Thus, our second hypothesis is therefore as follows:

H2: Barriers to innovation are influenced by the nature of creation, depending on whether the contractor is accompanied or not.

The goal of our research is to evaluate the impact of these two factors on the innovation behavior of entrepreneurs. Thus a mixed approach combining qualitative and quantitative studies allow us to better understand the influence of obstacles on innovation.

3.1 QUALITATIVE METHODS: FOCUS GROUP

The methods of focus groups aim to highlight convergences of views and to identify some consensus on specific subjects. This is a quick way to gather information and views on the chosen theme.

In our study, the objective is to obtain information about opinions of the entrepreneurs, attitudes and experiences of goshawks about innovation in their business project, participants in this phase of the study were mostly active in the field of entrepreneurship, some are entrepreneurs in the Schumpeterian sense, other are a creators of a new business.

In order to maintain a certain range, we made up our groups according to several criteria including the age, sex and area of activity (entrepreneurs, coaches entrepreneurship, public actors in innovation, researchers in entrepreneurship or in innovation.

Our groups are made up of:

- 8 women: including 6 entrepreneurs, 1 public actors, and one researcher;
- 8 people: 4 entrepreneurs, 2 researchers, 2 public actors;
- The age of participants varies from 24 years to 45 years;
- All enterprises employ no more than 10 employees.

These interviews lasted an average of one hour and a half, aimed to understand the perception of innovation among new entrepreneurs interviewed and identify barriers to innovation and people who influence the entrepreneur innovation decision.

3.2 QUANTITATIVE METHOD: THE QUESTIONNAIRE

In the light of the qualitative study, we generated a set of items, which have helped us refine the questions of the quantitative study. The latter aimed to evaluate the importance of each of the identified variables consisted of three main parts: the entrepreneur and innovation, barriers to innovation, the decision of innovation.

Thus, the informant tells us about his judgment on the weight of each item based on his experience. Responses are spread over a Likert scale of 5 points.

- 1 = unimportant obstacle
- 2 = slightly significant obstacle
- 3 = moderately significant obstacle
- 4 = major obstacle
- 5 = very important obstacle

This construction technique of attitude scales is more manageable than other techniques developed for reasons of consistency and duration of the questionnaire. Each statement provides information on the subject's attitude. It is the accumulation of information that characterizes the subject's position on the scale.

3.3 DATA ANALYSIS

In our study, the most appropriate technique seems to be:

- Firstly the classical statistical analysis (classification, average, standard deviation and correlation coefficient);
- In the second step we used ANOVA method to examine the effect of the phase in the creative process and the type of creation;
- In the third step, the test of comparison of means to understand the influence of the variables on the decision of the innovation.

3.4 THE SAMPLE

During this study, we have investigated 274 entrepreneurs on the barriers that prevent them to innovate. The target population includes informants from different backgrounds and different sectors.

To be more subjective approach in our process of research, we separated the results of the classification of the degree of severity of barriers by three categories of entrepreneurs carrying a business project at the start-up stage.

- The auto-entrepreneurs are dependent creators. They named their businesses autonomously. Some were trained in entrepreneurship, or participated in competitions for starting a business, but have never received counseling or support entrepreneurial approach. We will call them "auto-entrepreneur".
- Accompanied entrepreneur. They set up projects receiving support in the creative process from the part of institutions supporting entrepreneurship institutions (incubator, association, foundation, private or public company).
- The third category, are entrepreneurs with business creation project in the pre-startup stage. These entrepreneurs are programs entrepreneurship graduates, and they are present in almost all the events that deal with the subject of entrepreneurship.

4 RESULTS OF THE STUDY

4.1 PERCEPTIONS OF BARRIERS TO INNOVATION: A DESCRIPTIVE ANALYSIS

The descriptive statistics presented in Table 1 show that the most important barriers are related to financial factors: the cost of financing and the degree of risk for these vulnerable business. Another obstacle mentioned the difficulty of finding a partner to engage in the innovation process.

This is due to the access to adequate information difficulty (on technological opportunities in the market ....), and the absence or inadequacy of support services and government policy.

In addition to these obstacles there is the weight of the regulatory rigidity and lack of training. Finally, comes the obstacle due to the change resistance and the issue of an innovation culture that are in fact the consequences of all previous barriers.

Table 1 shows the results by type of entrepreneur

	auto-entrepreneurs	Accompanied entrepreneur	pre-startup stage
The concept of risk	25	22	48
Innovation cost	33	29	32
Difficulty to access to information	29	31	31
Difficulty of finding a partner	31	29	24
Government policy	34	28	22
Lack or inadequacy of supervision	27	27	28
Rigidity of the regulation	26	20	28
Training inadequacy	23	26	24
Networking knowledge	22	26	24
Innovation culture	27	23	18
Change resistance	22	17	24

Tests of the effect of the phase dependence of the creation on innovation barriers have been verified by an analysis of variance.

H1: The obstacles vary depending on the nature of creation

The results show that the phase of creating impact:

- the concept of risk F = 6, 281; p = 0.000
- lack or inadequacy of supervision F = 14,689; p = 0.002
- difficulty to access to information F = 9, 536; p = 0.000
- rigidity of the regulation F = 13, 536; p = 0.000
- difficulties to realize partnerships F = 11.621; p = 0.000

In fact, the entrepreneur in starting activity perceives more risk, feel a lack of supervision is more important and more constraint to access to information.

While entrepreneurs have a stronger start perception constraints related to rigidity of the regulations and the difficulties to realize partnerships either with other companies, or public agencies.

H2: The obstacles vary depending on the type of design

Similarly, the ANOVA results show that the type of establishment of the company has an effect on other categories of barriers to innovation:

- change resistance (F = 9.297, p = 0.000),
- rigidity of the regulation (F = 12,705, p = 0.000).
- difficulties to realize partnerships (F = 10,849, p = 0.000)
- difficulty to access to information (F = 12,489, p = 0.000)

Indeed, entrepreneurs supported by supporting entrepreneurship institutions (incubator, association, foundation, private or public company) perceive more barriers to innovation related to resistance to change resistance and rigidity of the regulation.

For their part, dependent companies perceive more constraints in finding a partner, and lack of information access.

4.2 THE DECISION OF THE INNOVATION

To approach this aspect, we have chosen to identify prescribers in innovation decision, otherwise, know where the contractor turn for advice on strategic choices, we have proposed a list of potential advisors, we asked them to rate the importance of their opinions in an innovation decision. (Table 2)

Table 2 shows frequently advisor in innovation decision

customers	89,60
Fairs, exhibitions, industrial exhibitions, conferences	82,70
Internet and databases	78,50
Experienced employees in your company	73,10
suppliers	66,40
Other professionals with whom you are in contact	63,60
Specialized publications	56,40
Advisors and consultants	49,90
patent documentation	51,40
Members of your family (spouse, parents, relatives)	47,30
Accountants	46,40
Bankers or lenders	43,30
Family and friends	43,30
competitors	36,80
Programs governments	25,20%
universities and research laboratories	18,20

Not surprisingly, customers are favored, which confirms other research. The direction committee also appears very mentioned (when it exists). It is more surprising to financial and universities find in the wrong place.

Government programs information are the sources of information which are less consulted due to the absence or delay in the spread of information according to entrepreneurs.

A study of the difference among samples allows us to go a little further. (table3) The effect of the phase and the dependence on creation on obstacles to innovation has been verified by a comparison medium test (CMT). We see that even though they are not mentioned as frequently as customers, companies in pre-startup stage and auto- entrepreneurs consult largely their family, expert accountant and their banker more than accompanied entrepreneurs.

The results, classified according to the frequency of positive responses are found in table 3:

Table 3: frequently advisor in innovation decision b y type of entrepreneur

	auto-entrepreneurs	Accompanied entrepreneur	pre-startup stage
customers	38,27	31,29	30,44
Fairs, exhibitions, industrial exhibitions, conferences	34,52	34,68	30,80
Internet and databases	34,65	32,30	33,05
Experienced employees in your company	34,51	34,31	31,18
suppliers	37,47	33,89	26,64
Other professionals with whom you are in contact	34,73	34,14	31,13
Specialized publications	33,49	31,75	34,76
Advisors and consultants	32,33	34,89	32,78
patent documentation	34,35	32,78	32,87
Members of your family (spouse, parents, relatives)	36,13	24,25	39,62
Accountants	37,89	25,47	36,64
Bankers or lenders	37,68	23,52	38,80
Family and friends	34,63	30,45	36,18
competitors	32,74	30,70	36,56
Programs governments	33,66	32,08	34,26
universities and research laboratories	30,97	33,52	35,51

5 CONCLUSION

In developing countries, a particular attention begins to give innovation and the promotion of innovation and its role in economic growth.

The propagation behavior of innovation among SMEs largely depends on the establishing of a culture of innovation in the world of entrepreneurs. The innovation behavior of firms is affected by the appreciation of their founder's obstacles and difficulties encountered in the innovation process. This perception of obstacles has been studied extensively in the literature, and it is clearly linked to the experience and learning of the company (Ben moussa et Zaem , 2013).

In our research, we have tried to check up whether the perception of the factors preventing innovation could be affected by the position in the creative process and the nature of creation or selected by the contractor.

Thus, we have concluded that the barriers may be less pronounced for entrepreneurs supported and most important for entrepreneurs seed which are subject to high pressure created leading to a higher perception of barriers. Economic risk is one of the main barriers. More than half of companies (55.86%) reported problems of economic risk and financial constraints with a large proportion corresponding to independent contractors and seed. This can be affected by the lack of source information, but also a collection of technical and technological innovation. Institutes or agencies of government support should develop new mechanisms to encourage alternative sources of innovation activities (Freel, 2000).

The effect of type of design influences the perception of obstacles to innovation. Indeed seed firms suffer from a lack of access to information and need more guidance while startups perceive more barriers to regulation and partnership.

In decision-making innovation, companies in pre-startup, and self-seeking entrepreneurs solicit much more their family, accountant and banker entrepreneurs together.

To overcome barriers to innovation related to information gaps, our propose improving action in the promotion of innovation and public participation in the share capital through the strengthening of links between structure public and private, and the promotion and encouragement of university-business synergies.

Morocco now goes through a phase transition, it must imperatively eliminate, if not reduce barriers to innovation in assisting these companies to reduce the economic and financial risk and encourage its institutions and public agencies to confirm in the field innovation through the implementation of an effective strategy to promote innovation as well as the ease of access to finance, the enactment of tax incentives, through the development of links between universities and companies and public-private cooperation. Programs have been designed to support the dynamic evolution of innovation, but are still insufficient to ensure advantageous dynamic medium and long term.

Note that in this study the focus was on personal variables related to the entrepreneur. It would be interesting to include, in future research, other variables such as: innovation project started, the innovation strategy, external environment, and especially study the specific barriers to each type of entrepreneurs.

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Les motivations d'intégration des systèmes de management : Cas des entreprises marocaines

[The motivations for integrating management systems: Case of Moroccan companies]

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ABSTRACT: The integration of management systems (quality, safety, environment, ...) into one comprehensive management system allows the company to optimize its resources, improve efficiency and better meet the needs of all stakeholders . There are very few studies that examine the motivations for companies to integrate their systems of sequential management, some isolated empirical studies in paid developed that address this theme lead us to wonder about the fate of Moroccan companies.
The study was conducted via an empirical survey of 50 Moroccan companies double or triple certified (ISO 9001, ISO14001, OHSAS 18001,...). The willingness of senior management, improving business efficiency, the desire to provide overall management of the various management systems, development of competitiveness and customer satisfaction are all factors behind adoption of such a system by Moroccan companies.

KEYWORDS: Quality, Safety, Environment, ISO 9001, ISO 14001, OHSAS 18001.

RESUME: L'intégration des systèmes de management (qualité, sécurité, environnement,…) dans un seul système de management global permet à l'entreprise d'optimiser ses ressources, d'améliorer son efficacité et de mieux satisfaire les exigences de toutes les parties intéressées. Il existe très peu d'études qui s'intéressent aux motivations qui poussent les entreprises à intégrer leurs systèmes de management séquentiels, les quelques études empiriques isolées réalisées dans des payés développés qui abordent ce thème nous poussent à s'interroger sur le sort des entreprises marocaines.
L'étude a été réalisée via une enquête empirique auprès de 50 entreprises marocaines doublement ou triplement certifiées (ISO 9001, ISO14001, OHSAS 18001,…). La volonté de la Direction Générale, l'amélioration de l'efficacité de l'entreprise, l'envie d'assurer un pilotage global des différents systèmes de management, le développement de la compétitivité et la satisfaction des clients sont autant de facteurs derrière l'adoption d'un tel système par les entreprises marocaines.

MOTS-CLEFS: Qualité, Sécurité, Environnement, ISO 9001, ISO 14001, OHSAS 18001.

1 INTRODUCTION

L'intégration des systèmes de management procure aux entreprises plusieurs avantages [1],[2],[3],[4],[5]. Dans la littérature, plusieurs études empiriques traitent d'une manière générale le thème de management intégré, alors qu'il existe très peu d'études qui abordent les motivations qui poussent les entreprises à intégrer leurs systèmes de management. Les quelques études isolées réalisées dans des payés développés tels que: le Royaume-Uni, l'Italie, l'Espagne et l'Inde, nous pousse à étudier le cas des pays émergents et plus particulièrement le Maroc.

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Ces quatre pays font partie des TOP 10 en terme de certification ISO 9001 à l'échelle mondiale (Selon des statistiques données par l'organisation internationale de normalisation (ISO) en 2012 [6].

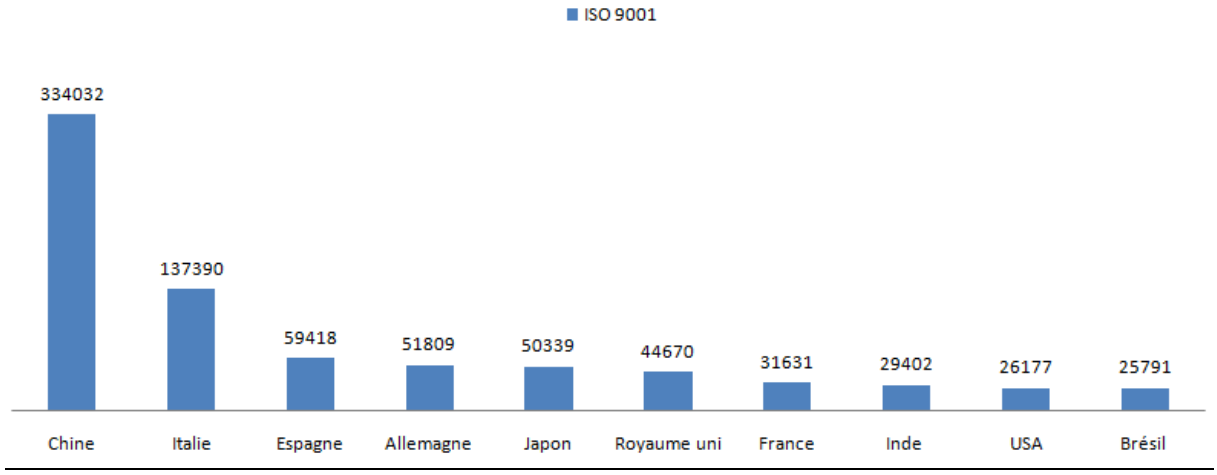


Fig. 1. TOP 10- ISO 9001 (Source ISO-2012)

Le nombre de certificats enregistrés vers fin 2012 à travers le monde s'élèvent à 1.101.272 certifications ISO 9001, soit une augmentation de 2% par rapport à 2011, tandis que les certifications ISO 14001 ont enregistré 285.844 certificats [7], soit une progression de 9 % par rapport 2011; une quasi stagnation des certifications ISO 9001 par rapport à une expansion en terme de l'ISO 14001. La figure 02 ci-après représente les TOP 10 ISO 14001 à l'échelle mondiale.

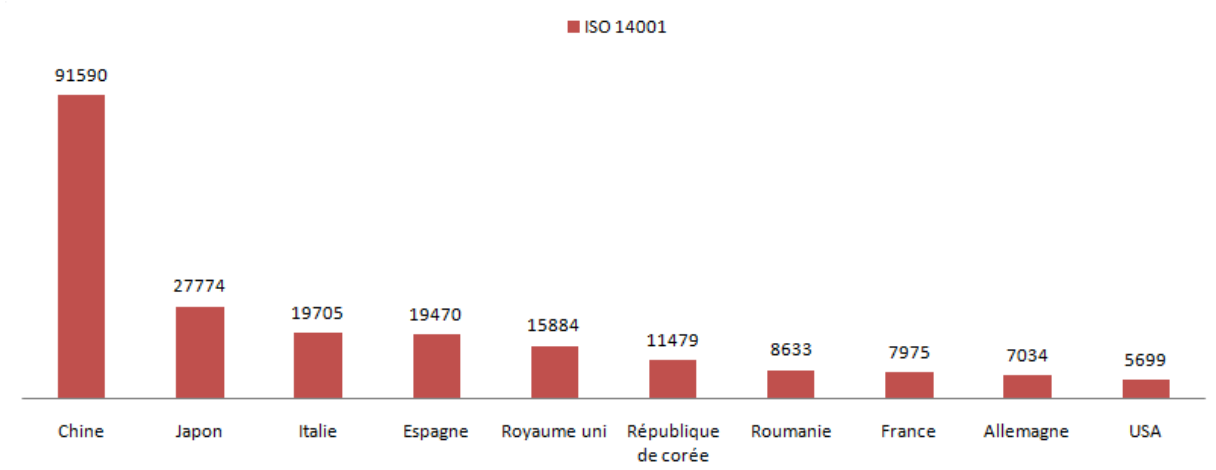


Fig. 2. TOP 10 - ISO 14001 (Source ISO-2012)

Au Maroc, l'adoption des normes ISO 9001 et ISO 14001 prend de plus en plus d'importance [6],[7].

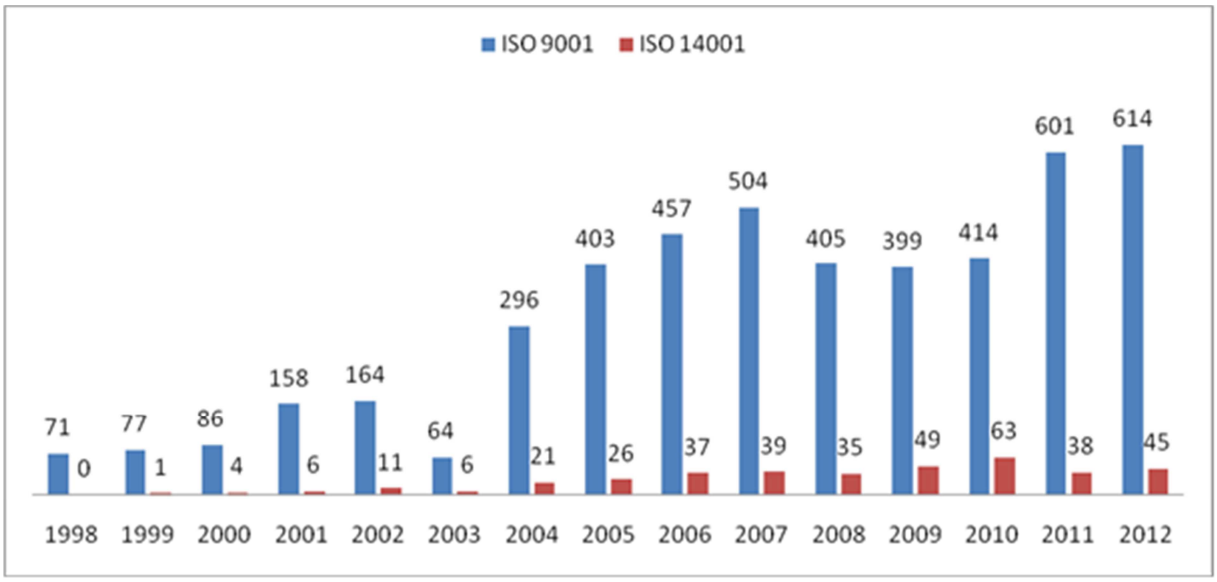


Fig. 3. Evolution des normes ISO 9001 & ISO 14001 au Maroc (Source ISO-2012)

Comme déjà cité, les motivations qui poussent les entreprises à intégrer leurs systèmes de management est un thème qui a été abordé par la littérature, cinq études isolées ont été trouvées :

1.1 1ère étude au Royaume-Uni

L'étude a été réalisée auprès de 28 entreprises ayant intégrées leurs systèmes de management qualité et environnement[8], elle a révélé que les motivations qui poussent les entreprises à intégrer leurs systèmes de management résident dans le fait d'éliminer la redondance documentaire, de réduire le nombre de procédures, d'opter pour des auditeurs polyvalents, de faciliter le management de leur système de management, d'améliorer l'efficacité de l'entreprise et son image de marque, d'optimiser la communication interne et de réduire les coûts de gestion de plusieurs systèmes à la fois.

1.2 2ème étude en Espagne

L'étude a été réalisée auprès de 249 entreprises espagnoles[9], elle a montré que les motivations derrière l'intégration des systèmes de management sont : l'amélioration de l'image de l'entreprise et de son efficacité, la satisfaction des exigences clients, le développement des parts de marché, la réduction des accidents de travail, la création de synergie entre les différents systèmes, les bénéfices que procurent l'intégration des systèmes de management et le fait de répondre à la pression exercée par l'état.

1.3 3ème étude en Catalane et Basque (Espagne)

Toujours en Espagne, cette fois ci l'étude a été réalisée auprès de 298 entreprises espagnoles situées dans la région Catalane et Basque[10], elle a illustré que les motivations qui poussent ces entreprises à adopter un tel système sont : l'amélioration de l'image de l'entreprise et de sa compétitivité, le développement de ses parts de marché et de son impact social, la réduction des problèmes et des accidents de travail, l'amélioration de l'efficience des entreprises, la maîtrise et l'amélioration continue du système de management, le souci de créer une synergie entre les différents systèmes de management et le fait d'assurer une réponse à la pression des clients et du gouvernement.

1.4 4ème étude en Italie

L'étude a été réalisée auprès de 103 entreprises italiennes[5], elle a décelé que les facteurs qui motivent ces entreprises à opter pour le système de management intégré sont : la pression de la communauté locale, la pression des clients et des distributeurs, le souci d'améliorer la compétitivité, l'image de marque, les produits et la productivité, l'envie de réduire les coûts de management de plusieurs systèmes, d'acquérir des nouveaux marchés et de s'engager dans une démarche d'amélioration continue.

1.5 5ème étude en Inde

L'étude empirique a été réalisée auprès de 60 entreprises indiennes[11], il ressort de cette étude que les motifs qui influencent les entreprises à adopter un système de management intégré sont : la réduction de la taille documentaire, la combinaison des objectifs des différents systèmes de management, l'implication du top management, la réduction des coûts, l'amélioration de la communication et de la compétitivité à long terme, l'amélioration de l'efficience du système de management, la réduction des coûts des audits tierce parties, la maîtrise des processus, le gain du temps lors de mise en place des autres systèmes de management, la suppression de la duplication des procédures, la réponse à la pression des clients et du gouvernement, l'engagement dans une démarche d'amélioration continue, l'amélioration de l'image de l'entreprise et la création de synergie entre les différents systèmes de management.

2 Méthodologie

L'étude a été réalisée via une enquête empirique, selon un questionnaire administré en ligne [12] auprès des entreprises marocaines doublement ou triplement certifiées (ISO 9001, ISO 14001, OHSAS 18001,..).

Le questionnaire a été élaboré sur la base d'une revue de la littérature [5],[8],[9],[10],[11].

L'administration du questionnaire a été réalisée entre le mois de décembre 2013 et mai 2014, cinq volets de recherche ont été visés:

- les données socio-économiques des entreprises,
- les motivations qui poussent les entreprises marocaines à intégrer leurs systèmes de management,
- les difficultés rencontrées lors de l'intégration des systèmes de management,
- les niveaux d'intégration des systèmes de management à l'échelle stratégique, tactique et opérationnelle,
- les avantages que procure l'intégration des systèmes de management.

La présente publication s'intéresse aux motivations liées à l'intégration des systèmes de management, les autres volets de recherche feront l'objet de publications dans le futur.

3 Presentation Des Resultas Obtenus

3.1 Taux de réponse

Après élaboration du questionnaire, ce dernier a été testé auprès de trois entreprises marocaines pour subir des améliorations, la dernière version, finalement validée, a fait l'objet d'une communication auprès de 120 entreprises marocaines doublement ou triplement certifiées, 65 questionnaires ont été renseignés en ligne, soit un taux de réponse de 54,16 %. Lors de l'analyse des résultats, 50 questionnaires ont été finalement acceptés et validés.

3.2 Données socio-économiques

Les entreprises interviewées appartiennent à plusieurs secteurs d'activité, la figure n° 04 donne de plus ample détail :

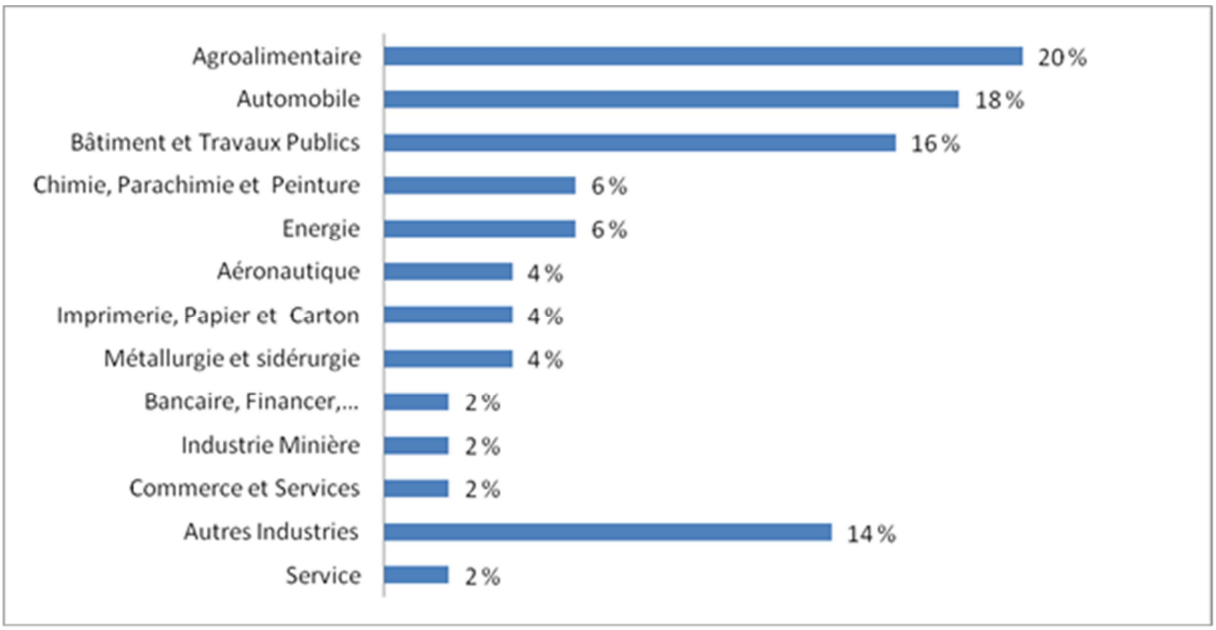


Fig. 4. Répartition des entreprises selon le secteur d'activité

54% des répondants font partie des secteurs : agroalimentaire, automobile et bâtiment et travaux publiques, ces trois secteurs sont en plein développement au Maroc, l'agroalimentaire car le Maroc est d'abord un pays agricole, l'automobile représenté par les différentes entreprises multinationales qui opèrent dans ce domaine et le secteur des bâtiments et travaux publiques qui connait un grand essor à l'échelle nationale.

3.3 EFFECTIF DES ENTREPRISES :

Lors de l'étude, les grandes entreprises ainsi que les PME ont été ciblées, la répartition des entreprises interviewées en fonction de leurs effectifs donne les résultats suivants :

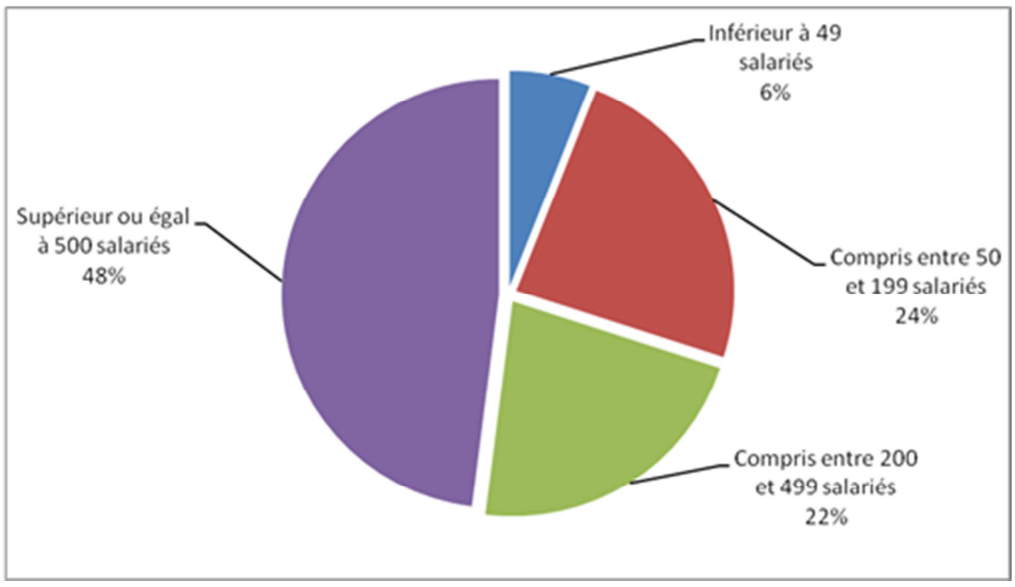


Fig. 5. Répartition des entreprises interviewées selon leur effectif

48 % des répondants font partie des grandes entreprises marocaines, tandis que les PME représentent 52 %.

3.4 CHIFFRE D'AFFAIRE DES ENTREPRISES

En vue de cerner davantage la taille de l'entreprise, le questionnaire a abordé en outre la répartition du chiffre d'affaire :

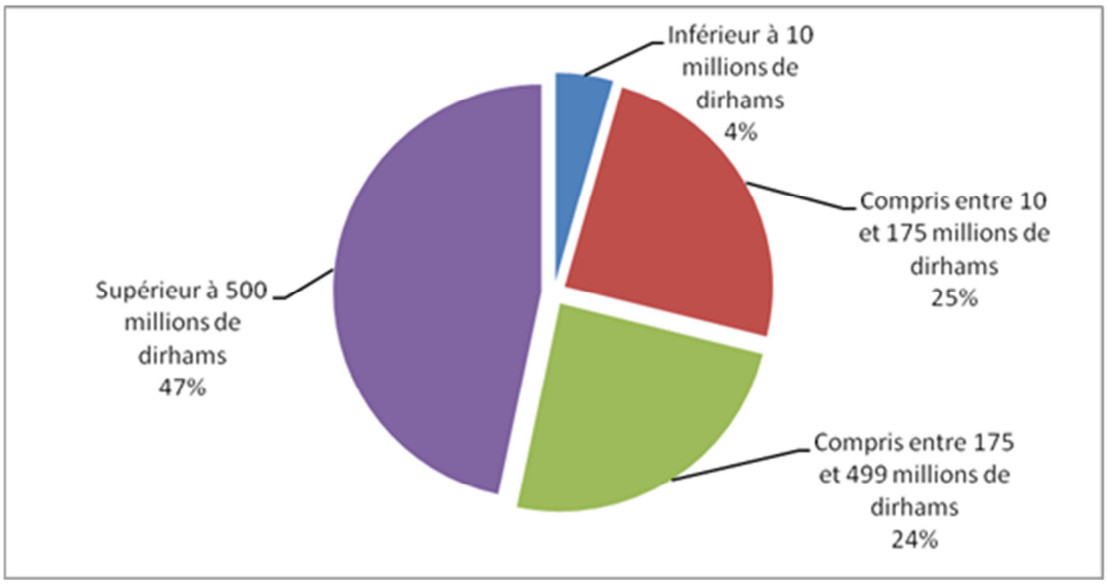


Fig. 6. Répartition des entreprises selon leurs chiffres d'affaire.

47 % des entreprises disposent d'un C.A supérieur à 500 millions de dirhams, un résultat qui correspond à l'effectif des grandes entreprises interviewées (48 % ont un effectif supérieur à 500 personnes).

3.5 NORMES DE CERTIFICATION

Lors de l'étude, seules les entreprises doublement ou triplement certifiées ont fait l'objet d'un échantillonnage, les 50 entreprises, ayant été acceptées, présentent les certifications mentionnées par la figure ci-après:

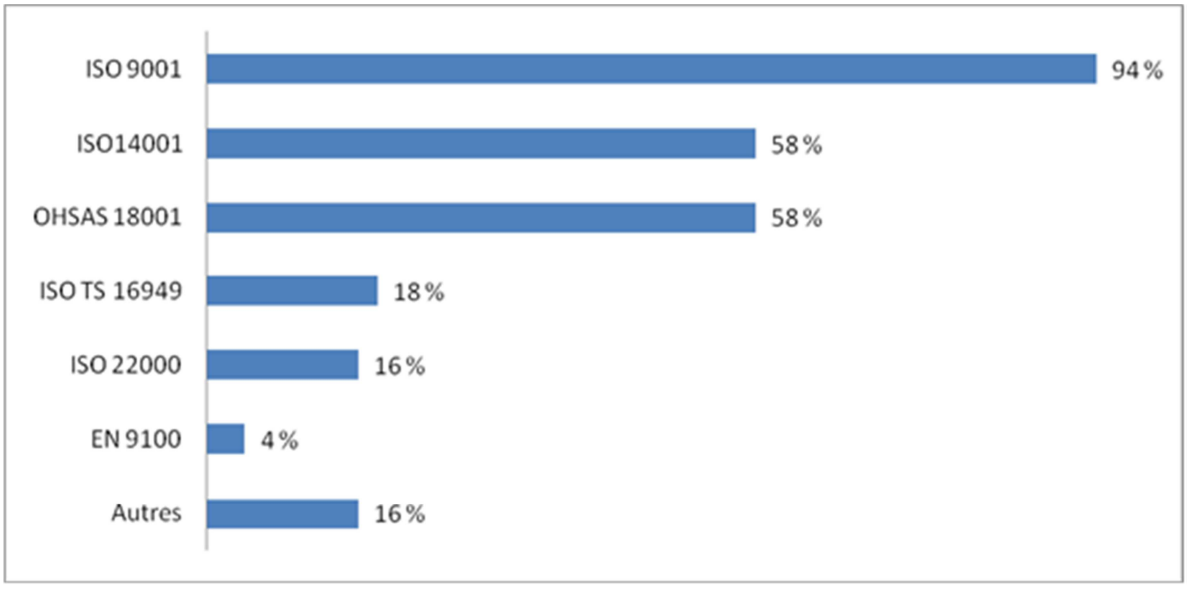


Fig. 7. Répartition des entreprises en fonction des certifications obtenues

Les trois certifications qui dominent sont l'ISO 9001, l'IS0 14001 et l'OHSAS 18001, 94 % des entreprises sont certifiées ISO 9001, tandis que les certifications ISO 14001 et OHSAS 18001 représente chacune un taux de 58%.

3.6 NIVEAUX D'INTÉGRATION DES SYSTÈMES DE MANAGEMENT

Trois niveaux d'intégration ont été abordés par l'enquête; l'intégration totale, l'intégration partielle ou la non intégration des systèmes de management par les entreprises marocaines :

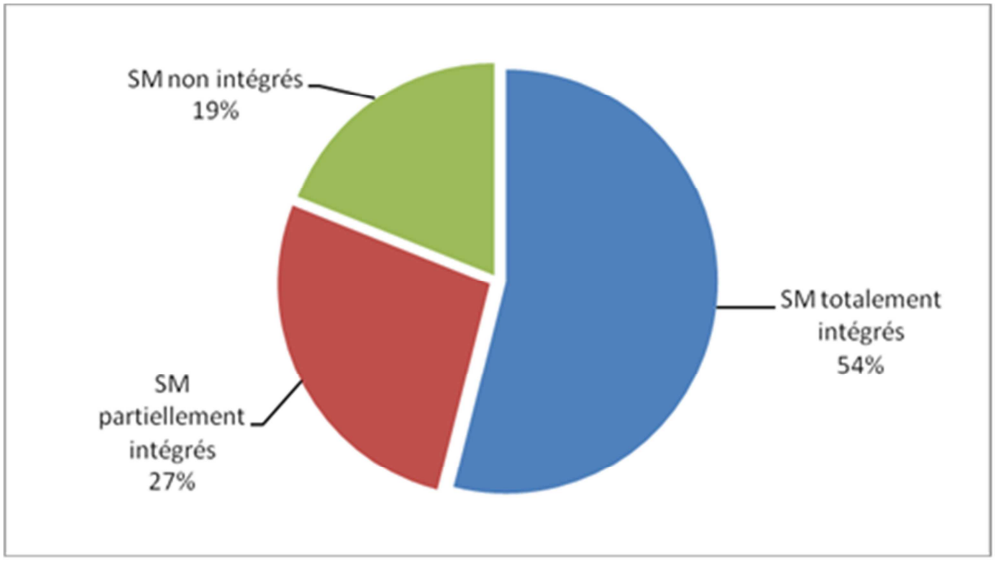


Fig. 8. Niveaux d'intégration des systèmes de management

81% des entreprises ont opté pour l'intégration totale ou partielle de leurs systèmes de management, alors que 19 % n'ont pas intégré leurs systèmes de management, il était donc nécessaire de clarifier les raisons qui empêchent ces entreprises à ne pas s'engager dans la voie d'intégration de leurs systèmes de management:

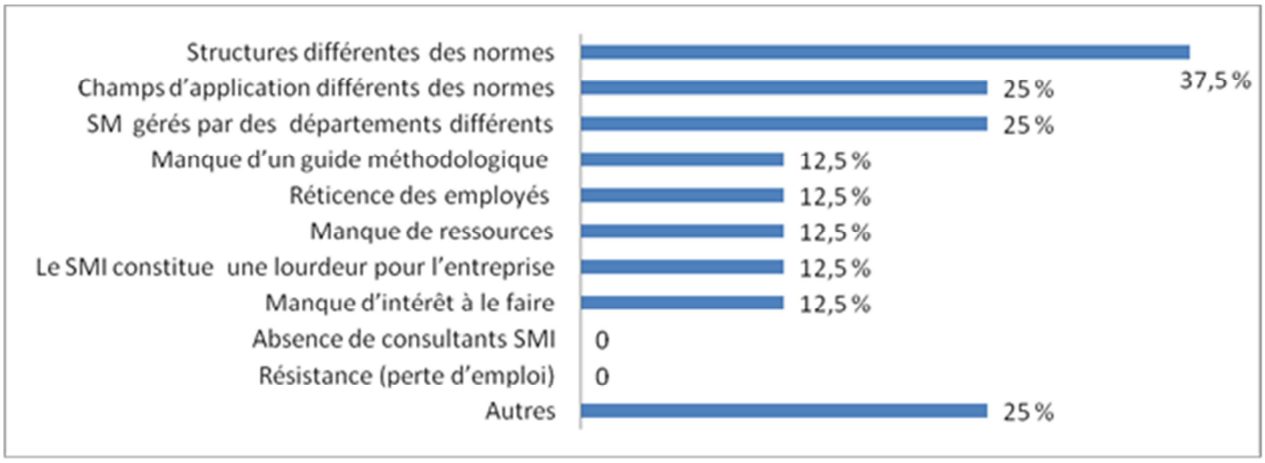


Fig. 9. Raisons de non intégration des systèmes de management

3.7 MOTIVATIONS LIEES A L'INTEGRATION DES SYSTEMES DE MANAGEMENT

L'étude a abordé 17 facteurs de motivation ; 11 facteurs internes (Figure n° 10) et 6 facteurs externes (Figure n° 11).

3.7.1 MOTIVATIONS INTERNES

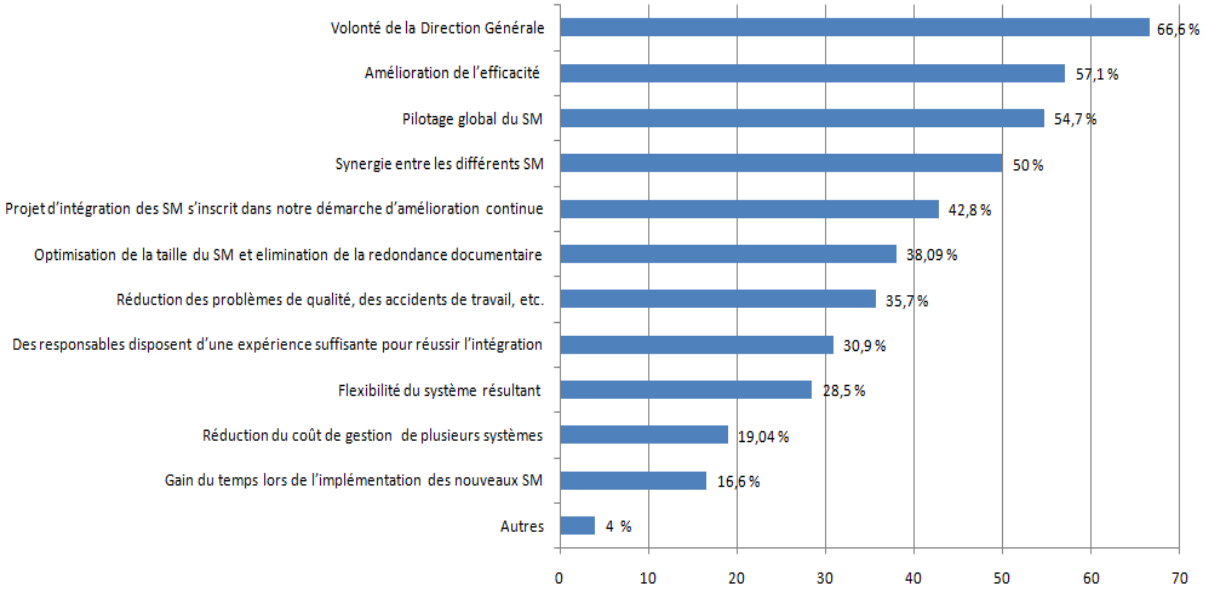


Fig. 10. Motivations internes d'intégration des systèmes de management

3.7.2 MOTIVATIONS EXTERNES

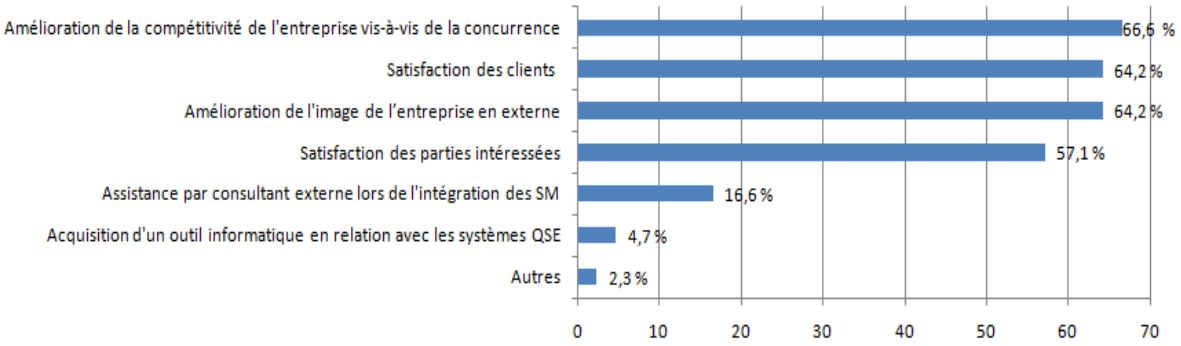


Fig. 11. Motivations externes d'intégration des systèmes de management

4 DISCUSSION

Dans un objectif de connaitre les motivations qui poussent les entreprises marocaines à intégrer leurs systèmes de management qualité, sécurité et environnement, une étude a été réalisée via une enquête empirique auprès de 50 entreprises marocaines doublement ou triplement certifiées (ISO 9001, ISO14001, OHSAS 18001,…). La volonté de la Direction Générale, l'amélioration de l'efficacité de l'entreprise, l'envie d'assurer un pilotage global des différents systèmes de management, le développement de la compétitivité et la satisfaction des clients sont autant de facteurs derrière l'adoption d'un tel système par les entreprises marocaines.

4.1 RAISONS DE NON INTÉGRATION DES SYSTÈMES DE MANAGEMENT

37,5 % des entreprises évoque que les normes présentent des structures différentes ; la norme ISO 9001 est orientée approche processus et cycle PDCA, tandis que les autres normes sont plutôt orientées cycles PDCA.

25 % des entreprises avouent que les normes objet de certification ont des champs d'application variés, la norme ISO 9001 s'intéresse à la satisfaction des clients via l'amélioration des produits et services, la norme ISO 14001 a comme objectif la satisfaction du voisinage et la population environnante via la maîtrise des impacts significatifs engendrés par les activités de l'entreprise, alors que le référentiel OHSAS 18001 est orienté personnel et vise la maîtrise des risques santé et sécurité au travail.

Si ces deux premières raisons ont un caractère externe à l'entreprise, le troisième facteur a un aspect plutôt interne, le fait que les systèmes de management sont gérés par des départements différents, ceci représente une réelle barrière qui empêche les entreprises à intégrer leurs systèmes de management, 25 % des entreprises ont opté pour ce facteur.

4.2 MOTIVATIONS LIÉES À L'INTÉGRATION DES SYSTÈMES DE MANAGEMENT

4.2.1 MOTIVATIONS INTERNES

Il ressort de l'enquête que l'engagement de la Direction Générale est le facteur le plus dominant qui permet aux managers d'initier leur démarche d'intégration, 66,6% des entreprises ont choisi ce facteur. Certes, la mise en place d'un système de management intégré est d'abord un projet d'entreprise, l'engagement de la Direction est fort important. Son rôle est de fournir les ressources nécessaires, d'orienter l'équipe projet conformément aux axes stratégiques de l'entreprise et surtout de suivre de près leur travail.

Puisque le projet d'intégration a un caractère transversal impliquant plusieurs départements au sein de l'entreprise, l'équipe projet a besoin donc d'être épaulée au plus haut niveau de l'entreprise.

En deuxième position, vient le souci d'améliorer l'efficacité de l'entreprise, un facteur de motivation qui a été choisi par 57,1 % des entreprises. L'efficacité dépend des choix stratégiques et organisationnels, de la capacité d'innovation, de la maturité des produits et marchés, de la notoriété de la marque…, la réalisation de ces résultats économiques dépend étroitement du système de management mis en œuvre.

Le troisième élément de motivation étant la volonté d'assurer un pilotage globale du système de management, 54,7 % des entreprises ont opté pour ce facteur , un pilotage qui permettra de garantir la cohérence des actions engagées par l'ensemble des intervenants, Ceci implique que les différents responsables dépassent la dimension technique de leur mission pour développer une réelle vision stratégique leur permettant de mieux piloter leurs activités selon plusieurs angles (qualité, sécurité, environnement, …) et de contribuer ainsi à l'amélioration de leur valeur ajoutée envers toutes les parties intéressées.

Le système de pilotage garantit l'alignement des actions sur les principaux enjeux de l'entreprise et accompagne le déploiement stratégique auprès des différents départements.

Le quatrième facteur de motivation réside dans l'objectif de créer une synergie entre les différents systèmes de management, 50 % des entreprises ont opté pour ce facteur.

L'un des problèmes majeurs des managers consiste à créer des synergies entre les différents systèmes de management en vue de les réunir autour des enjeux communs de l'entreprise. L'amélioration de synergie est néanmoins tributaire de l'implication de toutes les parties prenantes : production, qualité, finances…etc.

La synergie est l'un des avantages d'un système de management intégré [3]. Elle pourra être scindée en trois niveaux de l'organisation [4] :

1. une synergie stratégique ;
2. une synergie culturelle et ;
3. une synergie au niveau de la documentation.

4.2.2 MOTIVATIONS EXTERNES

Le souci d'améliorer la compétitivité de l'entreprise est le premier facteur qui a été choisi par 66,6% des entreprises. L'intégration des systèmes de management ne peut qu'améliorer la compétitivité de l'entreprise [5]. 64,2 % des entreprises

au travers l'intégration de leurs systèmes de management s'intéressent plutôt à la satisfaction de leurs clients, L'intégration des systèmes de management améliore significativement la satisfaction des clients [1],[2],[5]. L'ancrage du système de management et son acceptation par les managers et les autres employés ont conduit à des résultats très intéressants en terme de satisfaction des clients et d'amélioration de la qualité des produits [13].

64,2 % des entreprises vise l'amélioration de l'image de l'entreprise, un avantage cité aussi dans les deux études [5], [8].

L'image de l'entreprise étant un ensemble des représentations psychologiques, positives ou négatives, attachées à un produit ou un service; c'est ce que les clients perçoivent du produit, du service, de la marque, de l'entreprise ou du dirigeant [14]. La satisfaction des parties intéressées constitue l'un des facteurs de motivation, choisi par 57,1% des répondants.

Le tableau n° 01 récapitule l'ensemble des motivations par pays :

Tableau 1. Répartition des motivations par pays

Motivations	Pays					
	RU	Esp	Catalane Basque	Italie	Inde	Maroc
Amélioration de l'image de l'entreprise	●	●	●	●	●	●
Satisfaction des clients et des autres parties intéressées (Etat, communauté locale, …)		●	●	●	●	●
Réduction des coûts de gestion de plusieurs systèmes de management	●			●	●	●
Amélioration de la compétitivité de l'entreprise			●	●	●	●
Création de synergie entre les différents systèmes de management		●	●		●	●
Amélioration continue du système de management			●	●	●	●
Réduction des problèmes / des accidents de travail		●	●			●
Amélioration de l'efficacité de l'entreprise	●	●				●
Développement des parts de marché		●	●	●		
Optimisation de la taille du SM et élimination de la redondance documentaire	●				●	●
Optimisation de la communication	●				●	
Amélioration de l'efficience de l'entreprise			●		●	

En comparant les résultats issus des six études, l'amélioration de l'image de l'entreprise est le facteur de motivation le plus dominant qui suscite les entreprises à intégrer leurs systèmes de management, pour forger cette image l'entreprise est amenée à satisfaire ses clients et toutes les autres parties intéressées. L'optimisation des coûts de gestion est un facteur très demandé par les entreprises, maîtriser les coûts permet à l'entreprise d'être compétitive vis-à-vis de la concurrence. L'intégration des systèmes de management permet de créer une synergie en interne, un critère de motivation évoqué par quatre études.

L'amélioration continue des systèmes de management est une exigence demandée par toutes les normes de management, elle permet de réduire les problèmes de l'entreprise et d'améliorer son efficacité.

Le développement des parts de marchés et l'optimisation de la taille documentaire deux critères de motivation qui ont été choisis par trois études, tandis que l'optimisation de la communication et l'amélioration de l'efficience de l'entreprise sont traités comme facteurs de motivation par deux études.

5 CONCLUSION

Plusieurs critères de motivation poussent les entreprises à intégrer leurs systèmes de management, il existe très peu d'études qui s'intéressent aux motivations qui poussent les entreprises à intégrer leurs systèmes de management séquentiels, les quelques études empiriques isolées réalisées dans des payés développés qui abordent les motivations qui influencent les entreprises à intégrer leurs systèmes de management nous a poussé à s'interroger sur le sort des entreprises marocaines.

De part cette étude nous avons essayé de répondre aux deux objectifs suivants :

1- Connaitre les motivations qui poussent les entreprises dans des pays émergents, tel que le Maroc à intégrer leurs systèmes de management (Qualité, Sécurité, Environnement,…).
2- Comprendre les raisons qui poussent certaines entreprises à ne pas intégrer leurs systèmes de management.

A cet effet, une étude empirique a été réalisée auprès de 50 entreprises marocaines doublement ou triplement certifiées (ISO 9001, ISO14001, OHSAS 18001,…).

La volonté de la Direction Générale, l'amélioration de l'efficacité de l'entreprise, le pilotage global du système de management et la création d'une synergie à différents niveaux organisationnels constituent des facteurs internes pour impulser l'intégration des systèmes de management.

Quant aux facteurs externes, ils sont représentés par l'amélioration de la compétitivité et de l'image de l'entreprise, la satisfaction ses clients et des autres parties intéressées.

La démarche d'intégration des systèmes de management est un projet d'entreprise qui fait réfléchir les différents collaborateurs impliqués envers l'efficacité de leur processus, le résultat attendu est une communauté d'idées, d'initiatives, d'actions, toutes orientées vers un objectif stratégique compris et partagé.

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Influence of grasscutter manure, chicken manure and NPK fertilizer on the growth and yield of carrot and chemical properties of soil

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ABSTRACT: Field experiments were conducted in 2010 cropping season at the Research Centre of the College of Agriculture, Mampong Campus of the University of Education, Winneba (latitude 7° and 8° North of Equator and Longitude 1° and 24° West of the Greenwich) in the forest transitional zone of Ghana to evaluate the effect of three levels of grasscutter manure (GM), chicken manure (CM), and NPK on soil chemical properties, growth and yield of carrot. The treatments were, no fertilizer or manure (control), 300kgNPK/ha, 10tCM/ha, 3 levels of grasscutter manure (10t, 15t and 20t/ha), laid out in a randomized complete block design with 3 replications. The 3 levels of grasscutter manure and chicken manure enhanced the soil organic C, total N, available P, exchangeable K, Ca, Mg and CEC better than NPK and the control treatments. Organic matter content and percent base saturation were high in the amended plots than the control. Plant height, number of leaves, leaf chlorophyll content, root length, root diameter and root yield for the 15 and 20t/ha grasscutter manure performed better than the rest of the amendments. The study showed that among the organic manures evaluated, grasscutter manure of 15 and 20t/ha gave the improved levels of the soil chemical properties and yield of carrot.

KEYWORDS: Grasscutter manure, chicken manure, NPK, soil, chemical properties.

1 INTRODUCTION

Inorganic fertilizer has been found to increase yield of crops. Application of 300-450kg/ha NPK (15:15:15) before planting has been recommended for improved growth and yield of crops in Ghana [1]. Amjad *et al*. [2] observed that, application of NPK fertilizer increased plant height, seed yield and root yield of carrot. Hochmuth *et al*. [3] reported that the carotene content of carrot root was significantly influenced by nitrogen and potassium application.

Application of chemical fertilizers is very crucial for improving fertility of soil and have become integral part of modern crop production systems. High cost and sometimes non-availability of fertilizers at the time of sowing coupled with adulteration of some fertilizers poses a great problem [4]. Most farmers often use nitrogen alone and do not bother about the application of other macro and micro nutrients that are also essential for soil quality. Indiscriminate use of inorganic fertilizers has a myriad of problems. Generally, excessive amounts of inorganic fertilizers are applied to vegetables in order to achieve a higher yield [5] and maximum value of growth [6]; [7]; [8]. But the use of inorganic fertilizers alone may cause problems for human health and environment [7].

Organic manure can serve as alternative substitute for mineral fertilizers [9]; [10]; and [11] for improving soil structure [8] and microbial biomass [12]. In this vane, utilization of locally produced manures for vegetable production may increase crop yields with less use of inorganic fertilizer. Recently, consumers are demanding higher quality and safer food and highly interested in organic products.

Organic manure is known to contain macro and micro elements and substances that support growth, development and yield of crops and regular application improves soil structure and enhances root growth [13]; [14] and [15]. According to Zhang *et al*. [15], organic manure improves soil chemical properties including nitrogen, phosphorus, potassium, soil organic

carbon (SOC) and organic matter content. Adeleye [16] also observed an increase in pH, organic matter, total nitrogen, available phosphorus, exchangeable cations and percent base saturation due to addition of poultry manure.

Chicken manure has been widely used in various rates by both researchers and farmers. Kahangi [17] recommended the application rate of 10-20t/ha chicken manure for improved growth and yield of carrot in the tropics. Dauda *et al*. [18] reported a rate of 10, 15 and 20t/ha chicken manure for carrot growth and yield. Agyarko *et al*. [19] stated that application of chicken manure recorded heavier mean root weight, root length and root diameter in carrot were significantly better than the unamended soil. Dauda *et al*. [18] also recorded a significant increase in growth and yield of carrot for 10, 15 and 20t/ha chicken manure applied than the control.

Grasscutter (*Thryonomis swinderianus)* manure has been used to cultivate vegetables like tomatoes and cabbage and it has been found to give high yield in the western region of Ghana [20]. The yields obtained by these farmers since domestication of grasscutter can be compared to yields from chicken manure, cow dung and other manures. Grasscutter produces a lot of manure and like chicken manure, it is capable of releasing both macro and micro nutrients and improving soil conditions.

Since grasscutter domestication is in ascendancy in Ghana, most vegetable growers will continue its usage but the rate of application by farmers for vegetable crops are not often based on research recommendations perhaps since its usage is new. Due to this situation, there is the need to research into the use of grasscutter manure and its effects on soil chemical properties and yield of crops.

The objective of this study was to determine the effects of different rates of soil amendments on soil chemical characteristics and yield of carrot at Mampong-Ashanti which is a major producing area of carrot in Ghana.

2 MATERIALS AND METHODS

2.1 SITE AND TREATMENTS

The experiment was conducted at the College of Agriculture Education, University of Education, Winneba at Asante Mampong from March to July, 2010. The soil at the project site is of the Bediase series of the savannah Ochrosol. The soil exhibits all the features of sandy loam. It is well drained with thin layer of organic matter with deep yellowish red, friable and free from stones. The pH ranges from 6.5-7.0. It is permeable and has moderate water holding capacity [21]; [22]. The site has an altitude of 457.5m above sea level and occurs within latitude 7 and 8̊ North of Equator and Longitude 1 and 2̊ West [23].

A randomized complete block design was used with six (6) treatments and three replications on beds. Each bed measured 2.0m x 1.5m and was prepared with a hoe to a height of 25cm. Well decomposed chicken manure (CM) and grasscutter manure (GM) were thoroughly incorporated separately into the beds before leveling with rake. The treatments were, 10t/ha chicken manure and three levels of grasscutter manure (10tGM_1/ha, 15tGM_2/ha and 20tGM_3/ha) as sole amendments, 300kgNPK/ha which was applied after thinning out and a control.

2.2 SOWING OF CARROT

Seeds of carrot *var new* improved *Kuroda* were sown by drilling to a depth of about 2cm and at 25cm between rows on each bed. The beds were covered with straw to prevent excessive heat and possible falling of the tiny seeds and were later watered. Germination was observed six days after sowing. The seedlings were thinned out 21days after germination to intra-row spacing of 10cm. Weed control was carried out by handpicking. Earthening-up was done every two weeks after thinning out to check exposure of roots by watering. The interows were stirred up with hand fork at two weekly intervals throughout the growing period to improve aeration for enhancement of growth of the crop.

2.3 DATA COLLECTION

2.3.1 PLANT SAMPLING AND MEASUREMENTS

Twenty plants were randomly selected from the middle rows and tagged for record taking. Plant height and number of leaves were taken from 5 weeks after planting (5WAP) to 12 WAP. Root length and root diameter at 2cm from the top were recorded immediately after harvest with the aid of metre rule and veneer calipers respectively. Plant height was taken with a

long plastic rule from the soil level to the tip of the longest leaf whilst number of leaves per plant were counted. The yield of taproots from each plot was weighed with an electronic balance.

2.3.2 SOIL SAMPLING AND ANALYSIS

Soil samples were randomly taken from different spots (10 points) at a soil depth of 0-15cm from each treatment and replication. Samples from each treatment and replication were bulked, air dried and sub-sampled for analysis at the Soil Research Institute, Kumasi before planting. Soil samples were then taken six weeks after soil ammendment. Soil pH was measured using a glass electrode (pH meter) in accordance with the methods of [24] and [25]. Soil organic matter was determined by the wet combustion method [26]. Percentage total nitrogen was determined by the micro kjeldahl-technique [27]. The available phosphorus was extracted by the Bray method and determined calorimetrically [28]. Potassium was determined by flame emission photometry. The exchangeable cations, calcium, magnesium, potassium and sodium were determined as recommended by [24] using EDTA Titration after extraction with 0.1N Ammonium Acetate at pH 7. Effective Cation Exchange Capacity (ECEC) was calculated as the sum of the exchangeable bases and exchangeable acidity.

3 DATA ANALYSIS

Data collected were analyzed by Analysis of Variance (ANOVA) using GenStat Statistical Package. Significant means obtained were separated by least significant difference (LSD) method at 5% significance level.

4 RESULTS AND DISCUSSION

Table 1. Chemical properties of poultry and grasscutter manure used in field studies

Property	pH 1:1	Ca%	Mg%	P%	K%	N%
Chicken manure	9.3	0.96	1.33	1.39	0.65	2.01
Grasscutter manure	8.2	0.61	0.78	0.49	1.08	1.13

Table 2. Initial soil chemical properties at the experimental site

pH, H_2O 1:1	Org.C %	Total N %	Org. M %	Exch. Cations (me/100g)				T.E.B	Exch. A(Al+H)	ECEC me/100g	Base Sat %
				Ca	Mg	K	Na				
4.6	1.25	0.09	2.00	0.54	0.36	0.21	0.05	1.17	0.37	1.71	68.36

Table 3. Effects of amendments on nutrient levels and chemical characteristics of soil

Treatments	**pH, H_2O 1:1**	**Org.C %**	**Total N,%**	**Org.M %**	**Exch. Cations (me/100g)**				**T.E.B**	**Exch. A(Al+H)**	**E.C.E.C me/100g**	**Base Sat %**
					Ca	**Mg**	**K**	**Na**				
300kgNPK/ha	5.2	1.53	0.12	2.97	1.25	1.05	0.46	0.07	3.37	0.52	4.20	80.23
10tCM/ha	6.2	2.11	0.15	3.34	2.95	1.15	0.38	0.11	4.59	0.54	5.25	87.38
10tGM_1/ha	6.35	2.06	0.13	2.96	2.25	1.01	0.32	0.09	3.65	0.48	4.36	83.32
15tGM_2/ha	6.15	2.20	0.14	3.30	2.43	1.02	0.39	0.10	3.94	0.57	4.60	85.59
20tGM_3/ha	6.3	2.32	0.18	3.49	2.77	1.03	0.45	0.10	4.34	0.59	4.98	87.05
Control	4.6	1.25	0.09	2.00	0.54	0.36	0.21	0.05	1.17	0.37	1.71	68.36
$LSD_{0.05}$	0.43	0.22	0.02	0.15	0.41	0.08	0.09	0.03	0.43	0.09	0.24	2.33
CV%	3.5	6.0	19.0	6.1	6.5	4.2	6.5	11.6	6.0	20.5	5.9	1.3

4.1 EFFECT OF ORGANIC AND INORGANIC AMENDMENTS ON SOIL CHEMICAL PROPERTIES

Table 1 shows nutrient contents of chicken manure and grasscutter manure used in the studies. Chicken manure gave higher values of the total nitrogen (N), phosphorus (P), calcium (Ca) and magnessium (Mg), than the grasscutter manure which gave higher value of total potassium (K). The pH of the chicken manure and grasscutter manure were above neutral. From Table 2, it can be seen clearly that the soil is very acidic for the top soil (0-15cm). Organic matter content and nitrogen

levels were lower under general situations. The levels of cations in the background/initial soil recorded lower values compared with the amendments. The cations recorded low values (Ca, Mg, K and Na) which affected the total exchangeable bases (TEB) and the effective cation exchange capacity (ECEC) which indicates low base saturation of 68.36%.

Amended soils recorded increases in pH (Table 3). The manured treated plots recorded higher levels of organic carbon, percentage total nitrogen, and organic matter than the NPK alone. All the amended plots showed increase in all the nutrient levels after manure decomposition and were significantly different from the control (Table 3). The exchangeable cations, total exchangeable bases and effective cation exchange capacity in the amended soil were also significantly higher than the control. All the amended plots had higher levels of base saturation than the control.

These increases were observed due to the high organic matter and organic carbon contents observed. According to Grichs [29] and Agbede [30] organic manure act as a storehouse for plant nutrients and is a major contributor of cation exchange capacity which contribute to the desired soil chemical properties providing a better condition for growth and development of crops. The study revealed that, the organic manure applied in the soil affected the chemical conditions which improved considerably as compared to the control. Again, the study is in line with the observation made by [13] and [30] that, addition of organic manure such as chicken manure and grasscutter manure as amendment improves soil organic matter, Organic C, N, K, Ca and Mg content.

The inorganic fertilizer also had much improvements in the macro nutrients levels compared to the control. The increases influenced the growth and yield of carrot. These increases could be due the availability of nitrogen, phosphorus and potassium made available to the soil at a faster rate and needed by plants in large quantities for growth and yield. Mallareddy [31] reported that a recommended dose of NPK fertilizer alone can perform better than a control.

Addition of organic manure has been found to have increased soil microbial activity and pH [32]. The use of both grasscutter and chicken manure were found to have increased the soil pH from 4.6 to between 6.2-6.35 of the organic manure (Table 3). The increase in soil pH could be due to the increase in organic matter content and onward increasing levels of basic cations released into the soil solution during microbial decarboxylation of the manure which causes the increase in soil pH. These finding is in line with [30] on tillage and fertilizer effects on soil characteristics.

Interestingly, the NPK fertilizer improved the soil pH, organic carbon, total nitrogen and other soil chemical properties but not to the level of the grasscutter manure and chicken manure (Table 3). It may be partly due to the fast rate with which inorganic fertilizers released nutrients into the soil. The contents of some major nutrients in the soil are slightly dependable on the level of organic matter [33], [34]. Organic matter has greater capacity to retain nutrients in forms that can easily be taken up by plants over a longer period of time. The nutrients found in NPK fertilizer was in mineralized form and they were released at faster rate in soil than organic manure. These assertions have also been reported by [35] and [30].

From the results in Table 3, it could be observed that, grasscutter manure also supplied both macro and micro nutrients like the chicken manure by providing the qualities that chicken manure revealed in the study. The (macro and micro) nutrients results obtained by the grasscutter manure application (Table 3) is in accordance with [36], [37] and [16] that animal manure increases soil pH, NPK, exchangeable cations and percent base saturation.

Table 4: Plant height as affected by organic and inorganic fertilizers in 2010 season weekly (cm)

Treatments	5WAP	6WAP	7WAP	8WAP	9WAP	10WAP	11WAP	12WAP
300kgNPK/ha	11.88	18.40	25.98	37.11	42.93	45.32	46.48	48.80
10tCM/ha	16.54	24.30	33.54	43.96	49.19	50.45	52.01	53.66
10tGM_1/ha	16.23	22.21	31.44	40.54	46.77	48.22	49.91	51.56
15tGM_2/ha	19.35	27.50	35.61	44.63	52.40	54.64	55.73	57.68
20GM_3/ha	19.77	28.42	36.15	46.13	53.19	55.26	56.69	57.50
Control	8.03	12.00	16.66	22.19	28.98	32.16	35.27	40.18
LSD (0.05)	2.30	3.50	4.27	5.81	4.39	4.27	4.59	4.54
CV (%)	10.70	5.30	7.80	8.11	5.33	4.99	5.19	4.96

Table 5: Number of leaves as affected by organic and inorganic fertilizers in 2010 season weekly

Treatments	5WAP	6WAP	7WAP	8WAP	9WAP	10WAP	11WAP	12WAP
300kgNPK/ha	4.33	5.67	7.10	8.53	10.10	10.22	10.63	11.33
10tCM/ha	5.00	7.00	8.23	10.13	11.47	11.67	12.70	13.50
10tGM_1/ha	4.67	6.37	8.10	9.17	10.27	11.43	11.87	12.43
15tGM_2/ha	4.73	7.03	9.80	11.23	12.80	13.17	13.70	14.80
20GM_3/ha	5.60	7.83	10.97	11.97	13.47	14.33	14.60	14.83
Control	3.63	4.77	5.47	5.87	6.90	7.67	8.03	8.30
LSD (0.05)	0.72	1.32	1.75	2.03	2.31	2.16	2.53	2.13
CV (%)	8.73	11.72	11.87	11.97	12.04	10.91	12.25	9.91

4.2 VEGETATIVE GROWTH

4.2.1 PLANT HEIGHT

Differences in plant height was significant (p=0.05) at 5WAP to 8WAP between the organic amendments and the NPK as well as the control however, there were no significant differences between the treatments at 12WAP except the control (Table 4). Plant height tended to increase by the increasing dose of organic manure particularly the 15t and 20t/ha grasscutter manure. This was higher than the heights obtained from the chicken manure, the NPK and the control (Table 4) but there were no significant differences between them (15t and 20t/ha), chicken manure and the NPK from 9WAP to 12WAP. Throughout the growing period, all the amended plots were significantly higher than the control. This observation could be due to the higher amounts of nitrogen released from organic matter produced by the increasing amounts of grasscutter manure as asserted by [19] and [18] that increasing levels of manure increases vegetative growth especially plant height due to the corresponding increase in nitrogen from organic matter. The nitrogen released from the NPK also accounted for higher plant height than the control.

4.2.2 NUMBER OF LEAVES

Similar observations were made as reported in the plant height for number of leaves which showed significant difference with increased organic manure dose (Table 5). The amendments were significantly (p=0.05) higher than the control at 8WAP to 12WAP. The highest numbers of leaves were obtained by 15t/haGM_2 and 20t/haGM_3 with the 300kg/ha NPK recording the lowest among the amended plots for all the data from 5WAP to 12WAP. These increases could be due to the higher amounts of organic matter produced and the nutrients released into the soil for absorption due to the large amounts of manure applied to the plots as stated by [38].

4.2.3 CHLOROPHYLL CONTENT

Generally, the leaf chlorophyll content of the carrot was significantly higher in the amended treatments than the control (Table 6). Among the amendments, grasscutter manure of 15 and 20t/ha at 9WAP were higher than the rest of the sole amendments. The results obtained could be due to the improvement in soil condition such as porosity, infiltration rate, root penetrability, and the presence of other growth factors such as hormones. Apart from these soil conditions, chlorophyll formation is also aided by K, Mg, Ca, Zn and Fe as stated by [39], [40] and [14]. Therefore the organic manure was capable of releasing both macro and micro nutrients which played a vital role in increasing these nutrients for chlorophyll formation as revealed by this study.

Table 6: Chlorophyll content of carrot leaves as affected by organic and inorganic amendment (Ug/g)

Treatments	6WAP	9WAP	12WAP
300kgNPK/ha	198.41	317.31	285.72
10tCM/ha	222.55	366.14	297.87
$10tGM_1$/ha	227.36	340.59	290.22
$15tGM_2$/ha	238.38	394.84	316.44
$20tGM_3$/ha	230.12	396.60	324.00
Control	133.98	231.81	264.72
LSD (P < 0.05)	52.35	57.55	49.72
CV (%)	13.84	9.46	9.60

Table 7: Nutrient composition of carrot root (%)

Treatments	Ca	K	Mg	N	P	S
300kgNPK/ha	1.45	1.21	0.62	1.67	0.58	0.11
10tCM//ha	2.14	1.62	0.33	2.18	0.98	0.06
$10tGM_1$/ha	1.13	2.25	0.90	2.03	0.75	0.03
$15tGM_2$/ha	0.65	2.66	0.93	2.03	0.85	0.04
$20tGM_3$/ha	0.59	2.48	1.07	2.39	0.88	0.03
Control	0.38	1.14	0.16	1.12	0.38	0.01
LSD (p<0.05)	0.03	0.03	0.02	0.03	0.03	0.01
CV (%)	0.40	0.10	0.60	0.20	1.00	5.20

4.3 EFFECT OF ORGANIC AND INORGANIC FERTILIZERS ON NUTRIENT CONTENTS OF CARROT ROOT

Generally the nutrient levels of the carrot roots from the amended soils were higher than those from the control (Table 7). Carrot roots from the grasscutter treatment of 15 and 20t/ha had the

highest nutrient values for Ca, Mg, P and N, with value from the 10t/ha CM and GM as well as 300kgNPK/ha following in that order of the carrot root nutrient levels as found in Table 7. Generally, the 20t/ha GM gave higher values for Mg and P except and N while the 15t/ha GM gave highest values of Ca and K.

The increase in nutrient composition of carrot root might be due to organic materials present in soil amendments which raised the level of nutrients in the soil which gave a corresponding increase in the nutrient level of plants growing on them [41]. The soil nutrient levels of nitrogen, potassium, phosphorus, sulphur, calcium and magnesium in the amended soils were higher than the control due to the corresponding increase of the nutrients levels in the amendment used for the study (Table 7). The present study is in line with the study by [19] on the relative increase of soil nutrients in amendments with corresponding increase in carrot roots and leaves. Again, similar observation has been made by [42] in sweet potato root.

Table 8 : Effects of organic and inorganic manures on yield and yield parameters

Treatments	Yield t/ha	Root length (cm)	Root diameter (cm)	Forked root kg/ha
300kg/ha NPK (15:15:15)	9.78	15.25	3.60	0.67
10tCM/ha	10.96	15.54	3.73	1.00
10tGM/ha	12.15	15.81	3.47	0.67
15tGM/ha	15.26	16.10	3.77	0.67
20tGM/ha	15.70	17.60	4.43	0.69
Control	3.85	12.40	2.43	1.33
$LSD_{0.05}$	2.79	0.94	0.12	1.74
CV %	13.61	3.48	1.88	1.28

4.4 EFFECT OF ORGANIC AND INORGANIC AMENDMENTS ON CARROT ROOT YIELD CHARACTERISTICS

The grasscutter manure of 15tGM_2/ha and 20t/haGM_3 gave 15.26t/ha and 15.70t/ha respectively of carrot yield which were significantly higher than the yields from the rest of the amendments and the control. These yields were higher than 4.8t/ha value reported by [43] but were lower than the 30t/ha reported by [1] even though different quantities of manure were applied. The chicken and grasscutter manure applied probably improved plant growth and increased root size since the organic manure could have a positive influence in soil physical properties. Asiedu *et al*.[44] also reported increased yield of carrot with the application of chicken and sheep manure.

Root length and root diameter of the manure treatment plots were significantly different from the control treatments (Table 8). The higher root length and root diameter recorded by the amendments might be due to the higher amounts of organic matter content and the improvement in soil physical attributes which made the soil loose for smooth root penetration and enlargement.

The yield and other yield characteristics of the carrot improved relatively with the increasing levels of the amendments which followed the pattern of the changes in the nutrient levels in the soil after treatment application. This assertion supports the earlier study by [19] that yield and yield characteristics of carrot improve in relation with rising levels of nutrient amendments and tend to be affected by increasing soil nutrients.

The forked root weight of carrot was high in the control and perhaps might be due to acid nature of the soil. Sinnadurai [45] stated that rich soils produce smooth roots with a suitable pH between 5.8 and 7.0. The addition of chicken and grasscutter manure released ammonium which raised the pH (Table 8) by reducing the acidity [46] and again increased the exchangeable Ca and Mg and improved P uptake thereby reducing Al and Mn levels as asserted by [47].

5 CONCLUSION

The study showed that the application of grasscutter manure and poultry manure improved the chemical properties of the soil as well as the yield parameters of carrot than the control. The grasscutter manure of 15 and 20t/ha gave better results for almost all the parameters in the study. From the results, it could be said that grasscutter manure can serve as an alternative source of manure for nutrients for carrot production and application rate of 15-20t/ha is recommended for optimum results.

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Potential and Viability Analysis for Ginger Cultivation using Fertigation Technology in Malaysia

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ABSTRACT: Ginger, or *Zingiber officinale Roscoe* in Latin, is a plant with high medicinal and commercial values. Most of high quality gingers are conventionally grown in mountain slopes such as in Janda Baik and Bukit Tinggi, Bentong, Pahang. Second phase planting on the same land can only be done after the land has been left (without any commercial crop) for at least 6 years. Thus, nomadic cultivation is still practised due to the soil-borne diseases such as bacterial wilt and fusarium wilt that attack ginger rhizomes, which results in yield decline. This study was conducted to evaluate the costs and benefits of ginger cultivation using fertigation with conventional methods for the production of mature and young ginger. Data were obtained from pilot project plot under MARDI and Department of Agriculture. Cost-benefit analysis showed that the costs of production for mature and young ginger using fertigation system were RM0.90/kg and RM1.41/kg, respectively, compared to RM1.36/kg and RM1.24/kg using conventional method, respectively. Annual net income for mature (RM174,680/ ha) and young (RM32,500/ ha) ginger production using fertigation system was higher than the conventional method (mature ginger: RM49,200 and young ginger: RM21,100). The higher net income was due to the high yield of ginger, two to threefold per hectare than the conventional method. Partial budget analysis also showed a higher benefit value than implication value in the event of farmers switching from using conventional methods to ginger cultivation using fertigation system. Overall, ginger cultivation using fertigation technology is proven to improve ginger yield and has a high viability. The high cost or initial capital will be offset by high production yield. This technology is also more environmentally friendly than the conventional methods and in accordance with the practice of sustainable agriculture development, besides conforms to present agriculture agenda.

KEYWORDS: Cost of Production, Ginger Cultivation using Fertigation Technology, Viability, Ginger, Fertigation system.

1 INTRODUCTION

Ginger, or *Zingiber officinale Roscoe* in Latin, is a plant with high medicinal and commercial values [1]. This plant produces greenish yellow flowers like orchids, which make ginger also good as an ornamental plant [2]. High quality gingers are usually grown in the highland areas at 1200–1500 meters above sea level [3]. In Malaysia, gingers are commercially grown in Bentong (Pahang), Keningau and Tambunan (Sabah), and Bakun (Sarawak). The main varieties preferred by the entrepreneurs are Bentong, Bara, Chinese, and Indonesian gingers. Malaysian ginger demands for domestic and international markets are very high especially for Bentong ginger. Bentong ginger has a better quality compared to gingers from Indonesia, Thailand, China (Hong Kong), Taiwan, and the United States of America. Therefore, Bentong gingers have high demands in Hong Kong and Britain's markets.

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Most of high quality gingers are conventionally grown in mountain slopes such as in Janda Baik and Bukit Tinggi, Bentong, Pahang. Nomadic cultivation is still practised. Second phase planting on the same land can only be done after the land has been left (without any commercial crop) for at least 6 years. The shrinking of the cultivation area is causing low production thereby limiting the amount of export capacity. The low production is due to the lack of suitable land for cultivating high-quality ginger. The soil-borne diseases that easily attack ginger crops are also causing the lack of interest among farmers to cultivate gingers [4]. The fertigation method using coco peat in black plastic bags is an alternative technique in ginger cultivation to overcome the problems in ginger cultivation.

The role of agriculture sector in the economic growth of developing countries is important [5], [6], [7]. The use of technology is crucial in increasing tha yield and income of farmers. Thus, the adoption and utilization of new technology is critical in agricultural growth. Fertigation technology is proved to be effective and efficient in the cultivation of leaf vegetables and fruits. The production yields of chillies, rockmelons, cucumbers, eggplants, and tomatoes have increased by three to fivefold per unit area compared to the conventional cultivation method [8], [9]. Ginger cultivation in lowland areas using fertigation method is also capable of increasing the average yield of ginger rhizomes (5.4 kg per clump) up to two or threefold compared to the conventional method (900 gm/clump). The use of fertigation system could also enable gingers to be cultivated in the same area repeatedly for years [10].

2 METHODOLOGY

This study focuses on the comparison in terms of benefits, costs, and revenues between conventional ginger cultivation and fertigation system methods. The evaluation of ginger cultivation using fertigation technology will also be done to observe the viability of this technology and the potential and appropriateness of this technology to be adopted by agricultural entrepreneurs and farmers to increase their production of ginger. Secondary data collection for ginger production using fertigation technique was done in three project areas namely (1) Fertigation Crops Complex at MARDI Kluang Station, Johor, (2) Serdang MARDI Station, Selangor, and (3) commercial-scale pilot production project in Kampung Sungai Assap, Bakun, Sarawak. Data collection was done for two years starting from 2009 until 2012. For conventional method, the same data were obtained from the Department of Agriculture. The analyses performed were the cost and revenue analysis, viability analysis, and partial budget analysis. The obtained data were used to prepare cash flow and subsequently financial analysis was done to compare these two cultivation systems.

Cost and revenue analysis was conducted to compare the revenues and costs of production per hectare of ginger production using fertigation system and conventional methods. The purpose of this cost and revenue analysis was to identify variable costs and fixed costs involved in ginger cultivation for both methods as well as estimating the incomes earned by ginger growers based on the secondary data obtained from the MARDI Plot and Department of Agriculture. The parameters involved were gross and net incomes, gross and net margins, production costs per kilogram, and profit margins per kilogram. Variable cost is the value and quantity of inputs that change according to scale of production. Variable costs for both cultivation systems were fertilisers, labours, insecticides, pesticides, and herbicides, while the fixed costs or capital costs included construction of infrastructures such as irrigation systems, farm machineries, farm roads, and farm stores.

Viability analysis is a tool used to assess the viability of a project for a certain period. Normally, viability analysis is used to estimate the feasibility and the time needed by an enterprise to prop up the total amount of investments in the specified period of time [11]. Viability analysis of a project is made by constructing cash flow charts within 10-15 years. In this study, cash flow charts for the last 15 years were prepared. In the cash flow charts, financial analyses such as net present value (NPV), internal rate of return (IRR), capital return period, and sensitivity test were performed.

3 RESULTS AND DISCUSSION

3.1 COST OF PRODUCTION

The cost of production of the project is divided into two, fixed or capital cost and variable cost. Fixed cost is the cost of development that is used as the capital to develop the farm. Among fixed costs involved in the development of farm are infrastructures for irrigation systems, roads, stores, farm machineries, and rain protective structure for ginger cultivation using fertigation system in lowland areas. On the other hand, the variable costs involve expenses that vary according to the scale of production such as the cost of labours, planting materials, fertilisers, pesticides and utilities. Two major infrastructures are required in ginger cultivation using fertigation system, which are fertigation irrigation system and rain protective structure. The development cost of fertigation ginger farm per hectare was RM355,400 of the overall costs, compared to the development cost of the conventional method farm, which was RM56,400 per hectare for the production of

mature gingers and twice the amount for young gingers. The development cost of the conventional method was repeated for every planting season due to the nomadic cultivation system (Table 1).

The development cost for fertigation system was nine times higher than conventional cultivation method for one-hectare area. The input costs, labours, and other costs for the production of young gingers were higher than mature gingers for both cultivation systems because the cultivation of young gingers can be done for two to three seasons per year compared to one year for mature gingers. Ginger cultivation using fertigation system that can be automated will be able to reduce the reliance on manual labours compared to the conventional cultivation method.

Table 1. Comparison of the costs of production of ginger cultivation system using fertigation system and conventional method

Parameter	Average cost for fertigation system				Average cost for conventional method			
	(RM / ha / year)		%		(RM / ha / year)		%	
	Mature ginger	Young ginger	Mature ginger	Young ginger	Mature ginger	Young ginger	Mature ginger	Young ginger
Development cost	355,400	355,400	85	80	56,400	112,800	66	72
Input cost	42,500	58,200	10	13	11,500	22,800	13	14
Labour cost	7,200	15,100	3	4	14,400	16,000	16	10
Other costs	8,900	12,800	2	3	4,100	5,900	5	4
Total	414,000	441,500	100	100	86,400	157,500	100	100

3.2 YIELD AND INCOME

Table 2 shows a comparison of ginger yield per hectare between fertigation system and conventional method for one season of ginger crops. The average yields of mature and young gingers cultivation using fertigation system were 64.8 and 20.4 tons, respectively. The development cost of fertigation system for mature gingers was RM58, 600 and RM28, 700 for young gingers. Meanwhile, the average farm price for mature gingers was RM3.60 and RM3.00 for young ginger. Entrepreneurs who used this fertigation system were able to earn average net incomes of RM174, 680 for mature gingers and RM32, 500 for young gingers. The average yields for the conventional method were 22 tons for mature gingers and 12 tons for young gingers. Data also showed that the cost of production for mature gingers using fertigation system was lower than the conventional method. However, the cost of production per kilogram for young gingers was lower for conventional method than the cost of production per kilogram for fertigation system. By considering the same average farm price, it was found that the average net income for the cultivation of mature and young gingers using fertigation system was higher than the conventional method. The average net income is affected by the level of production and its market price.

Table 2. Comparison of ginger yield per hectare between fertigation system and conventional method for one season of ginger crop

Parameter	Fertigation system		Conventional method	
	Mature ginger	Young ginger	Mature ginger	Young ginger
Average yield (kg/ha)	64,800	20,400	22,000	12000
Average gross income (RM) @ RM3.60/ kg for mature ginger @RM3.00/kg for young ginger	233,280	61,200	79,200	36,000
Production cost (RM/kg)	0.90	1.41	1.36	1.24
Average production cost (RM/ha)	58,600	28,700	30,000	14,900
Average net income (RM/ha)	174,680	32,500	49,200	21,100

3.3 VIABILITY ANALYSIS

A viability analysis was performed to assess the usability of both technologies based on the financial flows (Table 3). Despite the high development cost, mature ginger cultivation using fertigation system had a short-term capital return, which was three years. If the benefit-cost ratios are compared, entrepreneurs who used fertigation technology were able to earn RM0.78 for each RM1.00 invested in the production of mature gingers and RM0.68 for young gingers, which was much more profitable than the conventional method (mature gingers = RM0.17 and young gingers = RM0.16). However, planting system with BCR greater than 1 has greater benefit than liability to make. Results of the viability analysis showed that the use of fertigation technology in ginger production was more viable in long run. Comparison of the viability indicators in the productions of both mature and young gingers showed higher values for indicators of ginger cultivation using fertigation technology than using conventional methods.

Table 3. Viability Analysis of Ginger Production using Fertigation System and Conventional Method

Viability indicators	Fertigation system		Conventional method	
	Mature ginger	Young ginger	Mature ginger	Young ginger
Net present value (NPV) @ 10%	493,420	36,674	3,027	17,728
Internal rate of return (IRR)	34.57	12.31	12.15	19.64
Capital return period (year)	3	6	5	5
Benefit-cost ratio (BCR) @ 10%	1.78	1.68	1.17	1.16

3.4 PARTIAL BUDGET ANALYSIS

Partial budget analysis showed that the benefit value earned was higher than the amount of the implications for mature ginger cultivation (+RM28,580) and young ginger cultivation (+RM41,500) using fertigation system (Table 4). Therefore, it is recommended to shift the conventional method of ginger cultivation to the fertigation technology.

Table 4. Partial budget of ginger cultivation using fertigation technology compared to conventional cultivation method

Changes from conventional method to fertigation system					
	Mature ginger	**Young ginger**		**Mature ginger**	**Young ginger**
Benefits			Implications		
Yield increase	64.8 tons @ 10% = 6.48 tons 6.48 tons * RM3.60/kg * 1000 = RM233,280	61.2 tons @ 10% = 6.12 tons 6.12 tons * RM3.00 * 1000 = RM183,600	*Cost increase*	Rain protective structures (RPS) = RM270,000	Rain protective structures (RPS) = RM270,000
Cost reduction	Average labour cost/year =RM8,900 Average cost of repeated annual land preparation and development due to nomadic cultivation system = RM56,400	Average labour cost/year = RM15,100 Average cost of repeated annual land preparation and development due to nomadic cultivation system = RM112,800			
Total Benefits	RM298,580	RM311, 500	Total Implications	RM270,000	RM270,000
	+RM28,580	+RM41,500			

4 DESCRIPTION OF TECHNOLOGY

Commercial ginger cultivation method is carried out nomadically on highland slopes. This system has become the main reason of illegal invading activities in highland forests. Besides, this nomadic cultivation system has also caused harm to the environment and often caused landslides. The burning of the invaded forests has also become the major cause of environmental pollution. This nomadic cultivation system is applied because gingers cannot be grown continuously in the same area as the area has been infected with soil-borne diseases such as bacterial wilt and fusarium wilt that cause declination of ginger yield up to 80% in the second phase [12]. The former ginger crop area should be left idle for 6 years before the new phase of ginger cultivation can be carried out. Therefore, by using fertigation technology, ginger cultivation can be done in the same area continuously.

Fertigation technology is a cultivation system without soil. In the fertigation system, the crops media such as coco peat, perlite, and burnt paddy husk are used as a replacement of soil. The crops media are filled into polybags according to appropriate sizes. Besides, in this fertigation system, irrigation and fertilisation are done simultaneously and directly to the crops' roots [13]. This fertigation system is able to increase crop yields and reduce the use of fertiliser by supplying fertiliser solution based on each crop's formulation while distributing the solution to the crops based on their growth levels and needs. Fertigation technology is able to save the cost of production as it does not involve the cost of land preparation, weeding, and fertiliser spreading, unlike the conventional method. The technology can be automated using a timer, therefore it can reduce the labour force.

Ginger cultivation using fertigation technology can be used for the production of young and mature gingers. This fertigation technology does not only enable the cultivation of ginger to be carried out in the same area repeatedly, it also increases the yield of ginger by two or threefold compared to the conventional cultivation method. This high yield is used to offset the high development or initial cost. High yield do not depend only on vast area put under cultivation but on yield potentials which may be as a result of use of improved planting system which include planting materials and good management practices [14]. The average yield of mature gingers is up to 5.4 kg for each polybag, which takes about 9 months, while the yield of young gingers is 1.7 kg for a polybag of 4–6 months [15]. This technology also uses a low amount

of ginger seeds than conventional method. Ginger seeds used are 1–2 inches long and weigh around 30 g with 2–3 buds. The percentage survival of the seeds after being transferred to polybags also increases up to 97%. Besides, the cost of embroidery works, which are the main task of the conventional method, is also reduced. However, this ginger cultivation using fertigation technology is less popular among farmers because of its high cost compared to the conventional method. Therefore, farmers are still reluctant to switch from conventional method to fertigation technology. No technology regardless of its ecological and economical soundness will have any impact on productivity and income unless it is adopted by significant proportion of farmers [16]. Furthermore, adoption of technical innovation by farmers also demands precise and detailed information on cost and return [17].

In addition, this ginger cultivation using fertigation technology can also be used for seed production of ginger. Ginger seeds produced using fertigation system are not contaminated with bacteria and fungi. Ginger seeds free from bacteria and fungi are difficult to find in the market. The price of ginger seeds especially Bentong gingers can reach up to RM12 and this price provides a lucrative business opportunity for entrepreneurs. Hence, a new business opportunity is created by them.

The cultivation of high-quality gingers such as Bentong ginger can provide a quick return. Bentong ginger definitely has high demands from countries like Dubai, China, Korea, and Hong Kong. Bentong ginger export value in 2012 was RM65.4 million and all of them were grown in Bukit Tinggi, Bentong [18]. Therefore, the use of fertigation technology can ensure continuous production of Bentong ginger for export purposes. In fact, Bentong ginger can be grown in lowland areas with high yield and similar quality to the Bentong ginger grown in highland areas [15]. This opportunity could provide a lucrative return to the capital that has been issued because of extremely high export price for Bentong ginger.

5 CONCLUSION

In short, ginger cultivation using fertigation method has been proven to increase the yield and income of farmers and entrepreneurs compared to conventional method. The high cost or initial capital will be offset by higher production. Significant increase in yield of up to two or threefold than the conventional method is able to provide high net income for entrepreneurs. However, the high initial investment for the construction of rain protective structures has impeded the use of this technology among farmers. Nevertheless, the viability analysis showed that this technology has a strong competitive edge and is suitable to be adopted by farmers as it can provide higher return than conventional method. If it is viewed from environmental sustainability perspective, this technology is more environmentally friendly than the conventional method and it is in accordance with the agenda of current agricultural practices namely sustainable agricultural development practices.

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Caractéristiques biochimique et sensorielle du niébé (*Vigna unguiculata*) conservé au moyen des huiles essentielles extraites de plantes de la famille des Myrtaceae

[Biochemical and sensorial Characteristics of cowpea (*Vigna unguiculata*) stored with essentials oils extracted from plants of Myrtaceae family]

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ABSTRACT: Cowpea storage showed a big problems in post-haverst systems and the synthetics antimicrobials using are dangerous for the population. The object of this study has been to develop effective method of cowpea preservation by essentials oils. In this context, the essays of cowpea preservation with essentials oils extracted from *Pimenta racemosa* and *Syzygium aromaticum* were investigated. The biochemical and sensory characteristics of seeds after preservation by the products were then estimated. The results of the microbiological analyses revealed that a significant reduction (p > 5 %) of the fungal flora in the samples of cowpea seeds preserved with essential oil, compared with untreated samples. The nutritional analyses indicated that both varieties of cowpea studied are rich in proteins and in minerals. The seeds of cowpea preserved by essentials oils improve its organoleptic characteristics with an incidence on the taste and the aroma of products.

KEYWORDS: Cowpea, essentials oils, biochemical, sensory characteristics, Benin.

RESUME: La conservation du niébé demeure encore un problème récurrent dans les systèmes post-récolte. Ainsi, face aux nuisances associées à l'utilisation des antimicrobiens de synthèse chimique, la présente étude vise à développer une méthode efficace de conservation du niébé au moyen d'huiles essentielles. Dans ce cadre, des essais de conservation du niébé avec les huiles essentielles de *Pimenta racemosa et Syzygium aromaticum* ont été effectués. Les caractéristiques biochimique et sensorielle des graines conservées et des produits dérivés ont été ensuite évaluées. Les résultats des analyses microbiologiques ont révélé une réduction significative (p>5%) de la flore fongique dans les échantillons de niébé conservés avec les huiles essentielles, comparativement aux échantillons témoins. Les analyses nutritionnelles ont indiqué que les deux variétés de niébé étudiées sont riches en protéines et en matières minérales. La conservation du niébé au

moyen d'huiles essentielles améliore aussi ses caractéristiques organoleptiques avec une incidence sur le goût et l'arôme des produits dérivés.

MOTS-CLES: niébé, huiles essentielles, caractéristiques biochimiques et sensorielles, Bénin.

1 INTRODUCTION

En raison de son efficacité et de son application facile et pratique, l'utilisation des produits chimiques constitue à l'heure actuelle la technique la plus utilisée pour lutter contre les moisissures nuisibles, les insectes, les ravageurs des légumineuses en post récolte [1]. L'emploi intensif et inconsidéré de ces produits a provoqué une contamination de la biosphère et de la chaine alimentaire, une éradication des espèces non cibles telles que la faune auxiliaire et l'apparition des microorganismes résistants. Ces dangers ont conduit l'OMS à interdire l'usage de certains insecticides et fongicides chimiques [2]. La rechercher des nouvelles molécules, prenant en compte d'autres critères que l'efficacité uniquement, est devenue un souci majeur du temps actuel. Depuis quelques années, l'utilisation des substances naturelles connait un regain d'intérêt. Parmi celle-ci, se trouvent les huiles essentielles, qui sont des extraits volatils à pouvoirs antimicrobien, insecticide, antiparasitaire très intéressants [3, 4]. Ainsi, leur utilisation comme bio-conservateurs constitue une alternative crédible, parce que garant de la préservation de la santé des consommateurs [5]. Selon Cseke et Kaufman [6], les huiles essentielles sont par définition des métabolites secondaires produits par les plantes comme moyens de défense contre les ravageurs phytophages. D'autres études ont montré que les huiles essentielles ont une activité insecticide indéniable vis-à-vis de *Callosobruchus maculatus* F. [7, 8]. Ces huiles essentielles agissent par diffusion, ce qui leur permet d'atteindre toutes les interstices dans la masse de graines stockées. Le niébé *Vigna unguiculata* (L), Walp. est l'une des principales légumineuses d'importance dans le monde [9, 10]. Il est susceptible de combler les nombreux déficits protéiques enregistrés dans les pays en développement [11]. La production annuelle mondiale varie entre 3,1 et 3,3 millions de tonnes de graines sèches [10] dont plus de 64% sont produits en Afrique. La valeur réelle des déperditions notées lors du stockage est depuis fort longtemps sujette à polémique. Selon Coulibaly et Lowenber-Deboer [12], l'Afrique Occidentale est actuellement loin de couvrir ses besoins en niébé par sa propre production. Malgré les initiatives prises de part et d'autre pour accroître la production, le contexte d'insécurité alimentaire est toujours marqué par des pertes post-récoltes non négligeables. La faiblesse du rendement est due au complexe parasitaire associé à cette culture [13]. Ainsi, au cours du stockage, les graines sont exposées aux insectes qui causent des dégâts considérables et des pertes de post-production variant de 50 à 90% [14]. Un autre aspect inhérent à l'établissement des insectes est la colonisation des stocks par des champignons [15, 16, 17, 18]. Il s'avère important face à ces problèmes, de rechercher d'autres méthodes de lutte respectueuses de l'environnement et qui garantissent la santé des consommateurs. Ainsi, la présente étude vise à évaluer les caractéristiques biochimiques et les propriétés organoleptiques des graines de niébés conservées au moyen des huiles essentielles de *Pimenta racemosa* et de *Syzygium aromaticum.*

2 MATERIEL ET METHODES

2.1 COLLECTE DU MATÉRIEL VÉGÉTAL

Le matériel végétal utilisé dans cette étude est constitué des feuilles fraîches de *Pimenta racemosa* récoltées à Adjarra (Sud-Bénin), de bourgeons floraux de *Syzygium aromaticum* à Kraké (Sud Bénin) et des graines de niébé appartenant à deux variétés locales (Dannoukoun et Kpayo). Les feuilles fraîches collectées ont été ensuite identifiées à l'herbier national puis envoyées au laboratoire pour l'extraction des huiles essentielles.

2.2 EXTRACTION DES HUILES ESSENTIELLES

Les huiles essentielles ont été extraites par hydrodistillation grâce à un appareil de type Clevenger. L'huile essentielle séparée de la phase aqueuse est été séchée sur le sulfate de sodium (Na_2SO_4) et conservé à 5°C à l'obscurité. Apres extraction, les huiles essentielles sont recueillies dans un flacon sombre et ont été conservées à 4°C pour les utilisations ultérieures. Les rendements en huiles essentielles ont été calculés selon la formule : **$R = (MHE/ MS) \times 100$ (R :** rendement d'extraction en % ; **MHE :** masse d'huile essentielle obtenue en g ; **Ms :** masse de matière végétale utilisée pour l'extraction et exprimée en g).

2.3 COMPOSITION CHIMIQUE DES HUILES ESSENTIELLES

Les huiles essentielles ont été analysées par chromatographie en phase gazeuse couplée à une Spectromètre de Masse. Le chromatographe en phase gazeuse VARIAN CP.3380 est équipé de deux colonnes capillaires (apolaire et polaire) et relié à un intégrateur Varian (Model C-R4A°). Le couplage CPG/SM a été réalisé sur un appareil de type Hewlett Packard-Quadruple (Model 5970). Le gaz vecteur (l'hélium) était réglé à un débit de 0,6mL/min. Les calculs d'indices de rétention ont été réalisés par comparaison des temps de rétention des constituants avec ceux d'un mélange d'alcanes (C_9-C_{20} pour DB-1 et C_9-C_{26} pour CWX 20M) obtenues dans les mêmes conditions expérimentales [19].

2.4 DISPOSITIF EXPERIMENTAL DE CONSERVATION DES GRAINES DE NIEBE AVEC LES HUILES ESSENTIELLES

Ces essais ont été réalisés en utilisant une méthode de conservation par ensachage avec introduction de disques de papier buvard imprégnés d'huiles essentielles. En tenant compte des propriétés antifongiques avérées des huiles essentielles abondamment rapportées dans la littérature, les sacs ainsi traités sont remplis à raison de 0,625 µL par gramme d'huile essentielle. Des échantillons témoins (sans adjonction d'huiles essentielles) sont également réalisés. Des inspections périodiques sont effectuées afin de suivre l'évolution de la qualité du niébé au cours du stockage.

2.5 EVALUATION DE LA MYCOFLORE DES ECHANTILLONS

Afin d'évaluer l'efficacité du processus de conservation, la mycoflore des échantillons conservés au moyen d'huiles essentielles et celle des échantillons témoins a été déterminée après 3 mois de conservation. La technique de l'ensemencement direct (*Direct Plating)* décrit par Pitt et *al*. [20] a été utilisée. C'est l'une des méthodes appropriées pour détecter, évaluer le taux de contamination des échantillons et isoler des mycètes des denrées alimentaires [21]. Par échantillon, cinquante (50) graines de niébé ont été prélevées puis désinfectées en surface grâce à une solution chlorée (0,4%) pendant 1min à température ambiante. Elles sont ensuite placées sur le milieu de culture PDA (Patato Dextrose Agar) préalablement coulé dans des boîtes de pétrie de 90 mm de diamètre. Les boîtes de pétri ainsi ensemencées sont ensuite incubées à 25°C pendant 5 jours. Cette méthode permet d'isoler la flore fongique se trouvant à l'intérieur des graines. Le taux de contamination (T_C) par échantillon a été calculé selon la formule : $\mathbf{T_C = (N_I / N_T) \times 100}$, avec $\mathbf{N_I}$ désignant le nombre de graines présentant un développement de moisissures et $\mathbf{N_T}$ le nombre total de graines ensemencées.

2.6 ETUDE DES CARACTERISTIQUES PHYSICO-CHIMIQUES ET NUTRITIONNELLES

Les caractéristiques physico-chimiques et nutritionnelles évaluées sont essentiellement la teneur en eau des graines [22], l'acidité titrable [23], la teneur en protéines selon la méthode Kjeldahl [24] et la matière minérale totale selon la méthode AOAC [23].

2.7 ANALYSE SENSORIELLE (TEST HÉDONIQUE) [25]

L'analyse sensorielle a pour but d'analyser et d'interpréter les caractéristiques organoleptiques d'un produit telles qu'elles sont perçues par les organes de sens [26]. Dans le cadre de cette étude, les analyses effectuées ont pour but d'étudier l'effet des HE sur la couleur, l'odeur, la texture et le goût des produits dérivés. Ainsi, après une durée de trois mois de conservation, les graines de niébé ont fait l'objet de transformations technologiques afin d'apprécier l'effet de la conservation au moyen d'huiles essentielles sur ses caractéristiques sensorielles. A cet effet, et en tenant compte des habitudes culinaires des populations de la localité, les graines conservées ont été réparties en trois lots. Le premier lot à été bouilli, le second lot à été transformé en purée de niébé et le troisième lot en beignets de niébé. Les produits ainsi obtenus ont fait l'objet de test hédonique auquel ont participé 40 dégustateurs de sexes, âges et milieux différents. A la fin de ce test, les notations numériques allant de 1 à 9 (où 1 correspond à «extrêmement mauvais» et 9 à «extrêmement bon», sont présentées sous formes de tableaux et analysées au moyen du test de l'analyse de la variance.

2.8 ANALYSES STATISTIQUES

Les analyses et les extractions ont été faites en triplicata. Les résultats ont été analysés par la méthode de variance (ANOVA) à l'aide du logiciel STATISTICA (Stat, Soft ; Inc, 1995). La comparaison des moyennes est effectuée par le test de la plus petite différence significative LSD (Least Significant Difference). Cette méthode d'analyse consiste à chercher les moyennes qui diffèrent significativement les unes des autres. Les différences sont significatives lorsque $P<0,05$.

3 RESULTATS

Le tableau 1 présente les rendements d'extraction en huiles essentielles des plantes étudiées. De l'analyse de ces résultats, il ressort que les rendements d'extraction varient en fonction du type de matériel végétal. Le rendement le plus élevé (17,80%) est obtenu avec les bourgeons floraux de *Syzygium aromaticum.* Par contre, les feuilles de *Pimenta racemosa* ont un rendement en huile essentielle relativement plus faible (3,87%).

La composition chimique de ces huiles essentielles varient également en fonction du l'espèce végétale (Tableaux 2 et 3). L'huile essentielle de *Syzygium aromaticum* est dominée par des structures de type *p*-menthane et est caractérisée par un pourcentage relativement élevé en eugénol (60,1%) suivi de trans-β-caryophyllène (24,0%) et 10% d'acétate d'eugénol. Au total 19 composés représentant 99 ,4% parmi lesquels 60,4% de monoterpènes oxygénés, 0,2% de monoterpènes hydrogénés 38,1% de sesquiterpènes hydrogénés et 0,7% de sesquiterpènes oxygénés ont été identifiés (Tableau 2). Les principaux constituants chimiques présents dans l'huile essentielle de *Pimenta racemosa* analysée sont : l'eugénol (51,1%), le myrcène (25,1%), le chavicol (7,5%), le limonène (3,0%), et le 1,8-cinéole (2,7%). Cet échantillon contient en forte proportion de composés aromatiques (56,6%) suivis de monoterpènes hydrocarbonés (29,9%) (Tableau 3).

Les résultats des analyses microbiologiques effectuées sur les échantillons de niébé (Tableau 4), indiquent une diminution significative de la flore fongique dans les échantillons après trois mois de conservation en présence d'huiles essentielles. Par contre, dans les échantillons témoins, on remarque que le taux de contamination est très élevé (87,32 - 92,5%).

Les résultats de l'évaluation des caractéristiques physico-chimiques des échantillons de niébé conservés (Tableau 5) indiquent que la teneur en eau des échantillons varie très peu ($p<0,05$) et est comprise entre 12,033 et 12,079%. Quant à l'acidité des échantillons conservés, les résultats obtenus montrent qu'il y a une légère augmentation de l'acidité au niveau des échantillons de niébé conservés avec l'huile essentielle de *Pimenta racemosa*, contrairement aux échantillons témoins et ceux conservés avec l'huile essentielle de *Syzygium aromaticum.*

Au niveau de la teneur en protéine, on remarque qu'il n'y a pas de différence significative ($p<0,05$) entre les échantillons de niébé conservés au moyen d'huiles essentielles et les échantillons témoins au niveau de la même variété locale. Par contre, en comparant les valeurs obtenues au niveau des deux variétés utilisées, on remarque que la variété locale *Dannoukoun* a une teneur en protéine plus élevée (22,88 ±0,03%) que celle de la variété locale *Kpayo* (21,40±0,01%).

Les résultats obtenus au niveau de la teneur en cendre indiquent que la variété locale *Kpayo* a une teneur en cendre (4,564 ± 0,427%) plus élevée que celle de la variété locale *Dannoukoun* (4,177 ± 0,033%). Cependant, les résultats indiquent qu'il n'y a pas de différence significative entre les échantillons conservés au moyen d'huiles essentielles et les échantillons témoins ($p<0,05$).

Les résultats des tests sensoriels (Figure 1) indiquent d'une part que tous les produits testés, notamment les graines de niébé bouillies, la purée de niébé et les beignets de niébé obtenus à partir des échantillons de niébé conservés au moyen d'huiles essentielles, ont obtenu des scores supérieurs à 5 sur l'échelle d'intensité, en ce qui concerne les paramètres sensoriels évalués. Cependant, au niveau de l'arôme des différents produits, on remarque des différences significatives entre les scores obtenus, ce qui indique que la conservation du niébé au moyen d'huiles essentielles à d'effet sur l'arôme des produits dérivés. Toutefois, les scores obtenus au niveau des échantillons conservés au moyen d'huiles essentielles sont nettement supérieurs à ceux obtenus au niveau des échantillons témoins. Ces résultats montrent que l'arôme des échantillons conservés au moyen d'huile à été plus apprécié que celui des échantillons témoins.

4 DISCUSSION

Les deux plantes investiguées dans la présente étude, appartiennent à la famille botanique comme l'indique le tableau 1, mais ont des rendements d'extraction en huile essentielle différentes. Ces résultats indiquent donc que les rendements d'extraction de métabolites secondaires des plantes dépendent aussi d'autres paramètres tels que la période de collecte, le stade de développement de la plante, la nature du sol [27]. Le rendement le plus élevé est obtenu avec *Syzygium aromaticum* (17,80%). Selon British Pharmacopée [28], les rendements en huile essentielle de *S. aromaticum* se trouvent dans la fourchette de 15 et 18 %. Ce rendement est supérieur à ceux obtenus par [29] et [30]. Quant à *Pimenta racemosa* le rendement d'extraction (3,87%) est supérieur à celui obtenu par Yèhouénou [29].

Tableau1 : Rendements d'extraction des plantes étudiées

Matériel végétal	Famille botanique	Partie utilisée	Rendements (%)
Syzygium aromaticum L.	Myrtaceae	Bourgeon florale	17,80±0,06[a]
Pimenta racemosa (Mill.) J. W. Moore	Myrtaceae	Feuille	3,87±0,02[b]

Les valeurs sont des moyennes (n= 3) ± SD. Les valeurs portant la même lettre dans la même colonne ne sont pas significativement différentes (p < 0,05)

Ces deux huiles essentielles ont une composition caractérisée par la présence de de monoterpènes oxygénés avec une forte proportion d'eugenol (60,1% pour l'huile essentielle de *Syzygium aromaticum* et 51,1% pour *Pimenta racemosa*). En tenant compte de la composition chimique de ces huiles essentielles on pourrait donc prévoir une activité antimicrobienne, compte tenu aussi de leur proportion élevée en alcool monoterpénique et en composés aromatiques oxygénés [31].

Tableau 2 : Composition chimique de l'huile essentielle de Syzygium aromaticum

Nom des composés	KI	%
furfural	831	0,2
Eugenol	1370	**60,4**
trans-β-caryophyllène	1423	**24,0**
β-Duprezianene	1438	0,1
α-Guaiene	1442	0,1
(Z)-β-Farnesene	1451	0,1
α-imachalene	1463	0,1
α-umulene	1473	0,1
γ-uurolene	1494	1,4
germacrene D	1514	0,1
eugenol acetate	1517	**10,0**
β-Sesquiphellandrene	1537	1,7
δ-cadinene	1560	0,2
10-epi-α-Cubebol	1569	0,1
Isolongifolanone	1616	0,1
davanol D_2 (isomere 2)	1639	0,2
davanol acetate	1697	0,1
Heptadecane	1708	0,1
Cedroxyde	1724	0,1
Monoterpènes hydrogénés		**0,2**
Monoterpènes oxygénés		**60,4**
Sesquiterpènes hydrogènés		**38,1**
Sesquiterpènes oxygénés		**0,7**
Total		**99,4**

Les résultats de la caractérisation physico-chimique des échantillons de niébé indiquent d'une part que les deux variétés locales utilisées, sont riches en protéines (21,40±0,01 - 22,88 ±0,03%) et en matières minérales (4,177 ± 0,033 - 4,564 ± 0,427%). Cependant la variété locale *Dannoukoun* à une teneur en protéine supérieure à celle de la variété locale *Kayo*. Par contre, la teneur en matière minérale de la variété *Dannoukoun* est plus faible que celle de la variété *Kpayo.* Selon Alzouma [32] le taux de protéine des légumineuses, notamment le niébé est compris entre 20 et 25%, avec quelques variations de teneurs qui pourraient être liées à la nature des sols, aux variétés cultivées et les types de traitements de culture (utilisation d'engrais). Cependant, les résultats obtenus au niveau de la teneur en eau des deux variétés locales investiguées, montrent qu'une attention particulière doit être accordée à ce paramètre afin d'éviter la prolifération de la flore fongique, notamment la flore toxinogène.

Tableau 3: Composition chimique de l'huile essentielle de feuilles de Pimenta racemosa

Noms des composés	KI	(%)
α-pinène	940	0,4
octèn-3-ol	974	2,4
β-pinène	982	0,1
Myrcène	**993**	**25,1**
α-terpinène	1018	0,1
p-cymène	1022	0,7
Limonène	**1034**	**3,0***
1,8-cinéole	**1041**	**2,7***
(E)-β-ocimène	1043	0,2
γ-terpinène	1058	0,1
Terpinolène	1089	0,2
Linalol	1092	0,6
terpinène-4-ol	1178	0,8
α-terpinéol	1188	0,7
Chavicol	**1250**	**7,5**
Eugénol	**1368**	**51,1**
β-caryophyllène	1440	0,1
α-humulène	1489	0,1
(E,E)-α-farnesène	1502	0,2
δ-cadinène	1533	0,1
Torréyol	1638	0,1
T-cadinol	1665	0,1
Diterpène (M+=272)	1941	0,6
Diterpène (M+=272)	1981	0,2
Monoterpènes hydrocarbonés		**29,9**
Monoterpènes oxygénés		**4,8**
Sesquiterpènes hydrocarbonés		**0,5**
Sesquiterpènes oxygénés		**0,2**
Dérivés aliphatiques		**2,4**
Composés aromatiques		**56,6**
Total		**96,4**

Tableau 4 : Caractéristiques physico-chimiques des échantillons de niébé conservés au moyen d'huiles essentielles

Graines de niébé/Variétés locales	Type d'extraits végétaux	Teneurs en eau (%)	Acidité (g/L)	Teneur en protéines (%)	Teneur en cendre (%)
Dannoukoun	*Pimenta racemosa*	12,069[a]	0,83±0,10[b]	22,81±0,03[a]	4,194±0,100[a]
	Syzygium aromaticum	12,071[a]	0,71±0,09[a]	22,87±0,03[a]	4,191±0,040[a]
	Témoin (sans extrait)	12,079[a]	0,70±0,10[a]	22,88±0,03[a]	4,177±0,033[a]
Kpayo	*Pimenta racemosa*	12,031[a]	0,81±0,10[b]	21,16±0,01[b]	4,680±0,306[b]
	Syzygium aromaticum	12,030[a]	0,72±0,09[a]	20,90±0,01[b]	4,710±0,601[b]
	Témoin (sans extrait)	12,033[a]	0,68±0,09[a]	21,40±0,01[b]	4,564±0,427[b]

Les valeurs sont des moyennes (n= 3) ± SD. Les valeurs portant la même lettre dans la même colonne ne sont pas significativement différentes (p < 0,05)

Ces résultats confirment ceux obtenus au niveau de la flore fongique des échantillons témoins (conservés sans adjonction d'huiles essentielles), où les taux de contamination fongique sont très élevés. Par contre, dans les échantillons de niébé conservés au moyen d'huiles essentielles, on observe une diminution totale de la flore fongique. Ces résultats montrent donc l'efficacité des huiles essentielles utilisées dans la conservation du niébé au Bénin. Cette efficacité serait due à la présence dans ces huiles essentielles de molécules bioactives tels que les terpénoides. Ces agents antimicrobiens détruisent la membrane plasmique de manière irréversible conduisant ainsi à la mort cellulaire par un processus lytique [33]. Cette propriété facilite leur insertion entre les phospholipides membranaires et assure leur solubilisation dans la bicouche lipidique. Il s'ensuit une déstabilisation de la structure de la membrane plasmique et une modification de sa perméabilité aux ions, protons et autres constituants cellulaires [34]. En plus des altérations membranaires provoquées, ces molécules peuvent franchir la bicouche lipidique, pénétrer à l'intérieur des cellules et interagir avec des cibles intracytoplasmiques [35]. De plus, selon Arras et Usai [36] et De Billerbeck [37], les phénols terpéniques des huiles provoquent au niveau des champignons, plusieurs dégâts tels que des perturbations morphologiques des hyphes mycéliens, la rupture de la membrane plasmique et l'altération de la structure des mitochondries.

Tableau 4 : Taux de contamination fongique des échantillons de niébé conservés

Variétés locales	**Taux de contamination fongique (%)**		
	Conservation aux huiles essentielles		**Témoins (sans huiles essentielles)**
	Pimenta racemosa	***Syzygium aromaticum***	
Dannoukoun	00	00	92,5
Kpayo	00	00	87,32

L'évaluation des caractéristiques physico-chimiques des échantillons de niébé conservés avec les huiles essentielles indique que cette conservation n'a pas d'effets significatifs sur les caractéristiques physico-chimiques des échantillons conservés. Cependant, les résultats de l'analyse sensorielle (Figure1) indiquent que l'utilisation des huiles essentielles influence significativement l'odeur et le goût des échantillons de niébé conservés et augmente la préférence des consommateurs. Toutefois, cette préférence varie en fonction de l'espèce végétale, comme rapporté par Tsigarida et al. [38]. Au regard de ces résultats, les huiles essentielles de *Pimenta rasemosa* et de *Syzigium aromaticum* peuvent être considérées comme des produits naturels de protection des graines niébé. En effet, selon Glitho [39], des programmes de recherches en Afrique s'intéressent à l'approche de valorisation des plantes dans les stocks des graines pour limiter les pertes post-récolte. Ces plantes à usages alimentaire et médicinale constituent donc une alternative pour la conservation des denrées stockées, et ce d'autant plus qu'ils sont pour la plupart été classés "généralement reconnus comme sains" (Generally Recognized As Safe GRAS), ou approuvés comme additifs alimentaires.

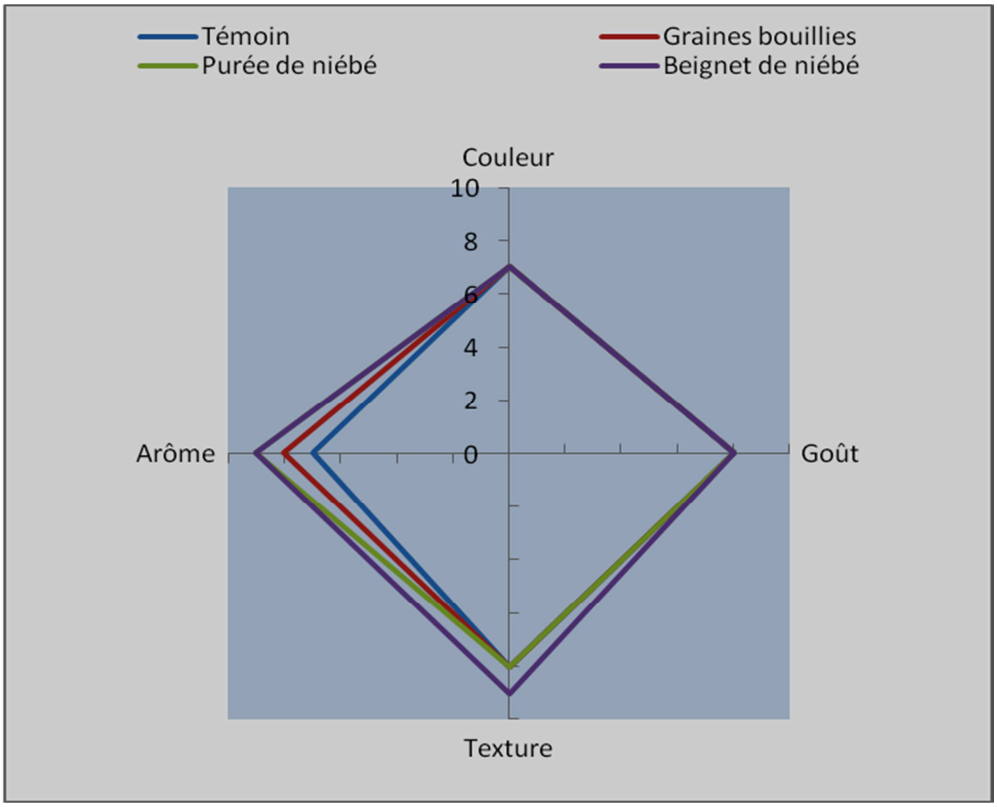


Figure 1 : Profil sensoriel des produits dérivés des graines de niébé conservées

5 CONCLUSION

Les huiles essentielles extraites des feuilles de *Pimenta racemosa* et *Syzygium aromaticum* possèdent des propriétés antifongiques avérées et améliorent les caractéristiques sensorielles, notamment l'arôme des produits traités. Elles pourraient donc constituer une alternative efficace dans la conservation du niébé, en remplacement des antifongiques de synthèse chimique, qui ne sont pas sans conséquences sur la santé du consommateur.

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Enquête entomologique sur la faune culicidienne de la ville de Maroua, Région de l'Extrême-Nord Cameroun

[Entomological Survey on Culicidae fauna in the City of Maroua, Far North Region Cameroon]

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ABSTRACT: An entomological survey based on the inventory of the Culicidae fauna in the town of Maroua, identified three genera and five species of mosquitoes in 2010. Of a total of 3915 mosquitoes have reached adulthood by breeding laboratory, the following species were identified: *Anopheles gambiae* (03.70%), *Anopheles funestus* (0.66%), *Culex quinquefasciatus* (53.33%), *Culex tigripes* (09.45%) and *Aedes aegypti* (32.84%). The seasonal distribution of larvae collected provides 83.06% to the rainy season and 16.94% in the dry season. Of the ten (10) breeding explored the Pont-Vert neighborhood is the most successful in the quality and quantity of larvae (20.53%). Meanwhile, 4700 adult mosquitoes were captured in 14 neighborhoods in the city of Maroua. However, only three genera and four species of mosquitoes were identified after capture. These are: *Anopheles funestus* (3.38%), *Anopheles gambiae* (14.91%), *Aedes aegypti* (23.08%) and *Culex quinquefasciatus* (58.6%). *Culex quinquefasciatus* mosquito species is the largest and most widespread in the city of Maroua. The months of October and September are the most successful in capturing adult mosquitoes.

KEYWORDS: Culicidae fauna, breeding, catching, Mosquitoes, Identification, Maroua, Cameroon.

RESUME: Une enquête entomologique basée sur l'inventaire de la faune culicidienne dans la ville de Maroua, a permis d'identifier trois genres et cinq espèces de moustiques en 2010. Sur un total de 3915 moustiques ayant atteint le stade adulte par élevage au laboratoire, les espèces suivantes ont été identifiées : *Anopheles gambiae* (03,70%), *Anopheles funestus* (0,66%), *Culex quinquefasciatus* (53,33%), *Culex tigripes* (09,45%) et *Aedes aegypti* (32,84). La répartition saisonnière des larves récoltées donne 83,06% à la saison des pluies et 16,94% à la saison sèche. Parmi les dix (10) gîtes larvaires explorés, celui du quartier Pont-Vert est le plus fructueux en qualité et en quantité de larves (20,53%). Parallèlement, 4700 moustiques adultes ont été capturés et répartis dans 14 quartiers de la ville de Maroua. Cependant, seuls trois genres et quatre espèces de moustiques ont été identifiés après capture. Il s'agit de : *Anopheles funestus* (3,38%), *Anopheles gambiae* (14,91%), *Aedes aegypti (*23,08%) et *Culex quinquefasciatus* (58,6%). *Culex quinquefasciatus* est l'espèce de moustique la plus nombreuse et la plus répandue dans la ville de Maroua. Les mois d'octobre et de septembre sont les plus fructueux en capture de moustiques adultes.

MOTS-CLEFS: Faune culicidienne, élevage, capture, Moustiques, identification, Maroua, Cameroun.

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1 INTRODUCTION

La progression souvent mal contrôlée de l'urbanisation dans les pays tropicaux, et plus particulièrement en Afrique, a des répercussions très importantes sur l'hygiène et la santé publique [1]. Au Cameroun, on dénombre plusieurs espèces d'insectes qui jouent un rôle dans la transmission de nombreuses endémies parasitaires et virales. Les Culicidae forment une Famille d'Insectes communément appelés moustiques. Classée dans l'Ordre des Diptères et Sous-Ordre des Nématocères, cette famille est caractérisée par des individus aux antennes longues et par des femelles possédant de longues pièces buccales en forme de trompe rigide de type piqueur-suceur [2]. Les moustiques possèdent une paire d'ailes et trois paires de pattes [3] ; [4]. Il y a environ 400 espèces d'anophèles dont une quarantaine seulement sont capables de transmettre le paludisme, et parmi celles-ci, seulement 15 sont des vecteurs d'importance majeure [5]. Les moustiques vecteurs des maladies graves sont surtout présents dans les pays du Sud, notamment l'Afrique, le Sud de l'Asie et l'Amérique latine [5]. Les Anophelinae sont constitués majoritairement du complexe *Anopheles gambiae* qui est le vecteur principal du paludisme et d'*Anopheles funestus* qui joue un rôle secondaire dans la transmission du plasmodium [6]. Les Culicinae sont principalement représentés par *Cx. quinquefasciatus* et *Aedes aegypti* dans la ville de Maroua [7] ; ([8]. Ces moustiques sont très abondants dans certaines régions où la densité de la population humaine est importante, et sont responsables de la transmission de la maladie à des millions des populations en Afrique [9]. À l'instar de la plupart des grandes agglomérations de la zone intertropicale, Maroua, ville de savane du Nord-Cameroun, connaît actuellement une croissance accélérée due non seulement à l'accroissement naturel de la population et/ou à l'exode rural, mais surtout à la création de l'Université de Maroua. Ce développement se fait de façon rapide et inorganisée, de telle sorte que les services de l'urbanisme et d'hygiène n'arrivent pas à assainir de façon efficace l'environnement urbain. Il en résulte alors une prolifération des collections d'eaux usées qui constituent des gîtes larvaires potentiels, particulièrement favorables au développement des stades immatures des moustiques dont les femelles piquent préférentiellement la nuit à l'intérieur des habitations. Le présent travail consiste à déterminer les différents genres et espèces de moustiques qui existent dans la ville de Maroua. Les objectifs spécifiques consistent alors à:

- recenser les gîtes larvaires permanents et semi-permanents de la ville de Maroua, puis prélever les larves de moustiques dans différents quartiers, les élever et identifier les moustiques au stade adulte ;
- user de plusieurs méthodes de capture directe des moustiques adultes dans différents quartiers de la ville de Maroua en vue de leur identification ;
- apprécier l'abondance des moustiques récoltés par espèce et en fonction de la variation saisonnière.

2 MATERIEL ET METHODES

2.1 PRESENTATION DE LA ZONE D'ETUDE

Maroua, chef-lieu de la Région de l'Extrême-Nord Cameroun est situé entre le 10° 35' de latitude Nord et le 14° 19' de longitude Est [10]. Cette ville s'étire sur les rives du Mayo-Kaliao. La végétation est celle de la savane et des prairies inondées périodiquement [11]. Elle est constituée de steppes à épineux sahéliennes et est dominée par des espèces telles que *Azadirachta indica, Balanites aegyptiaca, Anogeissus leiocarpus et Boswillia dalziellii* sur des sols meubles et rocailleux [12]. Le climat est sec et chaud, presque semi désertique. La pluviométrie annuelle est généralement comprise entre 600 et 1000 mm. La température moyenne annuelle est d'environ 27°C avec une valeur maximale de 43°C entre avril et mai et une valeur minimale de 24°C entre décembre et janvier [13]. La ville de Maroua compte environ 400 000 habitants [14].

2.2 METHODOLOGIE

L'étude portant sur la diversité culicidienne de la ville de Maroua s'est déroulée tout au long de l'année 2010. Cette étude est basée sur la récolte des larves dans des gîtes larvaires d'une part et des séances de capture directe des moustiques adultes en divers lieux d'autre part. En effet, les larves récoltées sont élevées au laboratoire de l'École Normale Supérieure de l'Université de Maroua, installé dans les locaux de l'Institut de Recherche Agricole pour le Développement (IRAD) de Maroua. La périodicité de récolte des larves de moustiques est d'une séance par mois. Les moustiques élevés sont identifiés au stade adulte. Une corrélation entre la pluviométrie et l'abondance des moustiques a été relevée. En fait, les travaux préliminaires sur les observations des gîtes larvaires ont bien commencé au préalable depuis 2009. Le choix des gîtes larvaires a été fait après prospection sur le terrain. Au cours de cette prospection, les types de gîtes larvaires potentiels ont été répertoriés et sélectionnés. Les critères de choix portaient sur les paramètres essentiels suivants : la présence des larves ; la proximité des maisons d'habitation ; le caractère permanent et/ou temporaires des gîtes larvaires ; le degré de pollution des gîtes. A la suite de ce travail, dix gîtes larvaires ont été retenus dans la ville de Maroua (Annexe 1). La position de chaque

gîte larvaire est localisée sur fond de carte de la ville de Maroua à l'aide d'un GPS garmin 12 (**Fig.1**). La récolte des moustiques adultes a été réalisée par diverses méthodes: pulvérisation d'insecticide, capture sur sujets humains dans des maisons d'habitation, dans des latrines à l'aide de moustiquaire, dans les puits et autour des forages, dans les caniveaux à eaux stagnantes, dans les poubelles.

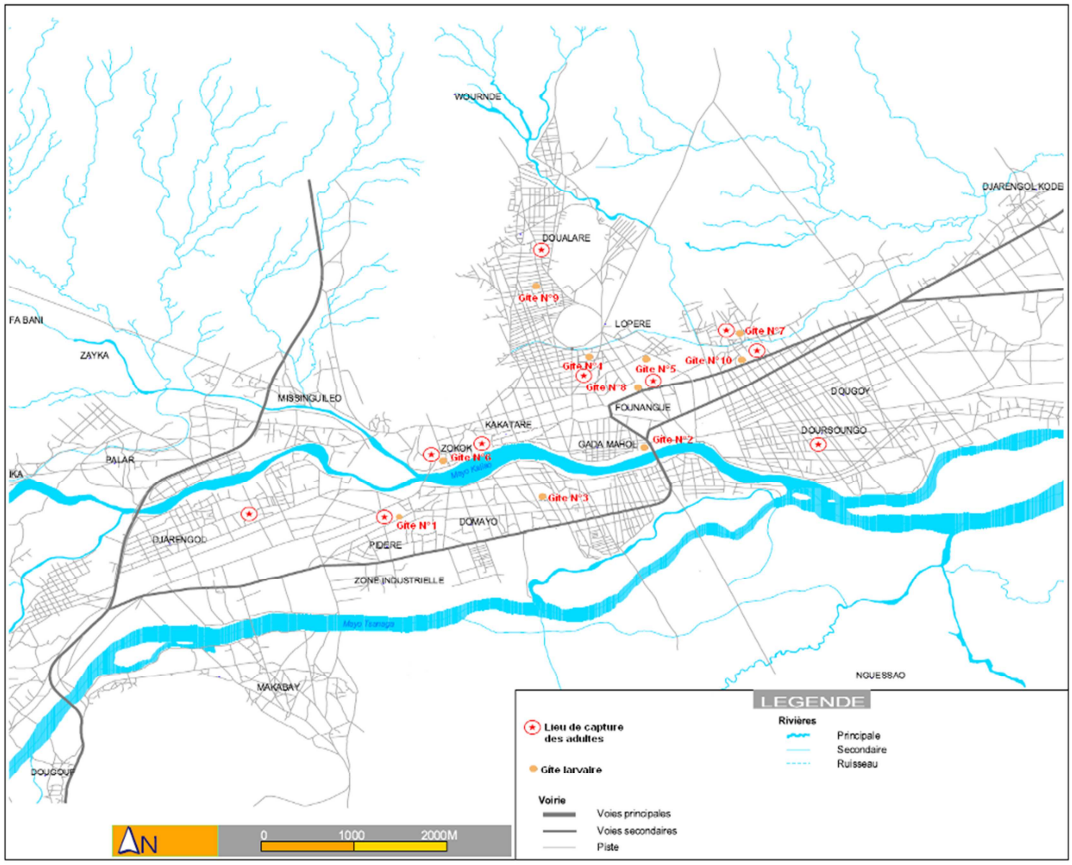


Figure 1. Localisation des gîtes larvaires et les lieux de captures des adultes de moustiques dans la ville de Maroua

2.3 IDENTIFICATION DES MOUSTIQUES ADULTES

Les adultes des moustiques issus de l'élevage sont tués à l'aide d'une bombe insecticide, puis examinés au laboratoire de l'IRAD à l'aide d'un microscope, d'une loupe binoculaire et des clés d'identification. Les moustiques adultes ont été identifiés à l'aide des clés d'identification morphologiques de : Edwards [15] et de Cordeliers [16] pour les Culicinae et les clés de Gillies et De Meillon [2] et Gillies et Coetzee [4] pour les Anophelinae.

2.4 ANALYSE DES RESULTATS

Pour analyser les résultats, les tests T, Khi-carré χ^2 et Z de comparaison de 2 moyennes de populations n_1 et n_2 ont servi pour comparer deux moyennes observées entre les moyennes. Le test de corrélation r pour établir des éventuelles corrélations entre deux variables a été également utilisé.

3 RESULTATS ET DISCUSSION

3.1 CARACTERISATION QUALITATIVE ET QUANTITATIVE DES MOUSTIQUES ELEVES A MAROUA

Cinq espèces de moustiques sont identifiées après l'élevage des larves dans la ville de Maroua pendant l'année 2010 (tableau 1). Sur un total de 3915 moustiques ayant atteint le stade adulte, les espèces suivantes ont été identifiées : *Anopheles gambiae* (3,70%), *Anopheles funestus* (0,66%), *Culex quinquefasciatus* (53,33%), *Culex tigripes* (9,45%) et *Aedes aegypti* (32,84%). *Cx. quinquefasciatus* est l'espèce dominante en terme de quantité car elle représente plus de la moitié des moustiques obtenus par élevage. La forte dominance de cette espèce est liée au niveau de pollution du milieu et à l'absence de système de drainage des eaux usées qui contribuent à sa pullulation. Des observations similaires dans les milieux

urbanisés ont été faites également par Fondjo [17] à Nkolbikock, un quartier de Yaoundé, Diallo [18] et Diallo *et al*., [19] à Dakar au Sénégal, Robert [20] à Diaradougou au Burkina Faso. Saotoing [9] ont réalisé une étude entomologique sur la bio-écologie des larves de moustiques dans la ville de Maroua et ont obtenu des résultats similaires, surtout la forte présence des stades pré-imaginaux de *Culex quinquefasciatus*. Des études antérieures ont révélé que les moustiques du genre *Culex* préfèrent les gîtes larvaires plus ou moins pollués. Ce constat va de pair avec la nature des gîtes larvaires où les larves ont été récoltées. La plupart des gîtes larvaires explorés à Maroua présentent presque les mêmes caractéristiques. Les polluants les plus rencontrés dans les gîtes sont des matières plastiques telles les bouteilles et les sacs d'emballage, les morceaux de carton, des tissus et des papiers de tout genre, les débris de matières organiques animaux et végétaux. La végétation est fortement dominée par des algues vertes qui recouvrent la surface de l'eau par endroit et d'autres types d'herbes se trouvant au bord du caniveau où l'eau est peu profonde. Le genre *Anopheles* est le moustique le moins rencontré dans les gîtes larvaires. La rareté des larves d'anophelinae dans les gîtes pourrait être expliquée par le fait que les gîtes larvaires ne présentent pas toutes les conditions requises et favorables à leur développement.

Tableau 1. Variations mensuelles des différentes espèces de moustiques adultes élevés à Maroua

Mois	Précipit.	*A. gamb.*	*A.funest.*	*Cx.quinq.*	*Cx tigripes*	*Ae.aegypti*	Total
Jan.2010	0	0	0	54	0	36	**90**
Fév.	0	0	0	103	3	51	**157**
Mar.	0	0	0	176	12	49	**237**
Avr.	16,6	4	0	172	31	85	**292**
Mai	36,1	4	3	149	33	105	**294**
Juin	111,3	11	0	251	26	156	**444**
Juil.	213,9	3	0	104	22	133	**262**
Aoû.	220,1	8	5	51	14	49	**127**
Sep.	165,6	45	2	295	58	206	**606**
Oct.	142,1	54	6	414	84	232	**790**
Nov.	0,2	12	10	202	61	152	**437**
Déc.2010	0	4	0	117	26	32	**179**
Total		**145**	**26**	**2088**	**370**	**1286**	**3915**

3.2 VARIATIONS SAISONNIERES DE LA DENSITE CULICIDIENNE LARVAIRE

La figure 2 montre que (3252/3915) soit 83,06% des larves de moustiques ont été récoltées en saison des pluies à Maroua pendant l'année 2010. Etant donné que les femelles de moustiques pondent dans l'eau, la saison des pluies constitue de ce fait, un facteur très important pour la multiplication des gîtes larvaires, favorisant ainsi l'obtention facile des lieux de ponte et la possibilité de pondre au moment opportun aux femelles de moustiques. En plus, la saison des pluies offre des possibilités de choix des gîtes larvaires aux différentes espèces culicidiennes en termes de qualité et de quantité. La faible quantité de larves récoltées en saison sèche (663/3915) est justifiée par le fait que, certains gîtes temporaires disparaissent pendant la saison sèche et les lieux de ponte deviennent rares. Ce phénomène a été aussi observé par Mouchet [21] qui a abouti à la remarque selon laquelle les sécheresses successives dans les régions de Sahel entraînent la disparition des gîtes larvaires habituels. En 2010, la saison des pluies était longue de 8 mois, ce qui a favorisé le grand nombre de larves récoltées.

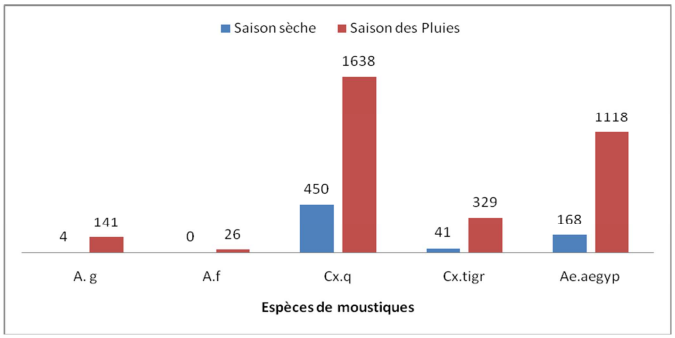


Figure 2 Variations saisonnières de la densité culicidienne larvaire

3.3 DISTRIBUTION DES MOUSTIQUES PAR GITE LARVAIRE ET PAR ESPECE

Le tableau 2 présente la répartition des larves de moustiques récoltées par quartier et par gîte larvaire. Nous constatons que les moustiques existent dans tous les gîtes larvaires explorés, par ricochet les moustiques sont dans tous les quartiers de la ville de Maroua. En dehors de *Anopheles funestus*, les autres espèces de moustiques présentent la même distribution. Le gîte larvaire du quartier Pont-Vert (804/3915) soit 20,53%, est le plus fructueux en larves par rapport au reste. Le gîte du Pont-Vert est un vaste ensemble constitué des sous-gîtes larvaires avec des caractéristiques plus ou moins variées. Ce qui explique la présence quantitative et qualitative de toutes les espèces de moustique dans ce gîte. Autour du gîte, que ce soit en amont ou en aval, se sont créées des activités humaines permanentes. La moyenne des profondeurs des gîtes est de 10cm environ. Les eaux du gîte sont plus ou moins sombres selon l'âge du gîte. Ce qui explique également la plus forte colonie des larves de *Anopheles funestus* dans le gîte du Pont-Vert. Croupie [22] expliquent l'abondance de *Anopheles funestus* par le fait qu'elle se développe facilement pendant la saison sèche dans les eaux usées qui sont maintenues de manière artificielle tout au long de l'année. En plus, Julvez [23] confirment que *A. funestus* a une préférence particulière pour les gîtes larvaires marécageux à forte végétation qui se créent dans les bas-fonds par collection des eaux. Le gîte larvaire du quartier Douggoï est celui qui a présenté une faible quantité en larve. La faune du gîte de Douggoï est marquée par la présence des larves de moustiques, autres insectes et des petits vers. La composition faunique influencerait le développement des larves de moustiques dans ce gîte.

Tableau 2: Distribution des moustiques par gîte larvaire, par quartier et par espèce

Gîte larvaires	*An.gamb.*	*An.funest.*	*Cx.quinqu.*	*Cx. tigripes*	*Ae. aegypti*	Total	%
DomayoCS	9	0	371	26	41	569	14,53
Pont vert	48	16	493	52	317	804	20,53
Domayo DG	16	0	116	79	17	228	5,82
Loperé	14	0	318	16	121	469	11,97
Founang. Tr	0	5	93	47	69	214	5,46
Kakataré	9	0	156	9	202	376	9,60
Sararé	12	0	237	39	162	470	12,00
Founang. CD	17	5	101	57	98	278	7,10
Bamaré	9	0	152	45	156	362	9,24
Douggoi	11	0	51	0	103	165	4,21
Total	145	26	2088	370	1286	3915	100

3.4 MOUSTIQUES ADULTES CAPTURES EN DIFFERENTS QUARTIERS DE LA VILLE DE MAROUA

En effet, 4700 moustiques adultes ont été capturés et répartis dans 14 quartiers de la ville de Maroua (tableau 3). Cependant, seuls trois genres et quatre espèces de moustiques ont été identifiés. Il s'agit de : *Anopheles gambiae*, *Anopheles funestus*, *Culex quinquefasciatus* et *Aedes aegypti*. *C. quinquefasciatus* occupe la première place en proportion (2755/4700) soit 58,61%, suivi de *Ae. Aegypti* (1085/4700) soit 23,08%, *An. gambiae* (14,91%) et *An. funestus* (3,38%). Les différentes espèces de moustiques sont presque représentées dans tous les quartiers de la ville de Maroua. Globalement, on note par quartier, les proportions suivantes : Pont-Vert (13,68%), Domayo (13,25%), Lpéré (12,80%), Doualaré (10,37%), Sararé (10,32%), Hardé (5,93%), Kakataré (5,21%), (Zokok (5,89%), Douggoï (4,95%), Founangué (4,40%), Pitoaré (3,95%), Palar (3,61%), Ouro-Tchédé (3,19%), (Doursoungo (2,42%). Les quartiers Pont-Vert et Domayo tiennent le peloton de tête. Ces

quartiers sont les plus populeux et regorgent diverses activités de nature à polluer l'environnement. Partout, on note les déchets de production de la bière locale (Bil-bil) ainsi que l'alcool reconnu sous le nom de « Arki ». Les eaux usées des toilettes et des ménages existent partout, favorisant par là la création des gîtes larvaires de moustiques.

Tableau 3 : Répartition des moustiques adultes capturés dans différents quartiers de la ville de Maroua

	Domayo	PV	Zokok	Lopéré	Fngué	Kakata	Sararé	Dourngo	Pitoaré	Dougoi	Doualaré	Palar	O.Tchédé	Hardé	Total
An. gambiae	61	105	46	104	22	73	92	33	11	24	87	16	8	19	701
An.funestus	22	37	7	17	0	9	19	0	0	0	13	21	0	14	159
C.quinquefasciatus	289	418	201	316	154	129	282	57	155	162	313	42	78	159	2755
Ae..aegypti	251	185	23	63	31	34	92	24	19	47	74	91	64	87	1085
Total	623	643	277	602	207	245	485	114	186	233	487	170	150	279	4700

3.5 VARIATIONS SAISONNIERES DES MOUSTIQUES ADULTES CAPTURES DANS LA VILLE DE MAROUA EN 2010

La plupart des moustiques adultes sont capturés pendant la saison des pluies (4015/4700 ; 85,42%) contre (685/4700), 14,58% en saison sèche (figure 3). Une différence hautement significative a été observée entre les deux saisons (Z= 19,44, ddl = 1). En saison sèche, les lieux de ponte deviennent rares. Ce phénomène est à l'origine de la réduction de la population culicidienne. Les endroits de captures les plus productifs se trouvent autour des points d'eau comme les forages publics. Alors qu'en saison des pluies, les gîtes larvaires existent partout en qualité et en quantité et la population culidienne abonde également. Les gîtes potentiels existant en saison sèche sont non seulement rares, mais sont fortement pollués pour la plupart. Des études similaires réalisées dans la ville de Ngaoundéré dans la Région de l'Adamaoua ont présenté des résultats semblable dont 1018 moustiques obtenus en saison des pluies (61%) et 632 en saison sèche (39%) soit une différence significative (Z=8,90) notée entre les deux saisons [8].

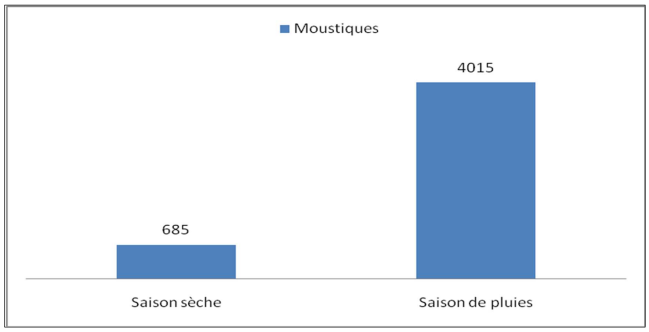


Figure 3: Variations saisonnières de la densité agressive des moustiques capturés à Maroua

3.6 REPARTITION DES MOUSTIQUES ADULTES CAPTURES EN DIVERS GITES DE REPOS

Le tableau 4 révèle que les moustiques adultes sont répartis en divers endroits dans la ville de Maroua. Les maisons d'habitation constituent de véritables points d'attraction pour les moustiques. Les résultats d'autres études ont montré que les moustiques vivent en densité élevée dans les milieux habités par des humains. Les femelles de moustiques sont guidées par le $C0_2$ et l'odeur corporelle émis par l'hôte. Cette odeur constitue un facteur d'attractivité individuel propre à l'hôte. Les porteurs de gamètes semblent également plus attractifs pour le moustique (IFMT-MS-Paludisme-Entomol-2007). Fontenille *et al*. [24] réalisent une étude au Sénégal sur la préférence trophique des anophèles femelles et obtiennent que *Anopheles gambiae* présente un taux d'anthropophilie assez élevé (62,1%) par rapport aux autres espèces.

Tableau 4: Moustiques adultes récoltés en divers lieux en 2010 à Maroua

Espèces de moustiques capturés	Pulvérisation d'insecticide dans les maisons	Sur Hommes (chambres ou dehors)	Autour des latrines	Autour des puits	Dans les poubelles	Dans les caniveaux	Autour des forages	Total
An. gambiae	233	237	0	39	0	0	192	701
An.funestus	33	24	0	23	0	16	63	159
Cx. quinquefasciatus	573	538	349	401	254	407	233	2755
Ae. aegypti	349	277	9	198	105	31	116	1085
Total	1188	1076	358	661	359	454	604	4700

4 CONCLUSION

Cinq espèces de moustiques sont identifiées après l'élevage des larves dans la ville de Maroua en 2010. *Cx. Quinquefasciatus* est l'espèce dominante en terme de quantité car elle représente plus de la moitié des moustiques obtenus par élevage. La forte dominance de cette espèce est liée au niveau de pollution du milieu et à l'absence de système de drainage des eaux usées. L'abondance des larves récoltées ne dépend pas nécessairement du volume mensuel des précipitations. Seuls trois genres et quatre espèces de moustiques ont été identifiés dans les 14 quatorze quartiers de captures des moustiques adultes. Il s'agit de : *Anopheles gambiae*, *Anopheles funestus*, *Culex quinquefasciatus* et *Aedes aegypti*. Aucun *Culex tigripes* n'a été capturé ni sur sujet humain ni dans les autres endroits de capture. Ceci traduit le caractère non anthropophile pour l'Homme de ce moustique. Les larves et les moustiques adultes ont été les plus abondants en début et en fin de saison des pluies. De manière générale, les moustiques sont présents tout au long de l'année dans la ville de Maroua. Dans l'avenir, il s'avère nécessaire de déterminer la durée du cycle gonotrophique des anophèles femelles de la ville de Maroua d'une part, et d'estimer leur espérance de vie.

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ANNEXE 1: GÎTES LARVAIRES



Figure 1 : Gîte larvaire de Domayo-Camp SIC



Figure 2 : Gîte larvaire de Founangué-Pont-Vert



Figure 3:Gîte larvaire de Domayo-Dépôt Guiness



Figure 4: Gîte larvaire de Lopéré



Figure 5: Gîte de Maroua larvaire de Founangué Place de fête



Figure 6: Gîte larvaire de Kakataré



Figure 7: Gîte larvaire de Sararé (Lycée Technique)



Figure 8 : Gîte larvaire de Founangué (Centre de Documentation)



Figure 9: Gîte larvaire au quartier Kaliao (Pont-rouge)



Figure 10: Gîte de Douggoï (grande Mosquée de Douggoï)

ANNEXE 2 : QUELQUES METHODES DE COLLECTE DES MOUSTIQUES ADULTES



Figure 1: Collection des adultes de moustiques après pulvérisation dans une chambre



Figure 2: Capture des moustiques adultes dans une latrine au quartier Sararé



Figure 3: Capture des moustiques adultes dans une poubelle à Maroua

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Apport de l'OT et du SIG à la cartographie des zones à risque d'érosion hydrique dans le bassin versant productif de Sanguéré, Nord-Cameroun, Afrique Centrale

[Contribution of EO and GIS to the mapping of water-erosion risk areas in the productive Sanguéré watershed, North-Cameroon, Central Africa]

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ABSTRACT: This work aims at identifying and mapping using Earth Observation (EO) and Geographic Information Systems (GIS), the water-erosion risk areas. The RUSLE (Revised Universal Soil Loss Equation) model, which can be used to estimate the water-erosion risk of soil, was applied to the productive Sanguéré watershed of North Cameroon. He includes factors such as: rainfall aggressiveness, soil erodibility, slope length and steepness, type of land use (cover and management practice) and support or conservation practice. Two land use maps were produced, one based on field observations and the other on the calculation of MSAVI2 (Second Modified Soil-Adjusted Vegetation Index) on Landsat 8 image of April 4, 2013, to judge the quality and the accuracy of each type of the information for the model. The analysis, the combination of data (satellite images, existing thematic maps, field observations) and the application of the model were all carried out using GIS; which enabled the production of synthetic maps showing the degree of sensitivity to water erosion. The erosion risk maps derived shows five degrees of vulnerability in this area: none to very low, low, moderate, high and serious. If we consider that the class of moderate erosion risk is high, our watershed would present about 62 Km² area exposed to water erosion, or approximately 75% of its total area. The Sanguéré watershed being representative of the region in terms of the geology, pedology and hydrology; the methodology presented in this study can be applied generally to the entire North Region of Cameroon where the risk of erosion is a threat to the rural agricultural sector.

KEYWORDS: Water erosion, watershed, EO, GIS, Cartography.

RESUME: Le présent travail a pour objectif d'appliquer une méthode utilisant les images d'Observation de la Terre (OT) et le Système d'Information Géographique (SIG) pour identifier et cartographier les zones à risque d'érosion hydrique des sols. Le modèle RUSLE (Revised Universal Soil Loss Equation), avec lequel on peut estimer les risques d'érosion hydrique des sols, a été appliqué au bassin versant productif de Sanguéré au Nord Cameroun. Il compte parmi ses facteurs : l'agressivité des précipitations, l'érodibilité des sols, l'inclinaison et la longueur des versants, le type d'occupation des sols et les pratiques antiérosives. Deux cartes d'occupation des sols ont été réalisées, l'une à partir des observations de terrain et l'autre à partir du calcul du MSAVI2 (Second Modified Soil-Adjusted Vegetation Index) sur l'image Landsat 8 du 04 avril 2013, pour juger la

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qualité et la précision de chaque type de ces informations dans le modèle. L'analyse, la combinaison des données (images satellitaires, cartes thématiques existantes, observations de terrain) et l'application du modèle ont été opérées dans un SIG. Ce dernier a permis de produire des cartes synthétiques de répartition des degrés de sensibilité à l'érosion hydrique. Les cartes de risque d'érosion qui en sont dérivées montrent cinq degrés de vulnérabilité dans notre site : nul à très faible, faible, modéré, élevé et grave. Si l'on considère qu'à partir de la classe d'érosion modérée le risque est important, notre bassin présenterait une superficie d'environ 62 Km² exposée à l'érosion hydrique, soit environ 75 % de sa superficie totale. Le bassin de Sanguéré étant représentatif de la région sur les plans géologique, pédologique et hydrologique, la méthodologie présentée dans cette étude peut être généralisée à toute la région du Nord Cameroun où les risques d'érosion constituent une menace pour le secteur agricole à majorité rural.

MOTS-CLEFS: Erosion hydrique, bassin versant, OT, SIG, Cartographie.

1 INTRODUCTION

Au Cameroun, les milieux ruraux sont très exposés aux problèmes environnementaux tels que les inondations, la dégradation des terres par l'érosion sous toutes ses formes (dont l'érosion hydrique…), le surpâturage, les criquets-pèlerins, la sècheresse des terres, la désertification, pour ne citer que ceux là, et qui affectent considérablement le secteur agricole rural. L'identification et la caractérisation de ces obstacles naturels au développement dans le monde rural à des fins de contrôle et de suivi, ainsi que la vulgarisation des résultats obtenus pour une prise de décision adéquate et une bonne orientation des actions à mener sont des réponses qui font partie de notre contribution à la perspective de développement de ce secteur.

L'érosion hydrique, objet de notre attention, est un phénomène de dégradation qualitative et quantitative des sols qui affecte de larges surfaces, en particulier dans les zones intertropicales et méditerranéennes [2].

Principal responsable de la dégradation des terres cultivées, ce phénomène entraine des pertes en terres considérables sur les sols dénudés et les défriches récentes [1], sur les pentes, à cause de la nature torrentielle des pluies, de la forte vulnérabilité des terrains (roches tendres, sols fragiles, pentes fortes et dégradation du couvert végétal) et de l'impact défavorable des activités humaines (déforestation, incendies, mauvaise conduite des travaux agricoles, urbanisme chaotique...) [2]. C'est la partie superficielle des sols, la plus importante pour les cultures, où sont concentrées la matière organique et la majeure partie des éléments minéraux assimilables par les plantes, qui disparaît en priorité [1], et c'est l'agriculteur qui, de façon spectaculaire, subit les premiers effets négatifs de ce phénomène.

Les études qui existent sur l'érosion hydrique et la dégradation des terres au Cameroun [20], [25] - [21] dans leur grande majorité n'intègrent pas ou très peu les méthodes d'OT et les techniques d'analyses spatiales par un SIG pour la connaissance et la cartographie de ces phénomènes. Ces outils qui sont pourtant de nos jours de plus en plus utilisés pour l'étude et la connaissance des phénomènes de surface, permettent également le développement d'une approche méthodologique pour le choix des données et des traitements nécessaires à effectuer pour étendre la méthode sur d'autres zones présentant les mêmes problèmes.

Nous nous proposons donc d'exploiter les possibilités qu'offrent l'OT et les techniques d'analyses spatiales par l'intégration des différentes couches d'informations dans un SIG et d'appliquer la version révisée de l'équation universelle des pertes en sol (Revised Universal Soil Loss Equation, RUSLE) de [16] dans un bassin versant productif exposé à ce phénomène et par conséquent à une dégradation de ses terres : le bassin versant de Sanguéré, situé au Nord du Cameroun.

Le but de notre étude est d'utiliser l'imagerie satellitale et des cartes thématiques existantes comme source de données d'entrée, et de coupler celles-ci avec des observations sur le terrain dans un SIG pour : identifier et cartographier les zones à risques d'érosion hydrique dans le bassin versant de Sanguéré; vulgariser les résultats pour une prise de décision adéquate, et une bonne orientation des actions à mener dans la lutte contre ce phénomène de surface.

2 ENVIRONNEMENT DU SECTEUR D'ETUDE : PREDISPOSITIONS A L'EROSION HYDRIQUE

Situé à environ 15 Km au Sud de la ville de Garoua (chef lieu du département de la Bénoué, Région du Nord Cameroun), de part et d'autre de la route Garoua-Ngaoundéré, entre les coordonnées 9°06' - 9°15' N et 13°26' - 13°31' E (figure 1), le bassin versant du Mayo Dadi (autrefois Mayo Ain Dala) dont la superficie est d'environ 82 km2 constitue l'ensemble des bassins versants de Sanguéré. Il appartient au grand bassin hydrographique de la Bénoué, important affluent du Niger.

Allongé dans le sens nord-sud, le bassin du Mayo Dadi est limité à l'Est et au Sud par une série de collines de grès crétacé, alors que la limite Nord et Ouest située dans une zone sans relief notable est assez imprécise [5].

Il est situé dans la zone de climat tropical de type soudanien caractérisé par l'alternance d'une saison sèche (novembre à mars) et d'une saison humide (de mai à septembre), les mois d'octobre et avril faisant la transition. La pluviométrie moyenne annuelle est de 1027,2 mm, avec le maximum des pluies en août de l'ordre de 238,7 mm. Les mois de novembre, décembre, janvier, février, mars et avril n'enregistrent généralement pas de précipitations. La température moyenne annuelle dans la région est de l'ordre de 28,3°C. Avril est le mois le plus chaud avec des températures atteignant 40°C.

Le paysage, mollement ondulé, est une succession de versants à faible pente séparés par des vallons très évasés (figure 2). De cette pénéplaine émergent quelques massifs résiduels (Inselbergs) à sommet tabulaire, très caractéristiques des formations gréseuses [4] : les "grès de Garoua".

Le secteur d'étude qui appartient entièrement au bassin versant de la Bénoué affluent du Niger, est drainé par le Mayo Dadi, et ses tributaires, qui prend sa source dans les massifs gréseux situé à l'Est et au Sud et se jette à l'Ouest dans le Mayo Douka, l'un des affluents de la Bénoué.

Le système de sol dominant est constitué de sols ferrugineux tropicaux, sur les "grès de Garoua", différenciés en un compartiment ferrugineux (80%) en position haute, un compartiment lessivé (15%) en position intermédiaire et un compartiment hydromorphe (5%) localisé dans les bas-fonds (figure 3). Ces sols qui contiennent essentiellement du quartz et de la kaolinite, un peu de goethite sont sableux, perméables, très pauvres en matières organiques et généralement très sensibles à l'érosion hydrique, accentuée par la disparition du couvert végétal [4]. Ils reposent sur les "grès de Garoua" du crétacé supérieur, séries sédimentaire à matériaux quartzeux dominant.

La végétation dans le bassin versant est constituée d'une savane arbustive soudanienne fortement dégradée avec quelques grands arbres, reliques de la savane boisée originelle, et d'une prairie marécageuse [4].

Le département de la Bénoué avec sa population de 851955 habitants, 519409 habitants en zone rurale contre 332546 en zone urbaine (3ème recensement général de la population du Cameroun, 2010), est de loin le département le plus peuplé de la Région du Nord, soit 50,47% de la population totale. Cette population essentiellement rurale (70%) et hétéroclite pratique principalement à près de 90 % l'agriculture et l'élevage. Ces pratiques culturales intenses et la vaine pâture se sont révélées être des facteurs de dégradation de la matière organique et de l'érosion des sols.

3 DONNÉES UTILISÉES ET MÉTHODOLOGIE APPLIQUÉE

La méthodologie adoptée pour cette étude repose sur l'exploitation des données multisources (satellitaires, pédologiques, météorologiques et des observations faites sur le terrain), multiéchelles, aux formats hétérogènes. Toutes ces données sont intégrées et analysées dans un environnement SIG pour la cartographie des zones exposées à l'érosion hydrique dans notre secteur d'étude.

3.1 DONNÉES UTILISÉES

Les données suivantes ont été utilisées dans notre étude :

- Une image Shuttle Radar Topography Mission (SRTM) de résolution 90 m ; de coordonnées 05° - 10°N, et 10° - 15°E, obtenue sur le site : http://srtm.csi.cgiar.org/SELECTION/inputCoord.asp.
- Une scène multispectrale Landsat-8/LDCM (Landsat Data Continuity Mission) OLI/TIRS (Operational Land Imager/ Thermal Infrared Sensor) de Path_185/Row_054, acquise le 12 avril 2013 (LC81850542013102LGN01). Cette image est fournie par le site http://earthexplorer.usgs.gov/, au format Geotif.
- Des observations de terrain, obtenues après une descente sur le site en avril 2013.
- Une carte pédologique détaillée, du bassin versant de Sanguéré, dressée par [4].
- Des données pluviométriques fournies par le Service d'Appui Technique (SAT) de la Société de Développement du Coton (SODECOTON), un réseau privé, complétées par celles de la station météorologique de Garoua dans la Bénoué, repérée par les coordonnées 09°20'N et 13°23'E, 242 m. Elles s'étalent sur une période de 14 ans (1998-2011) et couvrent notre zone d'intérêt.

3.2 MÉTHODOLOGIE APPLIQUÉE

Plusieurs méthodes intégrant les facteurs d'érosion ont été développées. Les modèles actuels de quantification des pertes en sol par érosion en nappe sont généralement basés sur l'équation universelle de pertes en sol USLE et sa version révisée RUSLE [16], régulièrement complétée et adaptée selon le milieu bioclimatique, qui peut parfois être totalement différent de celui à l'intérieur duquel l'équation a été conçue.

Il est question de choisir pour notre étude un modèle qui permette, grâce aux SIG, la spatialisation de l'érosion hydrique à l'échelle des bassins versants et non plus des parcelles. Il s'agit ici d'avoir une connaissance de la répartition spatiale de l'érosion sur notre bassin versant.

Notre choix pour cette étude s'est donc porté sur l'équation universelle des pertes en sol révisée (RUSLE) la version améliorée provisoire de l'USLE, pour la détermination des divers facteurs de l'érosion hydrique.

Le RUSLE reprend la même équation empirique que l'USLE et s'utilise à l'échelle du champ agricole ou du petit bassin versant [9]. Il a été informatisé ce qui facilite sa manipulation et sa diffusion comme outil de prédiction des pertes en sol. La convivialité de l'USLE/RUSLE fait qu'il demeure une approche de modélisation très populaire et pratique [9].

Cette équation s'écrit comme suit :

$$A = R. K. LS. C. P \quad (1)$$

Où :

A (t/ha/an), est le taux annuel de perte en sol ;

R (MJ/mm / ha. H. an), est le facteur de l'érosivité des pluies ; il correspond à la moyenne annuelle des sommes des produits de l'énergie cinétique de la pluie par son intensité en 30 mn consécutives ;

K (t. H / MJ. mm), est l'érodibilité des sols ; il est fonction de la texture du sol, du taux d'humus, de la structure de la couche superficielle du sol ainsi que de sa perméabilité ;

LS, est un facteur sans dimension qui représente l'inclinaison (S) et la longueur de pente (L) ;

C, est un facteur sans dimension ; c'est l'occupation du sol ou l'indice de couverture végétale et de pratiques culturales ;

P, facteur sans dimension, est un rapport qui tient compte des techniques culturales antiérosives telles que le labour en courbes de niveau.

Le prétraitement et le traitement des images ont été effectués avec Erdas imagine et ENVI, l'analyse, la combinaison de toutes données et l'application du modèle ont été effectuées avec le logiciel ArcGis 10.0 (numérisation des cartes, l'analyse spatiale, la combinaison des données, l'édition des cartes thématiques et la mise en place du SIG). La résolution de travail est de 90m, et le système de projection appliqué à toutes nos données est Transverse Mercator zone 33, dont les principales caractéristiques sont les suivantes : *Ellipsoïde–Clarke 1884; Datum (système géodésique)–WGS_1984; False_Easting: 500000.000000; False_Northing: 0.000000; Central_Meridian: 9.000000; Scale_Factor: 0.999600; Latitude_Of_Origin: 0.000000; Linear Unit: Meter (1. 000000).*

L'organigramme (figure 4) résume les différents traitements appliqués à nos données. La méthodologie utilisée est le croisement (dans un SIG) des paramètres sous forme de combinaison logique avec pour finalité l'élaboration de la carte de vulnérabilité multifactorielle à l'érosion hydrique des sols du bassin versant de Sanguéré.

3.2.1 LES DONNÉES PLUVIOMÉTRIQUES ET LE FACTEUR R

Le climat joue un rôle déterminant dans le risque d'érosion hydrique des sols, par le biais des précipitations (fréquence, durée et intensité). L'estimation du facteur R selon la formule de Wischmeier et Smith est assez complexe. Selon [10], la meilleure corrélation entre le facteur R et les valeurs de précipitation est celle basée sur l'Indice, (F), modifié de Fournier (tableau 1). Pour notre étude, nous avons utilisé la formule linéaire de [15] qui améliore l'indice F de Fournier en tenant compte des précipitations mensuelles allant d'avril à juillet et le total des précipitations pour ces mois (tableau2).

Cette période a été choisie car après juillet, la végétation (cultures, savane arbustive...) est assez développée dans le bassin versant pour assurer une résistance avancée du sol à l'érosion.

$$R = 95,77 – 6,08F + 0,477F2 / 17,2 \quad (2)$$

Avec : $F = \sum_{i=1}^{12} \frac{p_i^2}{P}$

F : indice de Fournier ;

P : précipitations annuelles (total des précipitations);

pi : précipitations mensuelles

Les valeurs de R calculées (tableau 3) ont été interpolées en utilisant une méthode d'interpolation simple, l'IDW (Inverse Distance Weight). En effet, les données espacées de plusieurs kilomètres ne présentent pas de précision suffisante pour justifier une méthode d'interpolation spécifique.

Les valeurs de R obtenues après interpolation (IDW) et découpage par rapport au secteur d'étude (figure 5) varient de 506,64 à 528,09 MJ/mm/ha.H.an dans l'ensemble du bassin versant de Sanguéré ; avec une moyenne de 520,94 et un écart type de 4,41.

3.2.2 LA CARTE PÉDOLOGIQUE ET LE FACTEUR K

Le facteur d'érodibilité exprime la vulnérabilité du sol à être érodé par la pluie. Il dépend de la granulométrie ou texture du sol, de la teneur en carbone organique, de la stabilité structurale, de la porosité, de la perméabilité, etc.

Une équation de régression a été établie par [24] pour estimer la valeur de K :

$$K= ((2.1*10-4*(12-MO) *M1.14) + 3.25*(S-3) + 2.5*(P-2))/100 \quad (3)$$

K, est le facteur d'érodibilité.

M, le facteur granulométrique, = (% limon + % sable fin) (100 - % argile).

M.O (matière organique) en %.

S, le code de la texture du sol (granulaire très fine : 1; granulaire fine : 2; granulaire moyenne et grossière : 3; en block ou massive : 4).

P, le code de la classe de perméabilité (rapide : 1; modéré à rapide : 2; modérée : 3; lente à modérée : 4; lente : 5; très lente : 6).

Les paramètres physico-chimiques des sols utiles pour le calcul de K sont indiqués dans le tableau 4.

Les textures à dominance sableuse et la très forte perméabilité des matériaux ont orienté l'attribution des valeurs indiquées dans le tableau 5 suivant pour les paramètres **S** (texture) et **P** (perméabilité).

Toutes ces données, introduites dans notre modèle RUSLE, ont permis de déterminer le facteur d'érodibilité K, suivant la formule de [24] de l'équation (3) et d'attribuer sous SIG le facteur respectif à chaque type de sol.

Le facteur K a été déterminé, dans ArcMap, en introduisant au niveau du champ_K de la table attributaire de notre carte des sols, la formule suivante (Field Calculator):

*((2.1*power(10,-4)*(12- [MO_pourcent])*power(M,1.14)) + 3.25*([S]-3) + 2.5*([P]-2))/100*

Avec : *M= power((100 - [Argile_pourcent]),2)*

En considérant que %Limon+%Sable+%Argile = 100, car les auteurs n'ont pas distingué les sables fins des sables grossiers.

Ce champ a été rastérisé (*conversion Tools > to raster > Feature to raster*) (figure 6).

Le facteur K n'a pas pu être calculé au niveau des lithosols sur grès et des sols peu évolués d'apport hydromorphes sur alluvions qui sont rencontrés respectivement sur des affleurements rocheux (inselberg) et au niveau des bas fonds marécageux, et n'ont permis aucun échantillonnage de sol d'où la valeur 0 au niveau de ces unités.

Les valeurs obtenues pour le facteur K varient de 0,080 sur les sols peu évolués d'érosion lithosolique à 0,100 t.H/MJ.mm sur sols lessivés tropicaux sur grès (tableau 6), avec une moyenne de 0,086 et un écart-type de 0,021.

Notre carte de répartition du facteur K épouse celle des sols du secteur d'étude.

3.2.3 L'IMAGE SRTM ET LE FACTEUR LS

La topographie du milieu est un facteur sensible pour l'érosion hydrique. La pente a une incidence importante sur le processus d'érosion hydrique ; le ruissellement est généralement fort et rapide sur des pentes raides causant ainsi une érosion hydrique très grave.

Le facteur topographique (LS) est calculé à partir de la longueur des pentes (L) et de leur inclinaison (S), déterminées à partir de l'image SRTM 90 m.

Les longueurs d'écoulement correspondent théoriquement au rapport de la longueur λ (m), calculée entre le sommet du versant et le début de la zone concave [16], à la longueur de la parcelle expérimentale de RUSLE (22,13 m) ; l'ensemble élevé à l'exposant m, sans dimension, intégrant l'inclinaison de la pente β.

Le facteur **L**, en fonction de la surface drainage, se calcule selon la formule suivante [7] :

$$L = ((FA + CS^2)^{m+1} - FA^{m+1}) / X^m.CS^{m+2}.(22,13)^m \quad (4)$$

Où :

FA (Flow accumulation), est l'accumulation du Flux.
CS (Cell size) est la taille du pixel.
X, un facteur de correction de la formule

L a été Déterminé dans Arcmap (*Field Calculator*):

*(Power(("Flow_acc" + 8100),("m" + 1)) - Power("Flow_acc",("m" + 1))) / (Power(90,("m" + 2)) * Power(22.13,"m")).*

Avec $F = (\text{Sin } \beta/0,0896) /(3.(\text{Sin}\beta)^{0,8} + 0,56)$ ou

*((Sin(("Pente") * (3.14 / 180))) / 0.0896) / (3 * Power(Sin(("Pente") * (3.14 / 180)),0.8) + 0.56).*

et $m =$ *"F" / (1 + "F")*

Ces deux paramètres calculés dans leur champ respectif dans la table attributaire de ce facteur, et les résultats intégrés dans l'équation finale.

Le facteur **S**, quant à lui est estimé grâce à deux régressions simples appliquées en fonction de l'angle d'inclinaison, avec la pente en degré :

$$S = 10,8\sin\beta + 0,03 \text{ si la } \tan\beta < 0,09$$

$$S = 16,8\sin\beta + 0,5 \text{ si la } \tan\beta \geq 0,09 \quad (5)$$

Sous ArcMap, il est obtenu à partir de la commande CON, qui est la fonction conditionnelle. Spatial Analyst Tools > Map algebra >Raster Calculator:

*Con(Tan(("Pente") * (3.14 / 180)) < 0.09,(10.8 * Sin(("Pente") * (3.14 / 180)) + 0.03),(16.8 * Sin(("Pente") * (3.14 / 180)) + 0.5)).*

La pente est convertie du radian au degré en multipliant par 3,14 et en divisant par 180.

Finalement le facteur LS est obtenu à partir du produit des facteurs L et S (figure 7), appliqué dans Spatial Analyst Tools > Map algebra >Raster Calculator :

"L" * "S"

Les valeurs de LS varient entre 0,03 à près de 19, avec une moyenne de 0,55 et un écart-type de 0,91.

La carte de répartition du facteur topographique (LS), montre que les valeurs les plus fortes se trouvent logiquement au niveau des altitudes les plus élevées de notre zone d'étude. Les zones de fortes pentes, correspondant aux zones de valeurs élevées du facteur LS restent très minoritaires sur la zone d'étude, avec seulement 1,03 % des valeurs supérieures à 10.

3.2.4 LES OBSERVATIONS DE TERRAIN (L'OCCUPATION DES TERRES), L'IMAGE LANDSAT-8/LDCM ET LE FACTEUR C

L'occupation du sol ou facteur de protection du sol par la couverture végétale, exprime l'affectation du sol et son usage. Ce paramètre peut influencer le risque d'érosion hydrique, en raison de son impact sur le ruissellement.

Le couvert végétal est considéré comme efficace contre l'érosion lorsqu'il absorbe l'énergie cinétique des gouttes de pluies et protège les sols surtout dans la période de l'année où les précipitations sont les plus intenses.

Dans notre étude, ce facteur a été déterminé à partir de deux supports : nous nous sommes tout d'abord appuyés sur la carte d'occupation du sol de notre secteur d'étude (figure 8, tableau 8, photo 1) dressée après une descente sur le terrain en avril 2013, période de l'année où le couvert végétal est à son plus bas niveau dans la région, pour affecter un coefficient en fonction du type d'occupation du sol observé (tableau 7) en nous référent aux travaux de [17] en Afrique de l'ouest et de [13] à Madagascar.

Nous avons par la suite utilisé l'image Landsat-8/LDCM pour déterminer l'indice transformé de végétation ajusté pour le sol, le MSAVI2 (Second Modified Soil-Adjusted Vegetation Index) de [14].

Le MSAVI2 (équation 6) développé à partir du MSAVI, en plus de ne plus nécessiter la détermination au préalable de la valeur de la pente de la droite des sols, est utilisé pour un faible indice foliaire. Leaf Area Index (L.A.I.), ou un faible couvert végétal ; ce qui est le cas dans notre secteur d'étude en cette période de l'année.

$$MSAVI2 = \frac{(2PIR+1-\sqrt{(2*PIR+1)^2-8*(PIR-R)})}{2} \qquad (6)$$

Pour le calcul du MSAVI2 notre image a été transformée en valeurs de réflectances au sol par une calibration radiométrique et une simulation de correction atmosphérique sur l'image.

La pratique d'un traitement radiométrique incluant une correction atmosphérique est indispensable ici, car l'on veut accéder aux propriétés quantifiées (grandeurs physiques de l'image) des surfaces pour le calcul de l'indice de végétation.

La technique utilisée pour la calibration radiométrique est celle développée par [22] pour l'obtention du TOA (*Top Of Atmosphere reflectance*) ou réflectance au-dessus de l'atmosphère, pour Landsat. Elle se résume comme suite:

- La conversion des valeurs numériques (DN, en anglais : Digital Number) en valeurs de réflectance au-dessus de l'atmosphère (TOA) par détermination du paramètre **Lλ'** à partir de la relation :

$$L\lambda' = ML * Qcal + A\rho \qquad (7)$$

Où:

Lλ' = le TOA (Watts / (m^2 * srad * um)) ; sans correction de l'angle du soleil.

ML = facteur multiplicatif de mise à l'échelle de la bande spécifique obtenu dans le fichier des métadonnées (.MTL) de l'image (REFLECTANCE_MULT_BAND_x, où x est le numéro de la bande).

Aρ = facteur additif de rééchelonnement spécifique de chaque bande, obtenu dans le fichier des métadonnées (.MTL) de l'image (REFLECTANCE_ADD_BAND_x), où x est le numéro de la bande).

Qcal = valeurs de pixels standards quantifiés et calibrés (DN) ou encore l'image de la Bande_x.

- Le calcul du TOA avec correction de l'angle solaire par application de la formule suivante :

$$L\lambda = L\lambda' / \cos\theta s$$

Où

Lλ' = la réflectance au dessus de l'atmosphère ou le TOA

cosθs = cosinus du zénith solaire; zénith solaire = 90° - élévation solaire.

L'élévation solaire est obtenue à partir du fichier des métadonnées .MTL de notre image.

Cette étape a été calculée pour chaque bande de notre image à travers le module Band Math du logiciel ENVI 5.0.

- La simulation de correction atmosphérique par conversion des TOA en réflectance de surface s'est faite par la méthode du Dark Object Subtraction (DOS).

L'application du DOS s'est faite automatiquement par le logiciel ENVI 5.0 à travers le module Dark Subtraction.

La carte obtenue après affectation des coefficients à C a été rastérisée à partir de l'outil Conversion Tools > To Raster > Polygone to Raster dans Arcmap, à une résolution de 90m et correspond à C1 ou facteur C1 (figure 11).

La détermination du MSAVI2 (figure 10) peut être faite soit dans Erdas Imagine à travers un Model Marker, soit implémentée à partir de *Spatial Analyst Tools > Map algebra >Raster Calculator*, où l'on introduit la formule suivante :

(2"B4"+1-(SquareRoot(Power((2*"B4"+1),2)-8*("B4"-"B3")))) / 2.*

Avec B4, la réflectance dans la bande proche infra rouge (PIR) et B3, la réflectance dans la bande Rouge (R) de notre image.

Ou encore implémentée dans ENVI à travers band math en introduisant :

float((2(b1)+1-sqrt((2*(b1)+1)^2-8 * ((b1) - (b2))))/2)*

Avec b1, la réflectance dans la bande proche infra rouge (PIR) et b2, la réflectance dans la bande Rouge (R) sont sélectionnées à la demande.

Nous avons opté pour le Model Maker (figure 9) pour sa simplicité.

Le calcul du MSAVI2 a permis la détermination du facteur C2 (figure 12).

Le MSAVI2 est un indice non normalisé, les valeurs ne sont donc pas bornées. Les zones claires (blanches) de notre image représentent un fort pourcentage de la végétation, les zones sombres un faible pourcentage de la végétation. Les valeurs obtenues dans notre bassin versant varient entre 0,174 et 0,607 avec une moyenne de 0,296 et un écart type de 0,050. Les valeurs correspondant à la végétation sont celles supérieures à environ 0,300. L'image MSAVI2 laisse transparaitre de faibles conditions de végétation dans notre secteur d'étude.

La valeur 1 du facteur C1 correspond à la valeur maximale en termes d'efficacité des processus érosifs. Les valeurs obtenues pour C2 varient de 0,1820 à 0,598 avec une moyenne de 0,296 et un écart type de 0,050.

Le facteur occupation du sol obtenu à partir des observations sur le terrain (C1) présente des données circonscrites aux coefficients introduits alors que ce même facteur obtenu à partir de l'image d'observation de la terre (C2) présente des valeurs continues caractéristiques de la transition non franche entre les différents types du couvert végétal.

3.2.5 LES OBSERVATIONS DE TERRAIN (LA CARTE DE TECHNIQUES ANTIEROSIVES) ET LE FACTEUR P

Le facteur P exprime l'influence des méthodes de conservation sur l'érosion. Les cultures en courbes de niveau, en bandes alternées ou en terrasses, les reboisements en banquettes, le buttage et le billonnage sont les pratiques les plus efficaces de conservation des sols. Les valeurs de P sont inférieures ou égales à 1. La valeur 1 est attribuée aux terrains sur lesquels aucune des pratiques citées n'est utilisée [19].

La population rurale de notre secteur d'étude a bénéficié de la part du projet Développement Paysannal et Gestion des Terroirs (DPGT), du projet Eau Sol Arbre (ESA), tous deux appuyés par les spécialistes de l'Institut de Recherche Agricole pour le Développement (IRAD), des formations et encadrements pour la mise en place des techniques culturales et pratiques

antiérosives (cordons pierreux, végétalisation par les graminées, des bandes antiérosives, les bourrelets au niveau des courbes de niveau…). Ce facteur a été déterminé à partir des observations faites sur le terrain (figure 13, photos 2).

Les valeurs correspondant aux différentes pratiques antiérosives (tableau 9) ont été introduites dans le champ approprié. Ce dernier a par la suite été rastérisé à 90 m de résolution à travers le module Conversion Tools > To Raster > Polygone to Raster (figure 14).

Les valeurs obtenues pour ce facteur P varient de 0,01 pour les pailles à recouvrement de plus de 50% à 1 pour les zones n'ayant aucune pratique antiérosive ; avec une moyenne de 0,417 et un écart-type de 0,349. La valeur 1, aucune pratique observée, correspond aux affleurements (inselberg) et aux zones non cultivées essentiellement. Les pratiques antiérosives sont bien développées dans la majorité de notre bassin versant avec une dominance de la technique du labour en isohypses (tableau 10).

Les zones où sont pratiquées des labours en isohypses représentent plus de la moitié de notre secteur d'étude et correspondent logiquement aux zones de cultures qui sont actuellement (en avril 2013) en chaume.

4 RÉSULTATS : ÉROSION HYDRIQUE, CERTES MODÉRÉE DANS LE BASSIN VERSANT MAIS, À TENIR COMPTE

SPATIALISATION DES PERTES EN SOL

Le croisement des différents facteurs utiles pour notre modèle s'est fait dans notre SIG (ArcGis) où nous avons introduit le produit de ces différents paramètres obtenus (R, K, LS, C et P) à travers l'option Spatial Analyst Tools > Map algebra >Raster Calculator :

"R" * "K" * "LS" * "Cx" * " P"

Le résultat obtenu, qui correspond aux zones de notre bassin versant exposées à l'érosion hydrique des sols, constitue le paramètre A de notre modèle RUSLE.

Les résultats de la spatialisation du risque d'érosion hydrique sont proposés sous deux formes.

La première forme (figure 15, a et b) présente le phénomène en continue; ce qui fournit un aperçu rapide de la situation dans la zone d'étude.

Chaque unité possède les valeurs homogènes des cinq facteurs du RUSLE.

La seconde forme (figure 16, a et b) présente la spatialisation du risque répartie en six classes (tableau 11 et tableau 12), pour C1 et C2 respectivement. Cette classification permet une représentation plus détaillée et, par là, une bonne identification des causes de risques dans le bassin versant.

Une analyse des données indique que les valeurs obtenues présentent un risque d'érosion variant dans notre zone d'étude et surtout une structure spatiale définie par la localisation topo-paysagère. Les secteurs où l'érosion n'a pu être déterminée (classe 1) correspondent aux zones où le facteur K n'a pu être calculé c'est-à-dire les affleurements rocheux (inselberg) et les bas fonds marécageux, qui n'ont permis aucun échantillonnage de sol. Les zones présentant les plus hauts niveaux de risque d'érosion sont localisées au niveau des sols sous savane sèche et de certaines pentes de collines et celles présentant le risque d'érosion modérée se trouvent, majoritairement, au niveau des chaumes. Si l'on considère qu'à partir de la classe d'érosion modérée le risque est important, notre bassin versant présenterait pour la première carte à risque (C1) une superficie d'environ 51,72 Km² exposée à l'érosion hydrique, soit 62,46 % de sa superficie totale ; et pour la seconde carte à risque (C2) une superficie d'environ 61,40 Km² exposée à l'érosion hydrique, soit 74,60 % de sa superficie totale

UNE ÉROSION HYDRIQUE DES SOLS, CERTES MODÉRÉE DANS LE BASSIN VERSANT MAIS, À EN TENIR COMPTE

Pour faciliter la comparaison des deux résultats obtenus, une avons effectué une superposition des valeurs de pourcentage de la surface des classes d'érosion de ces deux résultats (figure 17, tableau 13).

L'observation des résultats issus de la comparaison entre ces deux résultats (C1 et C2) présente globalement des différences peu significatives. En effet, l'écart entre les deux résultats ne dépasse que ponctuellement les 2%, les écarts les plus importants étant un peu plus de 10%. Ce résultat est logiquement expliqué par le fait que la couche facteur C qui joue un rôle important dans les processus d'érosion n'est pas la même pour C1 (coefficients affectés) et C2 (interprétation du

MSAVI2). La précision des thèmes d'occupation du sol, notamment des sols nus et des zones boisées ont agit directement sur le résultat de C1.

Par rapport aux observations faites sur le terrain et à l'interprétation visuelle des images Landsat 8 et google earth de la zone, la spatialisation du risque d'érosion obtenue avec la couche MSAVI2 nous semble présenter le mieux le risque dans le bassin versant de Sanguéré. Toutefois, nous notons une similitude entre les deux résultats de spatialisation du risque d'érosion avec une forte corrélation de plus de 80% (figure 18).

5 DISCUSSIONS

L'application du modèle RUSLE apporte une information intéressante sur le risque dans le bassin versant de Sanguéré. Il convient cependant de discuter les résultats présentés dans cette étude au vue de l'échelle d'analyse, des paramètres du modèle par rapport aux données (disponibles) utilisées et du choix de l'équation.

Les données utilisées dans le cadre de notre travail sont issues de bases de données globales (SRTM, USGS), des structures régionales publiques (Station météorologique de Garoua), privées (SODECOTON), des observations de terrain ou encore produites à partir d'anciennes cartes (carte pédologique). L'échelle de production des facteurs de l'équation est donc différente ; une maille de 90 m a donc été choisie.

L'échelle d'analyse qui est ici celle d'un bassin versant de quelques km² correspond à celle de la modélisation initiale proposée par [24] qui porte sur de petites parcelles (100 m²) ou de petits bassins versants de quelques hectares.

Le facteur R a été calculé à partir de l'équation de régression proposée par [15] qui améliore l'indice F de Fournier en tenant compte des précipitations mensuelles et la moyenne annuelle des précipitations (dans notre cas, le total des précipitations sur les mois considérés). Il a été calculé à partir des données fournies par le Service d'Appui Technique de la SODECOTON complétées par celle de la station météorologique de Garoua, toutes couvrant notre site. Le nombre insuffisant des stations de relevées pluviométriques dans la région, la qualité des instruments existant et les erreurs de relevés dus aux opérateurs poseraient le problème quant à la précision de ce facteur. Les résultats obtenus, semblables à ceux obtenus par Roose (1977) en Afrique de l'Ouest et du centre sont satisfaisants pour cette étude.

Le calcul du **facteur K** a été produit par application de la formule proposée par [24] sur les données issues de l'analyse de la carte pédologique détaillée du bassin versant de Sanguéré, dressée par [4]. Les valeurs moyennes des paramètres physico-chimiques des 20 premiers centimètres des sols ont été utilisées. Cette approche a permis d'estimer l'érodibilité des sols en fonction de leurs textures. Il faut tout de même noter que ce facteur varie dans le temps et dans l'espace en fonction des propriétés dynamiques du sol, de la pente, de l'occupation du sol et des techniques culturales [18]. Dans notre étude, les valeurs de K ont été attribuées en exploitant la notice explicative de la carte des sols. Mais, les données sur la pédologie, bien que détaillées de notre bassin versant, ne sont plus représentatives des conditions actuelles. La carte pédologique date des années 1970-1980 (comme toutes les autres cartes pédologiques de la région) et mérite d'être mise à jour. Les propriétés physiques et chimiques (texture, structure, matière organique, perméabilité…) pour les horizons superficiels ont pu changer dans le temps du fait de la rotation culturale annuelle et l'intense activité agricole dans le bassin versant. Une fois les sols dénudés, leur modification est favorisée par l'agressivité du climat et leur fragilité naturelle, ce qui entraîne l'accélération des pertes de sols. Il serait donc intéressant de disposer de données mises à jour sur la granulométrie en fonction des différents types d'occupation du sol et sur la matière organique.

Pour le calcul du **facteur LS**, tous les traitements permettant d'aboutir au calcul de ce facteur ont été réalisés à partir du SRTM à 90 m de résolution spatiale, ceci pose alors la question de la précision de la donnée produite en sortie.

Cependant selon différents travaux [11] - [6], le SRTM apporte une description plus fidèle de la topographie par rapport à d'autres types de données telles que les données ASTER DEM à 30 m de résolution. En effet, ces données à plus haute résolution spatiale sont produites à partir d'images optiques par stéréoscopie [8] - [12] et offrent une représentation moins réaliste de la topographie. Les calculs de pentes qui en découlent montrent une tendance à la surestimation des zones planes à modérément planes".

L'équation utilisée pour le calcul du facteur LS montre des résultats satisfaisants par rapport à la topographie réelle du bassin versant, dont la pente est en moyenne inférieure à 5 % et la longueur de pente maximale estimée à 263 m.

Pour **le facteur C**, il s'est tout d'abord posé le problème d'affectation des coefficients à ce facteur. En effet, il a été difficile pour nous de distinguer la nature exacte de l'occupation du sol ou encore le taux exact de recouvrement du sol, à cause de la période d'observation, ce qui poserait le problème quant à sa précision. Néanmoins, nous nous sommes appuyés sur d'autres

travaux ([17] en Afrique de l'ouest et [13] à Madagascar) pour affecter les coefficients à ce facteur en fonction du type d'occupation du sol. Par la suite nous avons utilisé l'image Landsat8 pour déterminer l'indice de végétation MSAVI2 ; les résultats obtenus pour les deux cas sont très proches quand à la spatialisation du phénomène, satisfaisantes et reflètent, presque, la réalité sur le terrain.

Le facteur P est essentiellement issu des d'observations faites sur terrain, c'est le seul facteur qui reflète parfaitement la réalité de terrain.

Aujourd'hui, beaucoup d'équations existent dans la littérature pour la détermination des pertes en sol. Le modèle le plus rencontré, le RUSLE a souvent été utilisé hors de son contexte d'application ; les équations dérivées permettent de le déployer dans des régions climatiques et géologiques différentes ainsi qu'aux pays peu renseignés dont les données sont peu disponibles ou inexistantes (les pays en voie de développement, intertropicaux, méditerranéens...). Dans ces milieux, le besoin d'information sur les processus érosifs à échelle régionale est important au vue de la dégradation actuelle sur les bassins versants.

Le RUSLE est un modèle empirique par conséquent son application à une zone d'étude donnée peut être à l'origine de biais ou d'erreurs dans l'évaluation des facteurs de cet équation et donc dans celle des pertes de sol. Cependant, son intégration dans un SIG présente beaucoup d'avantages, surtout ceux liés au grand nombre de résultats relatifs aux facteurs impliqués dans l'érosion hydrique :

- gestion de façon rationnelle, d'une multitude de données qualitatives et quantitatives relatives aux différents facteurs de l'érosion ;
- production d'une carte synthétique de répartition des degrés de sensibilité à l'érosion des différentes zones du bassin versant. Cette cartographie est un outil pour la gestion de l'érosion. Les décideurs locaux peuvent cibler leurs actions et simuler les scénarios d'évolution.

6 ESSAI DE VALIDATION DU MODÈLE

Une validation rigoureuse de notre modèle et les cartes produites nécessite la mise en correspondance de nos cartes à risque (sur quelques zones représentatives) avec des observations sur le terrain. Cependant, faute de pouvoir retourner sur le terrain pour cette étape de validation, nous avons comparé directement les résultats issus de notre étude à des données sur l'érosion hydrique acquises par d'autres voies.

Très peu de mesures sur l'érosion dans le nord existent. Les rares données concernent des mesures in situ sur quelques bassins versants représentatifs [23] et sur des parcelles d'érosion (57 parcelles) de 100 à 1080 m^2 [3] effectuées dans le Nord Cameroun (Sanguéré-Djalingo et Mbissiri, respectivement). Ces études ont essentiellement quantifié les pertes en terre ; il est donc difficile de faire une comparaison directe entre ces valeurs mesurées et notre carte spatialisant le risque. Cependant, les valeurs obtenues 0.5 à 35 t/ha/an à Sanguéré-Djalingo ; 05 à 35 t/ha/an (sur le système de culture conventionnel), 0.2 à 03 t/ha/an (sur le système conservateur), 03 à 05 t/ha/an (sur le labour paillé) à Mbissiri (un village situé au sud-est de Garoua) sont d'un ordre de grandeur pouvant correspondre aux classes de risque érosif spatialisé dans notre secteur. Les résultats fournis par ces méthodes différentes semblent cohérents.

Au-delà des difficultés de validation, et malgré le fait que la carte du risque d'érosion hydrique présente uniquement les secteurs à risque de détachement des sédiments, les zones de dépôt n'apparaissant pas, nous pensons que la répartition spatiale proposée reflète toutefois la réalité dans le bassin versant, productif, de Sanguéré.

En définitive, **on ne peut donc pas considérer que le modèle soit strictement validé à ce stade du travail**. Un programme de suivi sur plusieurs années est envisagé dans le site et dans d'autres bassins versant exposés au risque d'érosion hydrique.

7 TABLEAUX, FIGURES ET PHOTOS

7.1 TABLEAUX

Tableau 1. Calculs approximatifs de R (Eltaif et al., 2010)

Auteurs	R
Arnoldus (1977) – exponentiel	R = 0,03*F1,9 pour les USA et l'Afrique
Arnoldus (1980) - linéaire	R = (4,17*F-152)/17,2
Renard et Freimund (1993)	R = 0,07397*F1,847/17.2 quand F<55mm
Renard et Freimund (1993)	R = 95,77 - 6,08F + 0,477F2/17.2 quand F>=55mm
Yu et Rosewell (1996)	R = 3,82*F1,41

Tableau 2. Précipitations moyennes mensuelles (mm), totales (mm) pour la période 1998-2011

X (m)	Y (m)	Stations	avril	mai	juin	juillet	Total
322449	**1032111**	**Garoua**	38,35	95,5	163,79	177,42	475,06
353299	**1001537**	**Lagdo**	18,85	75,86	167,71	186,07	448,49
336429	**997764**	**Ngong**	19,71	82,43	141,43	163,14	406,71

Tableau 3. Valeurs moyennes de R calculées

Stations	Total_P (mm)	F	R (MJ/mm / ha. H. an)
Garoua	475,06	145,023	537,58
Lagdo	448,49	153,54	605,06
Ngong	406,71	132,28	444,08

Tableau 4. Propriétés physiques (sur 20 cm) des sols étudiés

Type de sols	Argile (%)	Limon (%)	Sable (%)	M.O(%)	Texture
Lithosols sur grès	-	-	-	-	**-**
Sols peu évolués d'apport hydromorphes sur alluvions	-	-	-	-	**-**
Sols peu évolués d'érosion lithosolique	13,1	8,8	78,1	0,8	Sableux
Sols ferrugineux Tropicaux lessivés	13,2	6,8	80	0,6	Limono-sableux
Sols Ferrugineux Tropicaux Beiges	6,6	11	82,4	0,82	Sablo-limoneux
Sols Ferrugineux Tropicaux Rouges	6,6	11	82,4	0,82	Sablo-limoneux
Sols peu évolués d'apport sur colluvions	9,9	7,3	87,8	0,6	Sablo-limoneux
Sols hydromorphes minéraux à gley de surface sur grès	5,25	12,5	82,25	0,7	Sablo-limoneux
Sols lessivés Tropicaux sur grès	5,4	11	83,6	0,5	Sablo-limoneux

Tableau 5. Valeurs de S et P des sols étudiés

Type de sols	Texture	S	Perméabilité	P
Lithosols sur grès	Sableux	3	Perméable	2
Sols peu évolués d'apport hydromorphes sur alluvions	Limono-sableux	3	Perméable	2
Sols peu évolués d'érosion lithosolique	Sablo-limoneux	3	Perméable	2
Sols ferrugineux Tropicaux lessivés	Sablo-limoneux	3	Perméable	2
Sols Ferrugineux Tropicaux Beiges	Sablo-limoneux	3	Très perméable	1
Sols Ferrugineux Tropicaux Rouges	Sablo-limoneux	3	Très perméable	1
Sols peu évolués d'apport sur colluvions	Sablo-limoneux	3	Perméable	2
Sols hydromorphes minéraux à gley de surface sur grès	Sableux	3	Perméable	2
Sols lessivés Tropicaux sur grès	Limono-sableux	3	Perméable	2

Tableau 6. Valeurs de S et P des sols étudiés

Facteur K	Surface (Km²)	Pourcentage
0,100	4,587	5,63
0,099	3,991	4,9
0,095	41,847	51,33
0,094	01,274	1,56
0,082	10,963	13,45
0,080	14,650	17,97
0	**4,211**	**5,16**

Tableau 7. Facteur C en fonction du type d'occupation du sol

Type d'occupation du sol	Facteur C
Champs et Plantations (vert)	0,01
Chaume	0,02
Inselberg	0,9
Savanes et arbustes sur colline de pierre	0,2
Savanes herbacées (verte)	0,01
Savanes sèches, quelques pieds d'arbustes	0,4
Sol nu	1
Villages	0,15
Zones boisées	0,001

Tableau 8. Répartition de l'occupation du sol dans le secteur d'étude

Occupation du sol	Surface (Km²)	(%)
Champs et Plantations (vert)	0,047	0,06
Chaume	55,069	67,33
Inselberg	6,972	8,52
Savanes et arbustes sur colline de pierre	0,259	0,32
Savanes herbacées (verte)	0,201	0,25
Savanes sèches, quelques pieds d'arbustes	7,004	8,56
Sol nu	0,992	1,21
Villages	3,001	3,68
Zones boisées	8,236	10,07

Tableau 9. Catégorisation du facteur P

Techniques	Code
Aucune pratique	1
Labour isohypse	0,5
Paille à recouvrement de 50%	0,2
Prairie, plantes de couverture	0,1
Murette de pierre	0,01

Tableau 10. Répartition du facteur P dans le bassin versant de Sanguéré

P	Nature	Surface (Km²)	Pourcentage
0,01	Paille à recouvrement de 50%	0,008	0,010
0,1	Murette en pierre	1,478	1,807
0,2	Labour isohypse	55,069	67,333
0,5	Prairie, plantes de couvertute	4,415	5,399
1	Aucune pratique	20,816	25,451

Tableau 11. Classes d'érosion et répartition dans le bassin de Sanguéré pour C1

Classe	Erosion des sols	Surface (Km²)	Pourcentage (%)
1	Non déterminée	03,93	04,75
2	Nulle à Très Faible	11,18	13,51
3	Faible	15,96	19,28
4	Modérée	28,54	34,48
5	Elevée	15,25	18,41
6	Grave	07,92	09,57

Tableau 12. Classes d'érosion et répartition dans le bassin de Sanguéré pour C2

Classe	Erosion des sols	Surface (Km²)	Pourcentage (%)
1	Non déterminée	03,9	04,73
2	Nulle à Très Faible	09,9	12,03
3	Faible	07,11	08,64
4	Modérée	37,1	45,07
5	Elevée	17,52	21,29
6	Grave	06,78	08,24

Tableau 13. Comparaison entre les surfaces (%) des résultats de C1 et C2

classes	Erosion des sols	C1	C2	C1 –C2
1	Non déterminée	4,75	4,73	0,02
2	Nulle à Très Faible	13,51	12,03	1,48
3	Faible	19,28	8,64	10,64
4	Modérée	34,48	45,07	-10,59
5	Elevé	18,41	21,29	-2,88
6	Grave	9,57	8,24	1,33

7.2 FIGURES

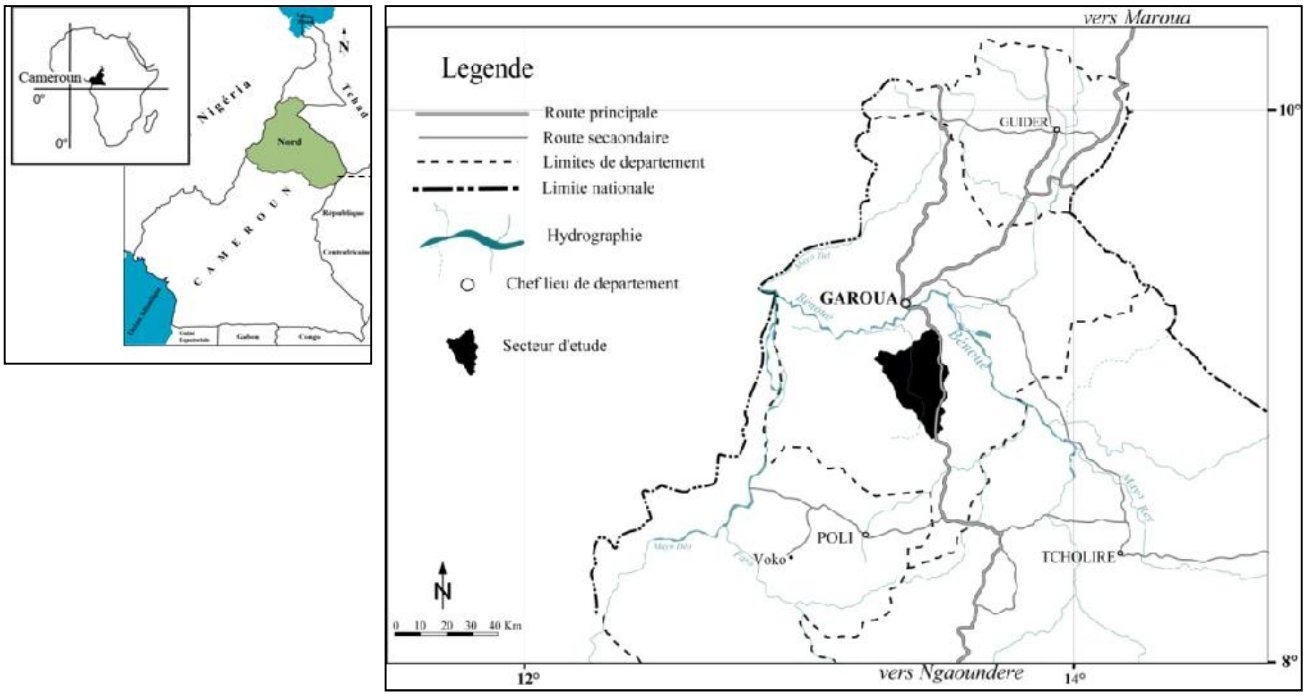


Fig. 1. Localisation du bassin versant de Sanguéré

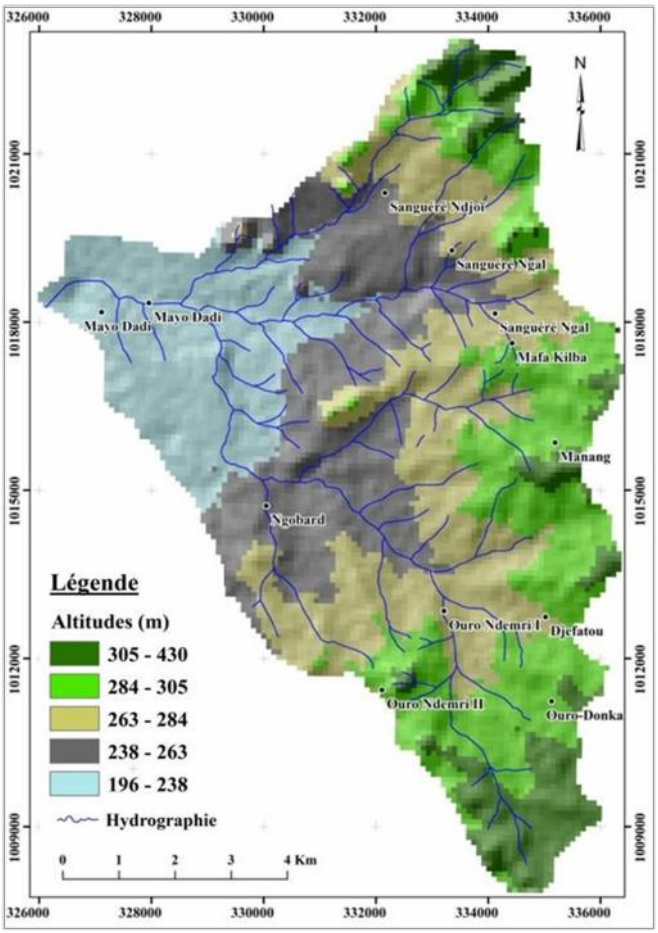


Fig. 2. Oro-hydrographie de la zone d'étude

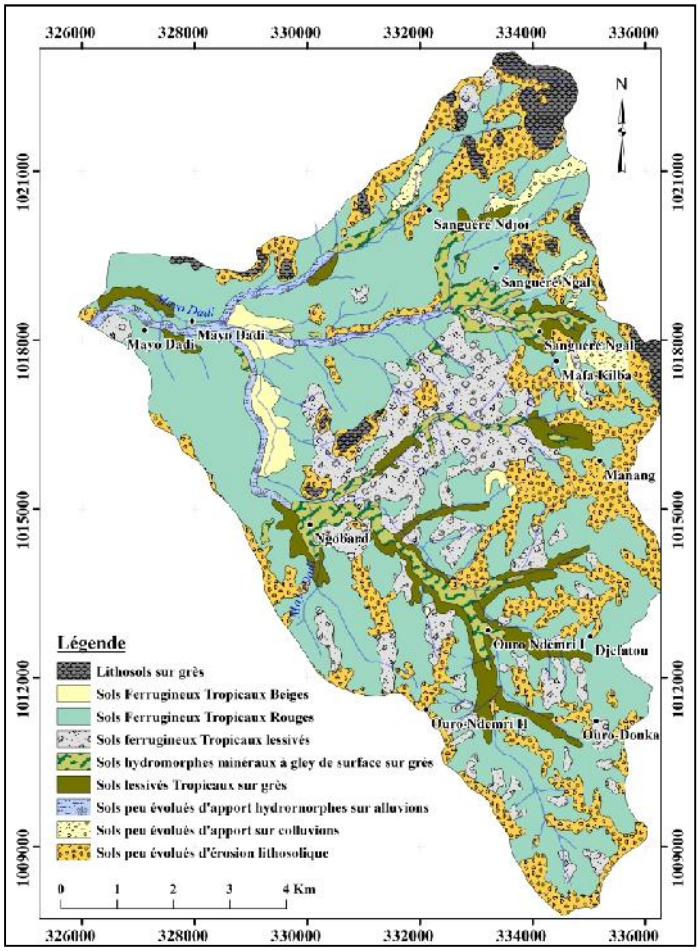


Fig. 3. Carte des sols du bassin versant de Sanguéré (Brabant et Fardin, 1979).

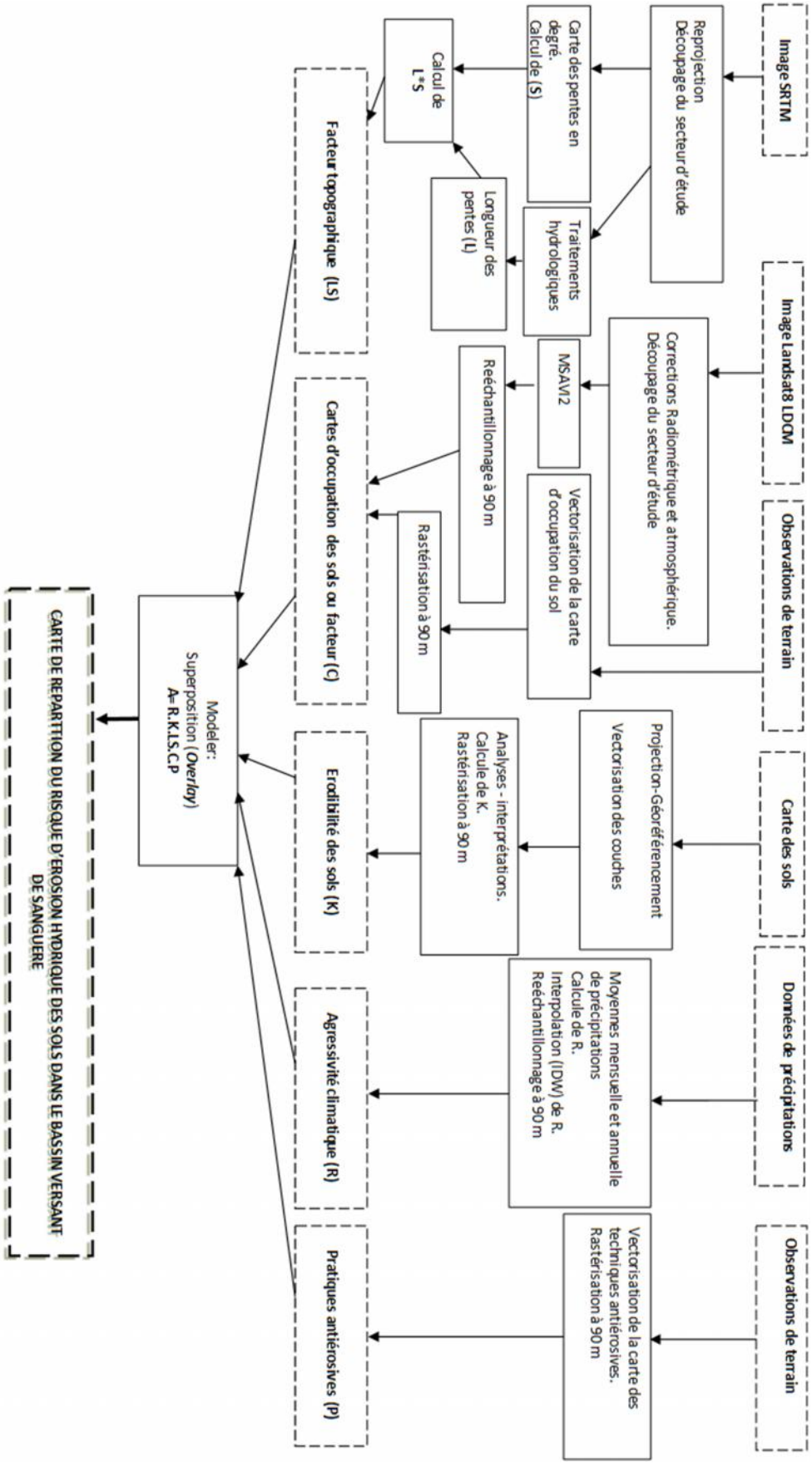


Fig. 4. Organigramme de la méthode suivie dans cette étude

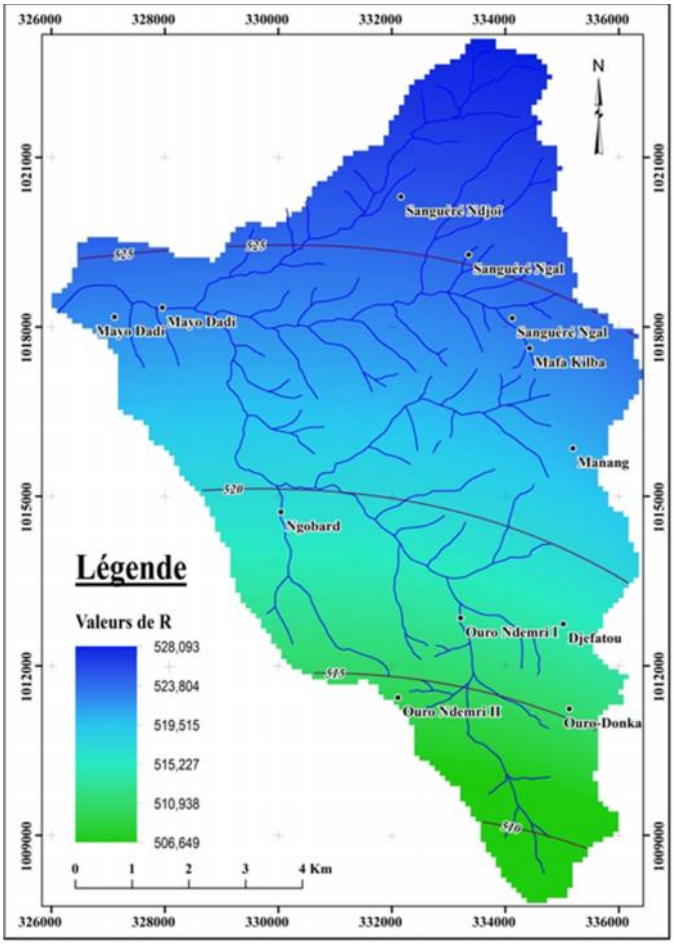


Fig. 5. Distribution des valeurs du facteur R

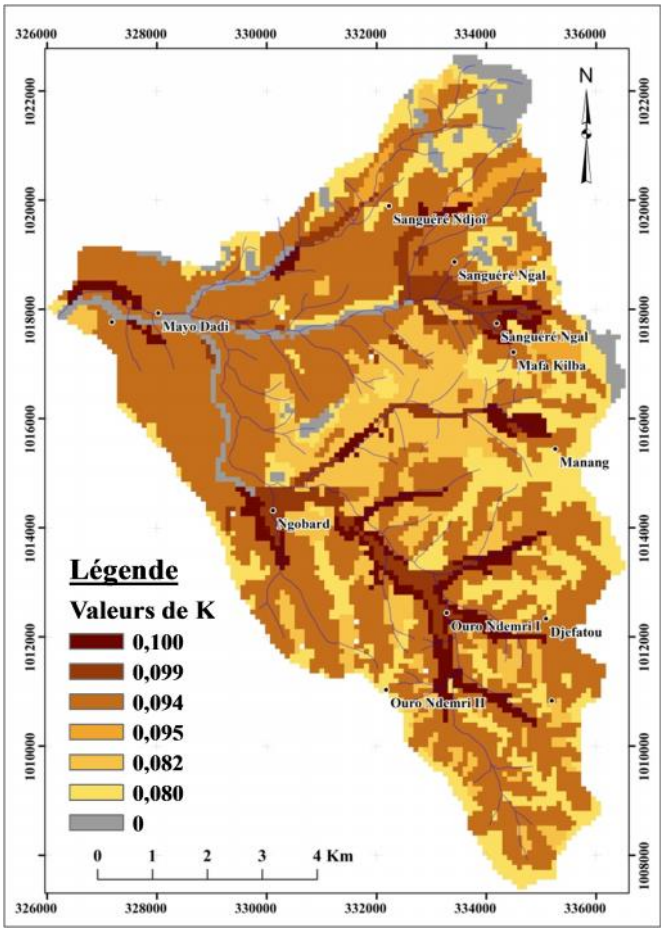


Fig. 6. Le facteur d'Erodibilité (Facteur K)

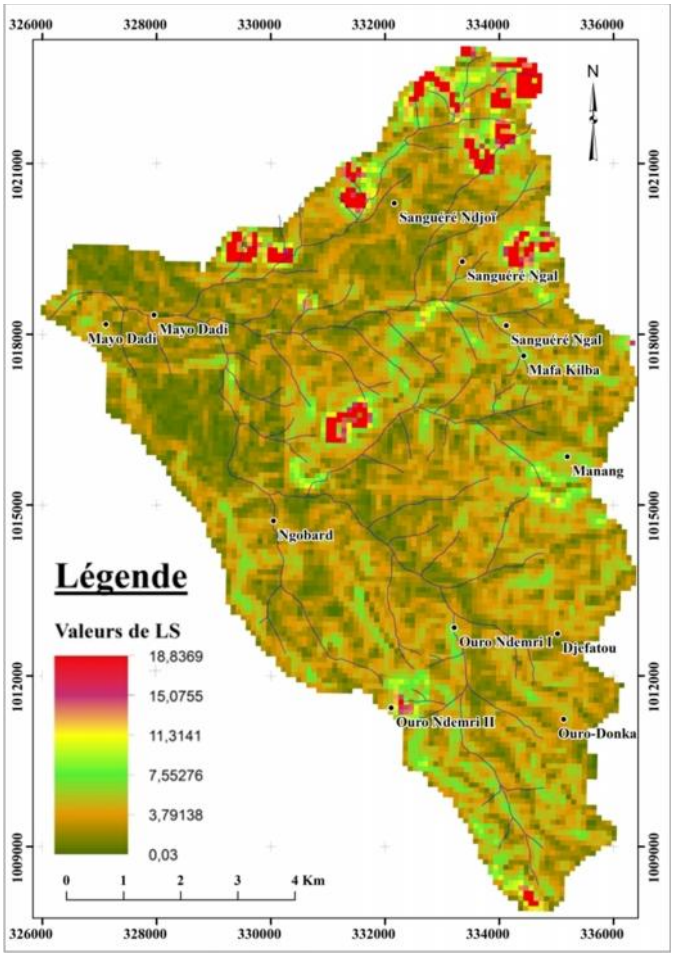


Fig. 7. Le facteur topographique (Facteur LS)

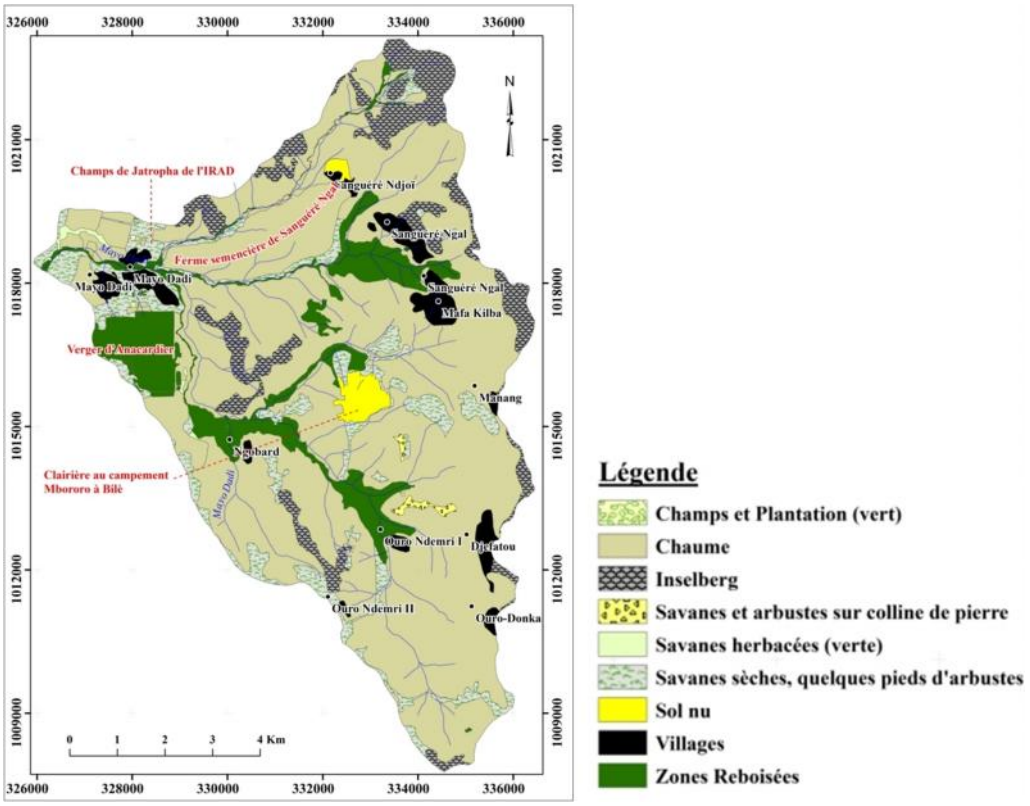


Fig. 8. L'occupation du sol dans le bassin versant de Sanguéré

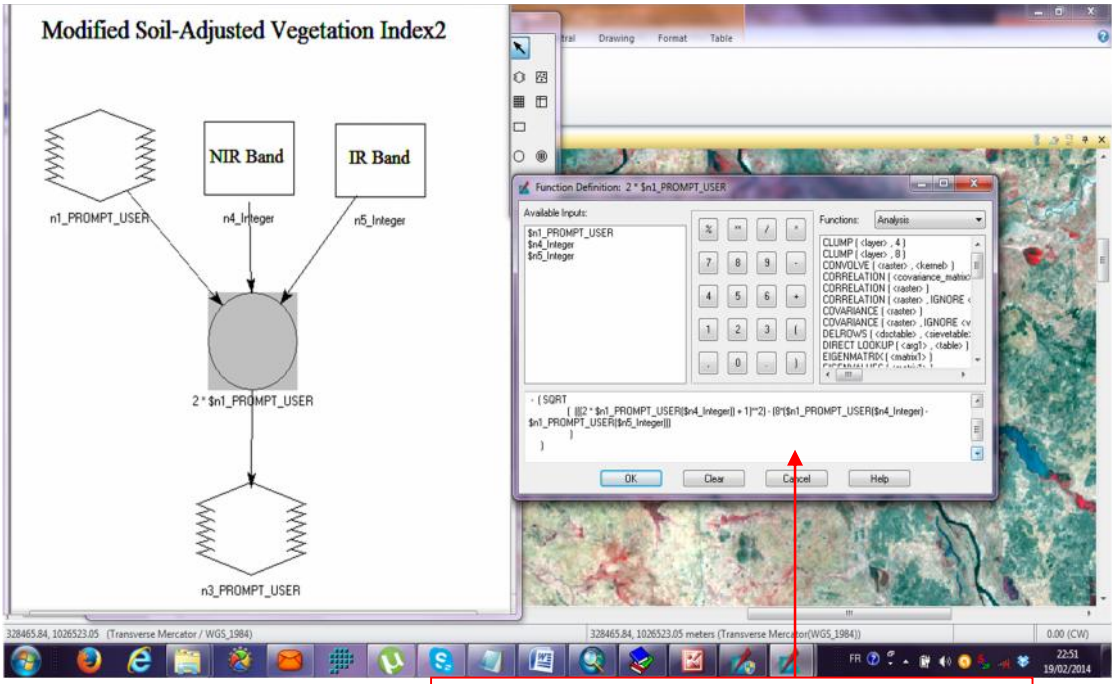


Fig. 9. Model Maker pour le calcul du MSAVI2

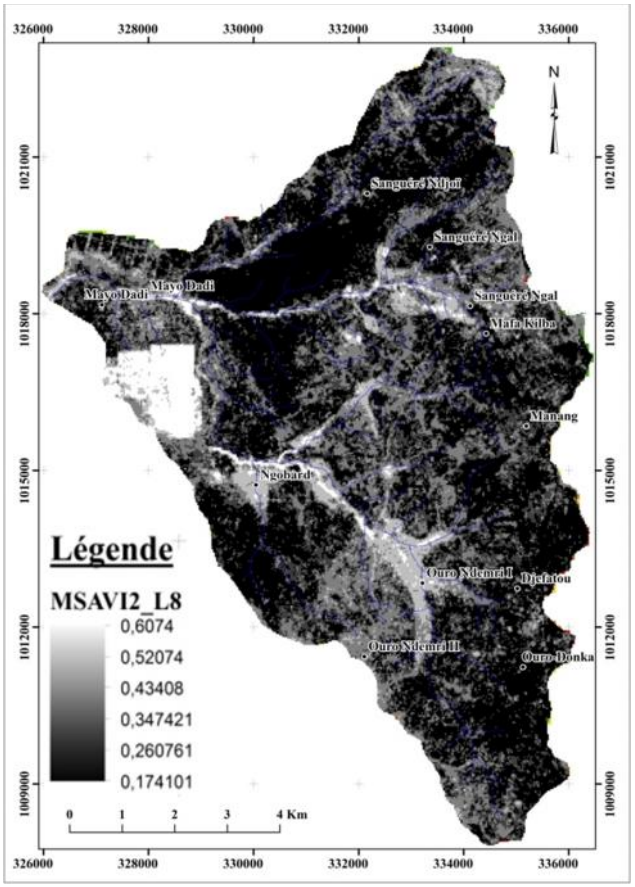


Fig. 10. L'image MSAVI2 dans le secteur d'étude

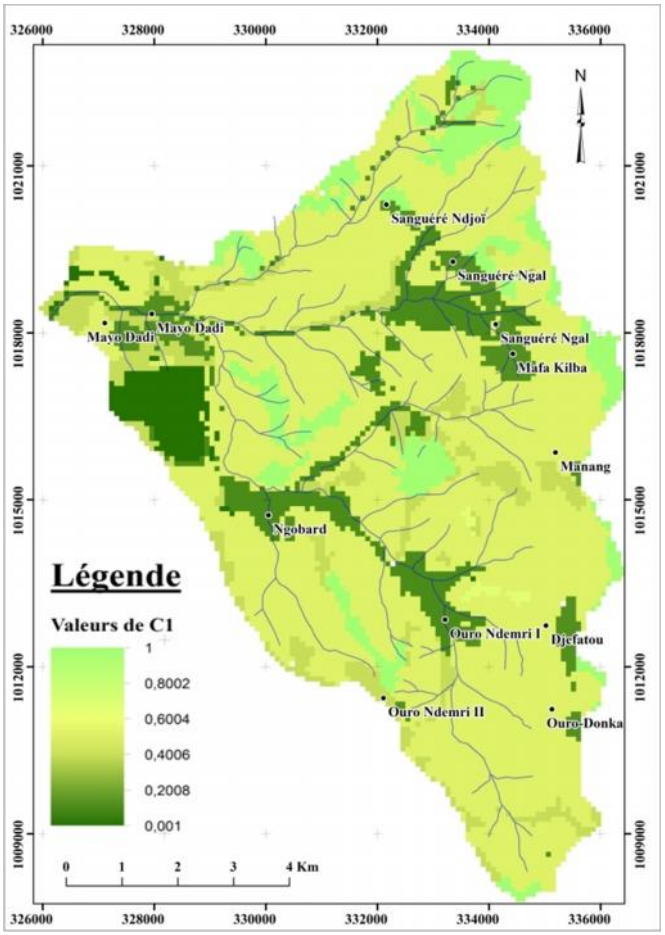


Fig. 11. Le facteur C1

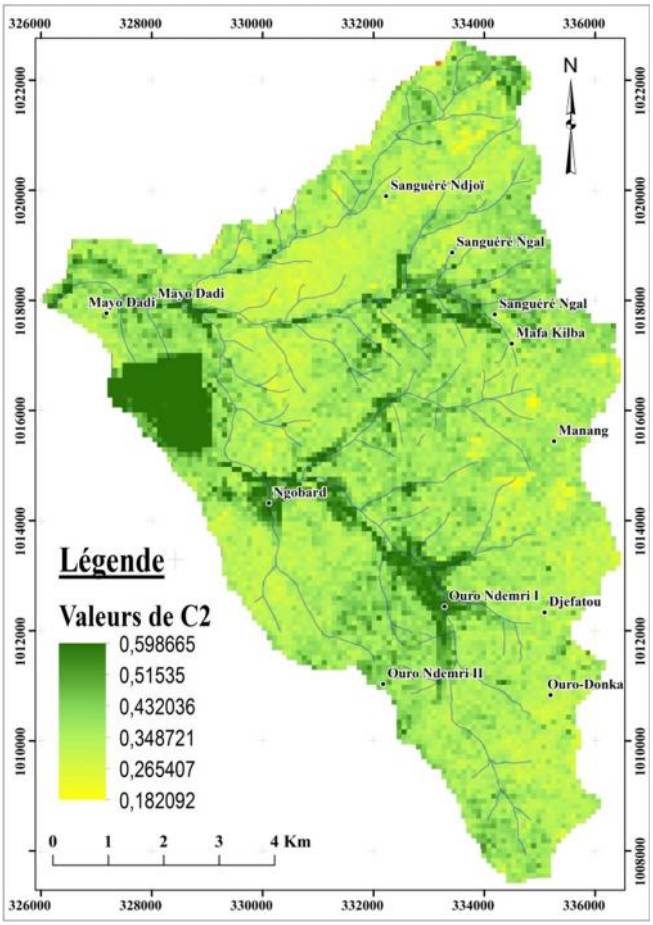


Fig. 12. Le facteur C2

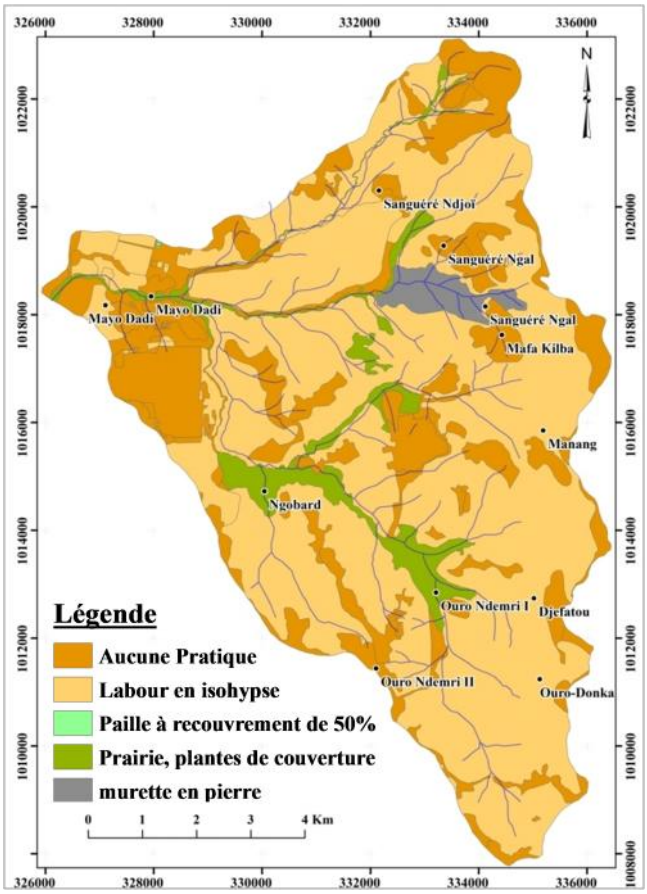


Fig. 13. Les pratiques antiérosives dans le secteur d'étude

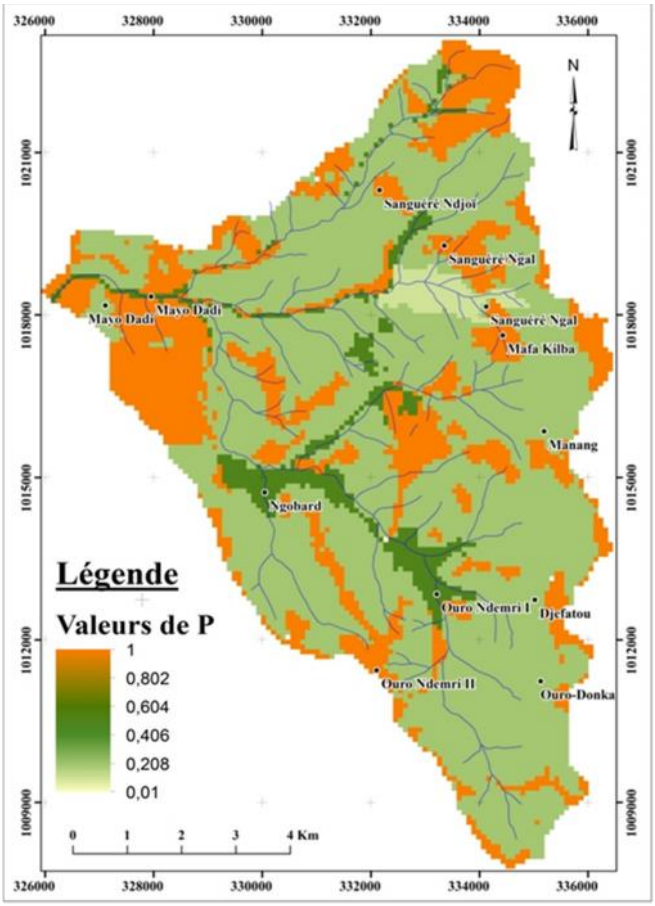


Fig. 14. Le facteur pratiques antiérosives

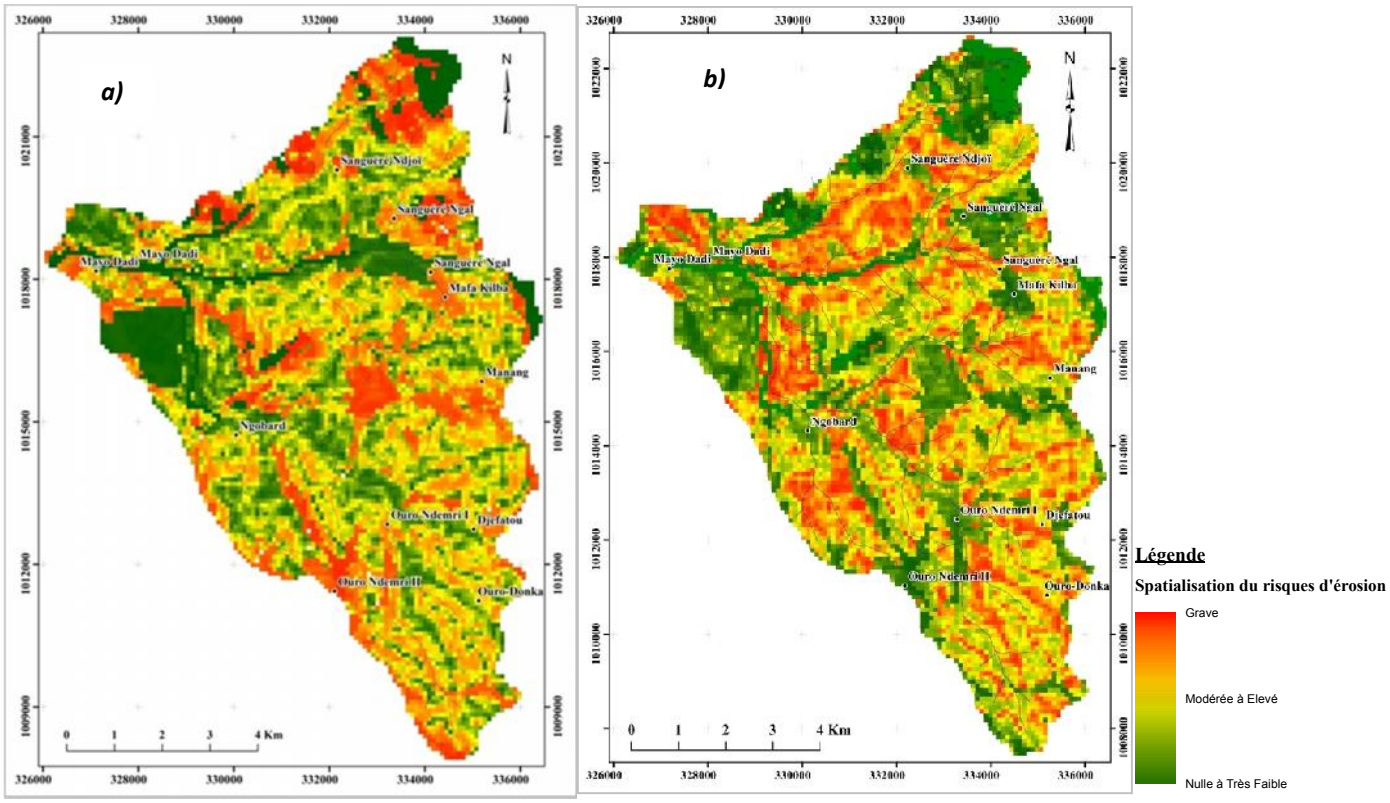


Fig. 15. Répartition spatiale en continue de l'érosion des sols dans le bassin versant de Sanguéré. a) en fonction de C1 ; b) en fonction de C2

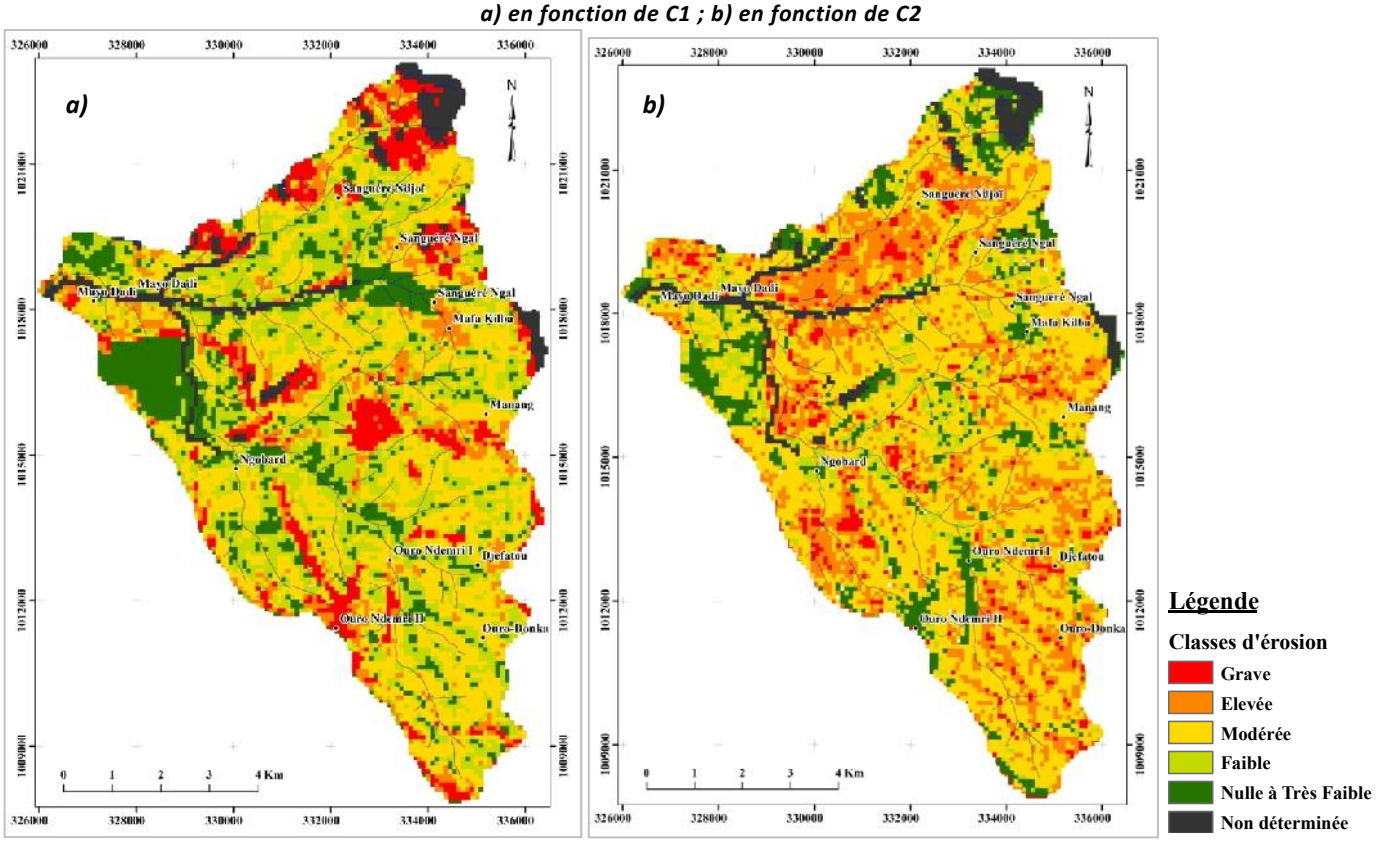


Fig. 16. Répartition spatiale en classe de l'érosion des sols dans le bassin versant de Sanguéré. a) en fonction de C1 ; b) en fonction de C2

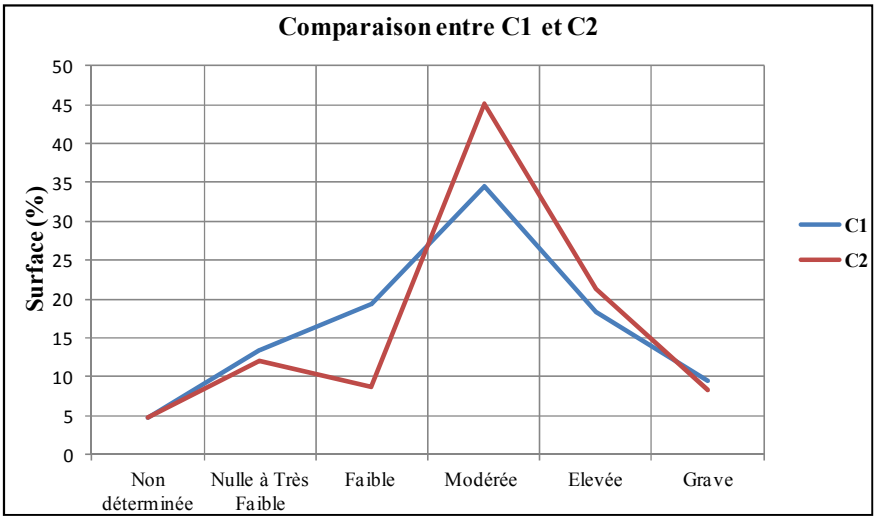


Fig. 17. Les écarts entre les résultats C1 et C2

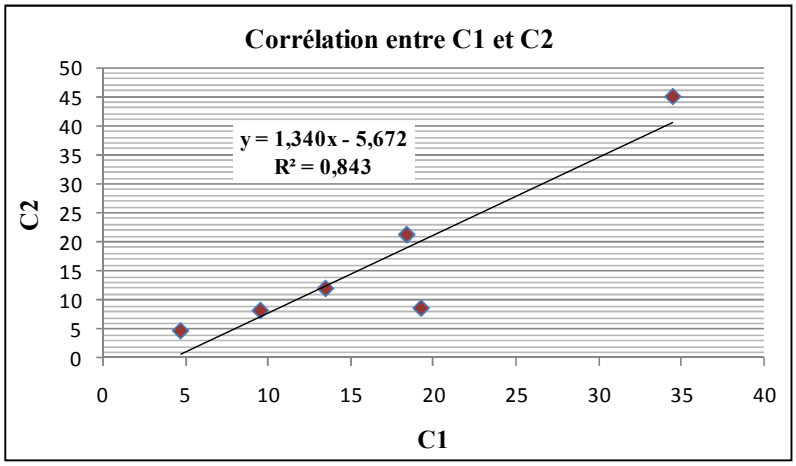


Fig. 18. La corrélation entre C1 et C2

7.3 PHOTOS



Champs et plantations



Chaumes



Champs de Jatropha de l'IRAD



Inselberg



Savane arbustive verte



Savane arbustive sur colline de pierre



Savane sèche



Verger d'anacardier (zone boisée)

Photo 1 : L'occupation des terres du bassin versant de Sanguéré (Avril, 2013). (Photos : Nguemhe Fils)



Labour en isohypse



Murette en pierre



Aucune pratique



Paille à recouvrement



Prairie, plantes de couverture

Photo 2 : Les pratiques antiérosives dans le bassin versant de Sanguéré (Avril, 2013). (Photos: Nguemhe Fils)

8 CONCLUSION GÉNÉRALE

Le présent travail avait pour objectifs d'apprécier l'apport de l'OT et des SIG à la spatialisation de l'érosion hydrique et de montrer l'application d'un modèle largement diffusé, le modèle RUSLE, à la mise en évidence des zones les plus sensibles à l'érosion dans le bassin versant de Sanguéré, au Nord Cameroun. Il apparait à l'issue de notre étude que l'érosion hydrique est omniprésente dans le bassin versant. Le risque dans tout ce secteur couvre une surface de plus de 50 Km² sur les près de 82 Km² de toute la zone, soit plus de 60 % de sa superficie totale exposée à l'érosion hydrique. Ces résultats doivent faire l'objet de beaucoup d'attentions de la part des décideurs. En effet, le phénomène d'érosion hydrique prend une ampleur considérable dans les zones soudano-sahéliennes et sahéliennes du grand Nord-Cameroun (une région les enjeux agricoles et environnementaux sont élevés) avec pour conséquences la dégradation des terres, les pertes de productions, etc.

Le RUSLE, s'est avéré être un modèle simple et pratique dans notre contexte. Malgré l'hétérogénéité des données une modélisation de l'érosion hydrique a pu être menée à l'échelle du bassin versant. Cette méthode de cartographie du risque érosif peut facilement être adaptée à l'ensemble de la Région du Nord, apportant une aide importante aux agriculteurs et aux décideurs pour l'identification des zones nécessitant la plus grande priorité d'intervention préventives pour la protection du patrimoine sol. Ce travail a également aidé à constituer une base de données multisources de la zone d'étude à l'aide du SIG, ce qui facilitera la vulgarisation, le suivi et la mise à jour des données et résultats.

En perspectives, il serait utile d'apporter une meilleure description des facteurs C, K et LS afin, en plus de spatialiser le risque, d'estimer une quantification des pertes de sols. Une expression des pertes en sols en relation directe avec la productivité des cultures serait d'un apport certains pour les populations rurales de cette région. Il est également envisageable d'effectuer une cartographie des zones à risque d'érosion hydrique liées aux inondations en tenant compte des changements climatiques.

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Effects of Body Mass Index (B.M.I) on Intelligence Quotient (I.Q)

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ABSTRACT: B.M.I and I.Q, both, are locally and internationally on the rise. A link between the two is likely but which one is influencing the other still remains a mystery. To solve the mystery of correlation between Intelligence quotient (IQ) and Body Mass Index (BMI) and to ascertain whether I.Q has any significant measurable effect on B.M.I, this study is conducted among the students of Liaquat University of Medical and Health Sciences Jamshoro. A structured questionnaire-based cross-sectional study was conducted on 120 students of Liaquat University of Medical & Health Sciences, of both genders, aged between 18-25 years. IQ was recorded using a questionnaire comprising twenty questions, designed on the principle of internationally taken IQ tests; students were advised to solve the test within 10 minutes. For BMI calculation, height and weight measuring machine (RGZ-160) was used; height was measured in m^2 and weight in kg. According to WHO classification of BMI, students were divided into four classes, i.e., class-1 (under weight, BMI <18), class-2 (normal weight, BMI 18-24) and class-3 (over weight BMI ≥25), class-4 (obese BMI ≥30). Data analysis was done on MS excel by applying students *t*-test. Students having average I.Q values of 5.09 and 5 belonged to class-1 (under weight), class-2 (normal weight) respectively, whereas students possessing an I.Q of 6.5 and 7 belonged to class-3 (over weight), class-4 (obese) respectively. IQ of class 3 and 4 students was found significantly higher (P = 0.01) than the class 1 and 2. Students having BMI values >25 had greater I.Q level. The findings can be associated to the life styles and habits of these people.

KEYWORDS: I.Q, Intelligence Quotient, B.M.I, Body Mass Index.

1 INTRODUCTION

Intelligence quotient, according to the oxford dictionary, is a number representing a person's reasoning ability (measured using problem-solving tests) as compared to the statistical norm or average for their age, taken as 100. While Body Mass Index (B.M.I), according to the same source, is an approximate measure of whether someone is over- or underweight, calculated by dividing their weight in kilograms by the square of their height in metres.

Their relationship, unlike their definitions, is not simple and easily understood. Conflicting beliefs exist about the relationship and a variation from place to place and time to time is expected. The uncertainty surrounding this issue stems from the lack of evidence based literature and this study serves the very purpose of filling this gap and helping increase our understanding of the matter.

Overweight and obesity are a global pandemic. According to a WHO report, there are 1 billion overweight people in the world, of whom 300 million are obese **[1]**. Findings of the National Health Survey, Pakistan, 1990–1994, found that the prevalence of obesity for adults from low, middle to high socioeconomic status (SES) was 9%, 15% and 27% for rural areas and 21%, 27% and 42% for urban areas respectively **[2]**. The mechanisms regulating body weight are complex, influenced by diverse factors: physiological, societal, environmental, genetic and behavioral. None of these is completely understood. At the individual level, nutritional, metabolic, hormonal and neuronal signals are integrated within the brain to produce changes in behavior (eating, physical activity) and body metabolism (through the autonomic nervous system and hormonal responses) so as to maintain energy balance **[3]**.

Observations of obesity clustering in families led to an early interest in genetic causes for the condition. About 200 different genes or loci have been linked to obesity in humans **[4]**. However, the pattern of inheritance of obesity suggests

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that the effect is polygenic, with each variant of many different genes making a small difference in effect **[5]**. The rapid increase in the prevalence of overweight and obesity in both developed and developing countries indicates that the trend is largely due to social, environmental and behavioral changes, rather than changes in hereditary factors **[3,6,7]**. Behavioral changes can be attributed to an individual's Intelligence Quotient since people with different I.Q follow different lifestyles and daily routines.

2 METHODOLOGY

A structured questionnaire-based cross-sectional study was conducted on a sample space of 120 students of Liaquat University of Medical & Health Sciences after taking written consent. Students of both genders, aged between 18-25 years were included in the study. IQ was recorded using a questionnaire comprising twenty questions, designed on the principle of internationally taken IQ tests; students were advised to solve the test within 10 minutes. For BMI calculation, height and weight measuring machine (RGZ-160) was used; height was measured in m^2 and weight in kg. According to WHO classification of BMI, students were divided into four classes, i.e., class-1 (under weight, BMI <18), class-2 (normal weight, BMI 18-24) and class-3 (over weight BMI ≥25), class-4 (obese BMI ≥30). Data analysis was done on MS excel by applying students *t*-test.

3 RESULTS

It was observed that students having average I.Q values of 5.09 and 5 belonged to class-1 (under weight), class-2 (normal weight) respectively, whereas students possessing an I.Q of 6.5 and 7 belonged to class-3 (over weight), class-4 (obese) respectively.

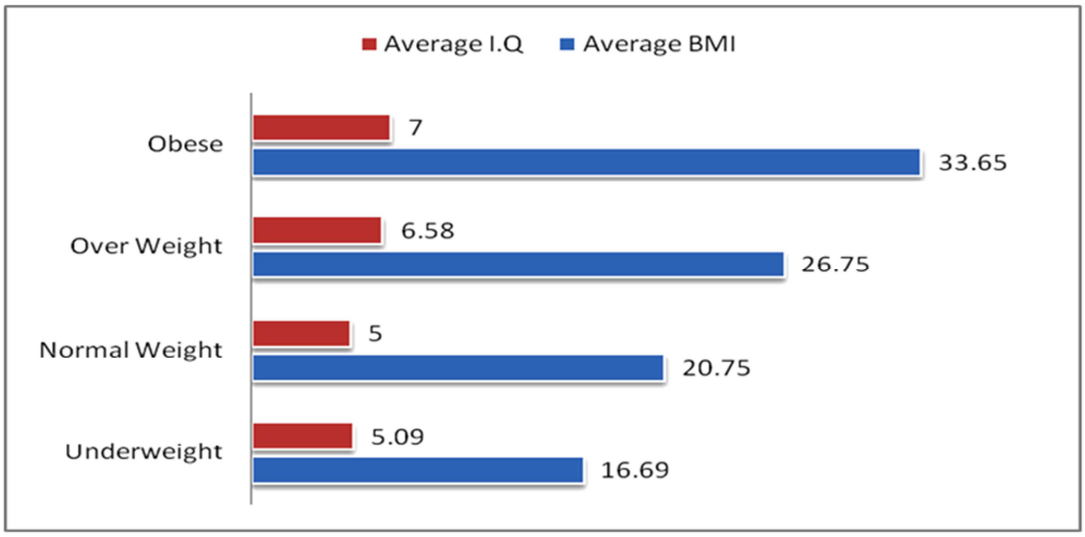


Figure 1 (Y-Axis: Body Mass Index category) (X-Axis: Intelligence Quotient)

The results also showed that a small increase in Intelligence Quotient corresponded with a significant rise in Body Mass Index as is evident in the line graph below.

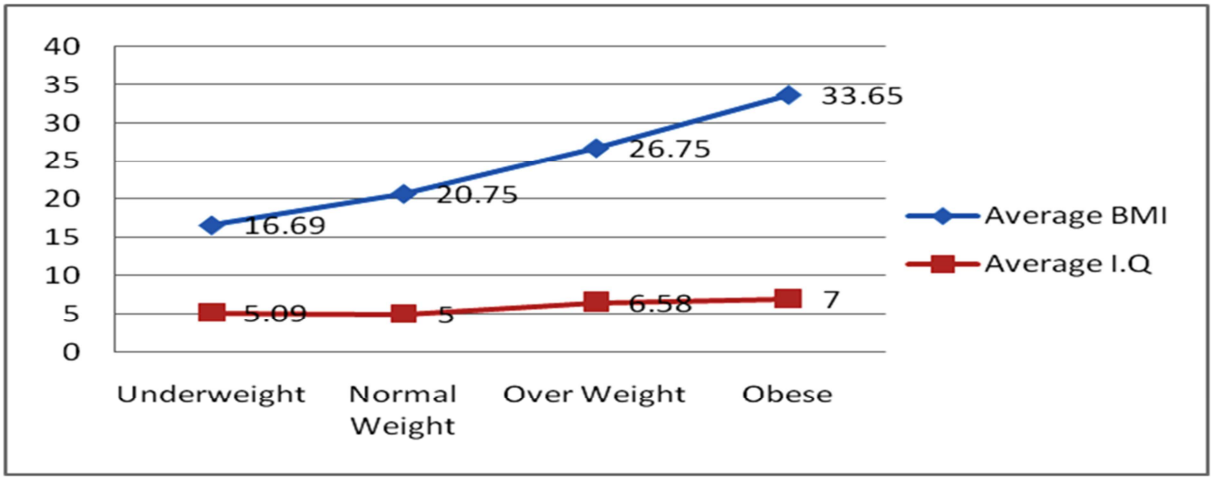


Figure 2 (Y-Axis: Intelligence Quotient) (X-Axis: Body Mass Index Category)

Table 1. IQ of class 3 and 4 students was found significantly higher (P = 0.01) than the class 1 and 2.

Category	Average BMI	St. Deviation BMI	Average I.Q	St. Deviation I.Q
Class 1 Underweight	16.69	1.07	5.09	2.61
Class 2 Normal weight	20.75	1.64	5.00	2.69
Class 3 Overweight	26.75	1.24	6.58	3.06
Class 4 Obese	33.65	3.17	7.00	3.46
T. Test value	0.01			

4 DISCUSSION

Pakistan is a country in transition and now faces double burden of coexistent overnutrition and under nutrition. Obesity is becoming an increasingly prevalent problem in Pakistan, as it has in other developing countries, with under nutrition remaining a problem simultaneously. Such has been observed in comparable developing countries such as Egypt **[8]** and India **[9]**. A recent study demonstrates that a quarter of the population of Pakistan would be classified as overweight or obese with the use of Indo-Asian-specific BMI cutoff values **[10]**. This is significant because the risk of being overweight in adulthood has a positive correlate with being overweight in childhood and adolescence **[11]**. The prevalence of obesity in adolescents in Pakistan is already significant, with one study putting the prevalence of adolescents with a BMI greater than 25 at 18% **[12]**, which is comparable with figures in the West. However, due to our different social and cultural setting, the associations leading towards obesity studied in the West cannot be applied on our population as for example, socioeconomic conditions are directly proportional to overweight as opposed to the Western World **[13], [14]**.

The Intelligence Quotient, like BMI, is also on the rise. The Flynn effect is the substantial and long-sustained increase in both fluid and crystallized intelligence test scores measured in many parts of the world from roughly 1930 to the present day. Test score increases have been continuous and approximately linear from the earliest years of testing to the present. For the Raven's Progressive Matrices test (Raven, John 2000), subjects born over a 100-year period were compared in Des Moines, Iowa, and separately in Dumfries, Scotland. Improvements were remarkably consistent across the whole period, in both countries **[15]**. This effect of an apparent increase in IQ has also been observed in various other parts of the world, though the rates of increase vary **[16]**.

The rise on both fronts led us to analyze B.M.I and I.Q values and find out what association existed between the two. In Pakistani society, the higher socioeconomic class is more likely to be overweight and obese **[13]**. Similarly, the educational status, exposure to more learned environments and familiarity with the test is also expected to be higher than other classes. This makes socioeconomic status an intermediary and/or a bridge, associating with B.M.I and I.Q simultaneously.

The students with greater I.Q, better cognitive ability and higher academic scores generally spend more time studying or indulging in educational activities. The societal pressures, peer competition and the common local belief that educational excellence is more or less directly related to future success in life drives these individuals to take up a largely physically inactive life style. This tends to make these Higher I.Q and better academic performers overweight and obese. This explanation is also valid for the weaker academic performers and lower I.Q individuals who spend less time indoors studying and more outdoors indulging in physical activities and chores.

5 CONCLUSION

Students having greater I.Q values had BMI values >25. The findings can be associated to the life styles and habits of these people. The possibility that better academic performers might have been previously acquainted to the test, resulting in better test score, means that better academic performers too have higher BMI values. This brings to light that our more intellectually able and gifted youth is indulging less in physical activities and likely spending considerably more time indoors resulting in higher weight to square height ratio. Awareness needs to be spread about the adverse health outcomes it can cause and steps need to be taken to preempt any bad outcomes for our youth. More work also needs to be done to further explore the results revealed in this study.

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Enhancement of P_2O_5 Content in SSP Made from Local Rock Phosphate of Pakistan

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ABSTRACT: The Phosphorus content is a necessary part of fertilizers used in Pakistan and is readily available in single super phosphate fertilizer. Pakistani rock phosphate being of low grade cannot be used by conventional method to prepare good quality SSP. This rock however, can be used by some unconventional techniques for preparing some better quality fertilizer. For the subject study rock phosphate samples were collected from Hazara, Pakistan and were ground to 150 mesh level containing 24% total phosphate pentoxide (P_2O_5) content and were treated with different ratios of sulphuric acid (H_2SO_4) and phosphoric acid (H_3PO_4). Seven samples with composition comprising of fix weight of rock phosphate i.e. 100 gm were prepared by treating it with H_2SO_4 (diluted to 65%) and H_3PO_4 (of 85% purity) in w/w ratios of (13:1, 13:2, 4:1, 11:4, 2:1 and 3:2) were manually prepared and analyzed through spectro-photometric method before and after a curing period of two weeks. The results obtained showed that there was enhancement in P_2O_5 up to 22.9% total and 19.9% available P_2O_5 content by addition of H_3PO_4 and H_2SO_4 (in weight ratios of 3:2) to the conventional formulation of single super phosphate (SSP) containing the rock phosphate and H_2SO_4 only. The results lead to conclude that the phosphorus content in SSP made from low quality local rock phosphate can be effectively enhanced and a market grade SSP(with 18% available P_2O_5) can be prepared using the local rock without any need to import rock phosphate from other countries.

KEYWORDS: P_2O_5 Enhancement, Hazara Pakistan, Rock phosphate, Single Super phosphate, H_2SO_4 and H_3PO_4.

1 INTRODUCTION

Phosphates are necessary elements in the fertilizers used to supply food and feed for human beings. Currently in the world, there is no alternate for phosphate rock as a raw material for the production of phosphate fertilizer. The demand for phosphate increases as the world population increases. Phosphate rocks are complex raw materials and are mainly used in the production of phosphate fertilizers. The composition of these rocks varies from one deposit to another. Therefore phosphate rocks from different sources are expected to behave differently in acidulation process [1].

In agricultural soils (cultivated land) readily available phosphorous is an important nutritional element and controls the growth of plants [2]. Even normal soils with intermediate fertility possess 0.4 – 1.2 g of phosphorous per kilo gram of soil. About 95 – 98% of this P is in the form metallic chelates and is insoluble hence difficult to utilize [3]. Therefore about all soils which are used for agricultural purposes are fertilized with compounds containing soluble phosphorous [4].

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In many countries, rock phosphate was first finely ground and applied directly to soil as fertilizers [5]. Rock phosphate is a natural, cheap and clean compound but unfortunately it is a poor phosphorous fertilizer since its solubilization is too slow to satisfy agricultural requirements [6]. It was soon recognized that treatment of these phosphate minerals with sulfuric acid (H_2SO_4) increased the availability and efficiency of the phosphate for agricultural purposes. At present, acidulation with Nitric Acid (HNO_3) or strong Phosphoric acid (H_3PO_4) or H_2SO_4 gives enhanced fertilizer values.

For the purpose of this available phosphorous acidulation of rock phosphate with H_2SO_4 is important now days. Triple Supper Phosphate (TSP) with 45 – 50% available Phosphorous Pentoxide (P_2O_5) and Single Supper Phosphate (SSP) with 16 – 18% of available P_2O_5 are manufactured by the reaction of phosphate rock with H_3PO_4 and H_2SO_4 respectively [7]. These are used to provide necessary phosphorous to crops and also balancing phosphorous contents of soils in agricultural areas.

Pakistan is blessed by rock phosphate deposits in Hazara area of KPK province in Pakistan. This is basically a tri-calcium phosphate [$Ca_3(PO_4)_2$] which is insoluble in water and not directly available to the plants [8]. These reserves are spreaded in Hazara, Tranawai, in the form of shist, shales and limestone, at Kakul, Guldaman and Lagerban villages of districts Abbotabad in the forms of dolomite and phosphorites, also at Thandiani in the forms of limestones Looking at the huge amounts of foreign exchange incurred on the imports of phosphatic fertilizers it is suggested to explore and exploit the local phosphate rock reserves and to enhance the extent of P_2O_5 release [9, 10].

In this research work, H_3PO_4 was used during the synthesis of SSP and observed that the P_2O_5 contents increased.

2 MATERIALS AND METHODS

2.1 PROCUREMENT OF RAW MATERIALS

Rock Phosphate was collected from Tarnawai area of Hazara division (Khyber Pukhtunkhwa), Pakistan. Rock phosphate was ground at 150 mesh level with a total P_2O_5 content of 24 %. H_2SO_4 and H_3PO_4 were purchased from Sigma Aldrich of purity 98% and 85% respectively. Distilled water was used for the dilution of the acid.

The ground rock was then treated with different ratios of acids to prepare samples. It was initially calculated that a total 40 % (70gm) of liquid (acid) is enough to wet a 100 gm. of solid (rock).

2.2 EXPERIMENTAL METHODS

100 grams of Rock phosphate ground at 150 mesh level was weighed and carefully taken in a Pyrex glass beaker. H_2SO_4 obtained from market was diluted to 65% by careful addition of distilled water. Now 65 grams of diluted H_2SO_4 and 5 grams of H_3PO_4 obtained from market were added into the rock and stirred with the help of glass stirrer. The sample was handled carefully and placed in oven at 80^{o}C for one hour before analysis. Other samples of SSP were prepared by using different amounts of acids are shown in table 1.

Table-1: Single Super Phosphate Samples

Sample #	Composition
1	100g rock + 65g H_2SO_4
2	100g rock + 65g H_2SO_4 + 5g H_3PO_4
3	100g rock + 65g H_2SO_4 + 10g H_3PO_4
4	100g rock + 60g H_2SO_4 + 15g H_3PO_4
5	100g rock + 55g H_2SO_4 + 20g H_3PO_4
6	100g rock + 50g H_2SO_4 + 25g H_3PO_4

2.3 PRODUCT ANALYSIS

Standard methods of Pakistan Standards Quality Control Authority were adopted for the analysis of samples to get accurate values of the contents present in samples. Following were the testing procedures adopted to analyze the samples for various types of phosphorus contents.

2.3.1 TEST FOR WATER SOLUBLE P_2O_5 CONTENT

1 gram of each sample was separately added in 250 ml round bottom flask, filled with distilled water and then was stirred on magnetic stirrer for 30 minute to assure complete dissolution. Then filtered and collected the filtrate, 2 ml of filtrate was further diluted in 100 ml volumetric flask by adding distilled water.

20 ml of Molybdovanadate reagent was added in each sample and these samples were analyzed in spectrophotometer (Model Company) set at wavelength of 405 nm, maximum absorbance. After that results were calculated for all the samples separately.

2.3.2 TEST FOR TOTAL P_2O_5 CONTENT

Samples were analyzed for the total P_2O_5 content present in them, 1 gm of every sample was digested with concentrated HCl and concentrated HNO_3 in a ratio of 3:1 to dissolve samples completely, heated it till boiling in fume cupboard and when was about to dry it was diluted using distilled water and made up 1000 ml volume. Filtered the solution and 5 ml of filtrate was further diluted in 100 ml volumetric flask then 20 ml of Molybdovanadate reagent was added and every sample was analyzed through 405 nm wavelength of spectrophotometer, maximum absorbance measured and results were further calculated.

2.3.3 CITRATE SOLUBLE P_2O_5 CONTENT

Samples were analyzed for citrate soluble P_2O_5 content, they were treated for un-reacted P_2O_5 content and was further used to calculate the citrate soluble P_2O_5. 0.5 gm of every sample was separately treated with 100 ml of neutral ammonium citrate ($C_6H_{17}N_3O_7$) solution, shook it and heated in water bath at 65^{o}C for one hour. Filtered it and the residue left on filter paper was ignited in furnace at 550^{o}C completely. The residues of furnace were further digested in conc. HCl and conc. HNO_3 in 3:1. When it was about to dry was diluted again by adding 40 ml of distilled water. Finally filtered it again and 2ml of filtrate taken in flask and was diluted to 100ml by adding distilled water and 20 ml of Molybdovanadate reagent. Then analyzed through spectrophotometer at 405 nm, the maximum absorbance, and un-reacted P_2O_5 calculated. Citrate soluble P_2O_5 was then found out by using formula:

$$\textit{Citrate soluble } P_2O_5 = \textit{Total } P_2O_5 - \textit{Water soluble } P_2O_5 - \textit{Un-reacted } P_2O_5$$

2.3.4 ESTIMATION OF AVAILABLE P_2O_5 CONTENTS

The available P_2O_5 contents in samples were estimated using the formula:

$$\textit{Available } P_2O_5 = \textit{Water soluble } P_2O_5 + \textit{Citrate soluble } P_2O_5$$

3 RESULT AND DISCUSSION

3.1 EFFECT OF COMPOSITION ON TOTAL P_2O_5 CONTENTS

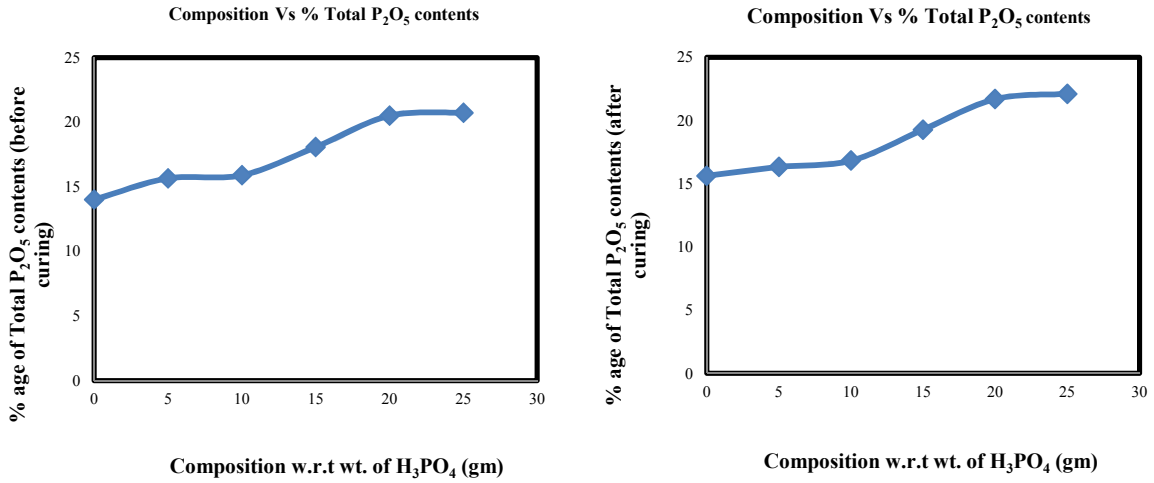
(a) Before curing

The samples prepared using different additives to the conventional formulation of SSP showed that the available P_2O_5 content varied with varying the composition markedly by increasing the ratio of H_3PO_4 as compared to the ratio of H_2SO_4.

The % total P_2O_5 contents increased as the H_3PO_4 was used in the samples as show in figure 1(a). When there was no H_3PO_4 in the sample the % total P_2O_5 contents were 14% which increased up to 20.73% total P_2O_5 contents with use of 25 gm H_3PO_4.

(b) After curing

After curing the samples for two weeks the maximum value of total P_2O_5 contents obtained was in the sample containing maximum percentage of H_3PO_4 and approached to the value up to 22.09 % by adding 25 gm H_3PO_4 as shown in Figure 1(b).This shows the direct relationship between total P_2O_5 content and H_3PO_4.



(a) (b)

Figure-1: Relation between single super phosphate samples with % total P_2O_5 contents (a) Before curing (b) After curing

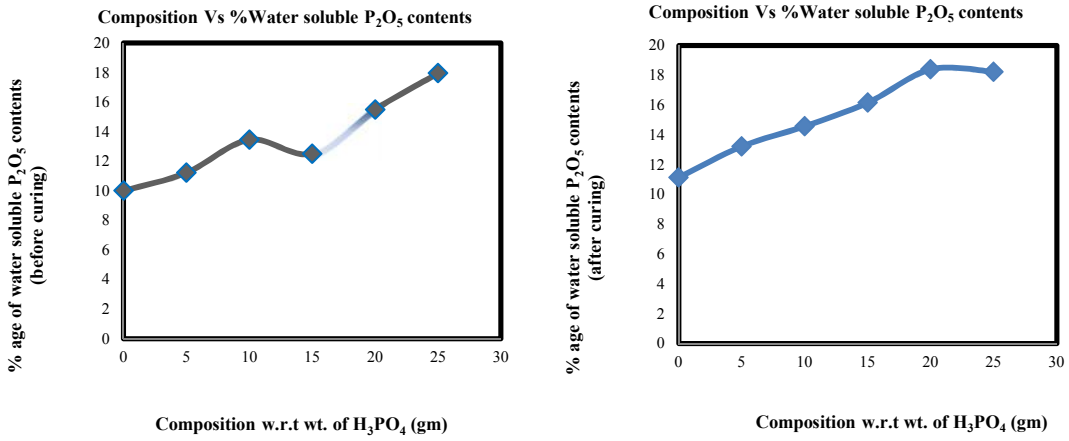
3.2 Effect of Composition on Water Soluble P_2O_5 Contents

(a) Before curing

The water soluble phosphorus content had an increasing trend as the amount of H_3PO_4 increased in the samples as shown in figure 2(a). The sample with no H_3PO_4 showed 10 % water soluble P_2O_5 contents. In comparison the sample that contained the maximum amount (25 gm) of H_3PO_4 had a very prominent value of 17.95% water soluble P_2O_5 contents.

(b) After curing

There was a remarkable enhancement in the water soluble P_2O_5 contents after curing the fertilizer ranging from 11.14% with no H_3PO_4 to 18.23% with 25 gm of $H_3PO_4$for various samples as shown in figure 2(b).



(a) (b)

Figure-2: Relation between single super phosphate samples with % water soluble P_2O_5 contents (a) Before curing (b) After curing

3.3 Effect of Composition on Available P_2O_5 Contents

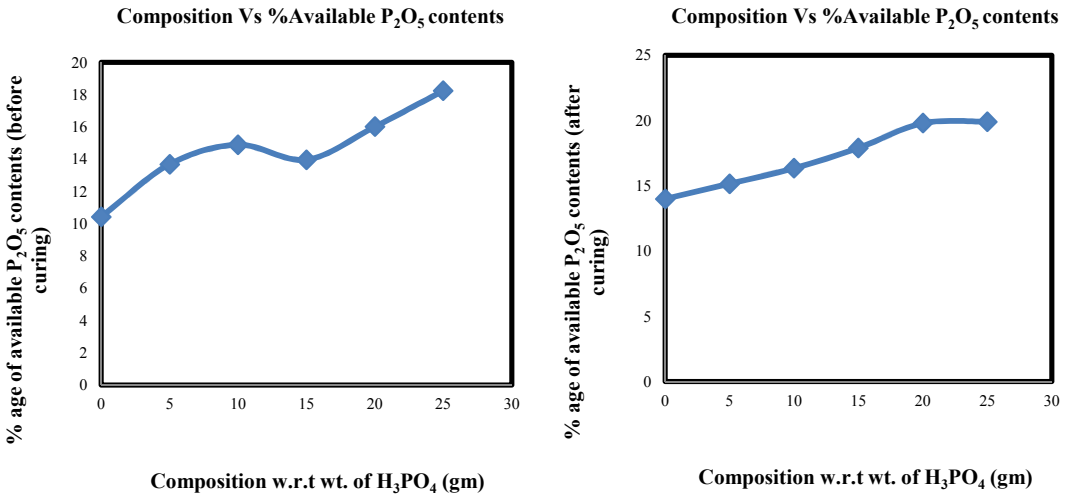
(a) Before curing

The available P_2O_5 contents which is actually that amount of phosphorus content which is readily available for the plant to be up taken, showed linear relationship with the amounts of H_3PO_4 added to various samples and approached a maximum

value of 18.52% for the sample containing 25 gm of the H_3PO_4 added in comparison to it the sample that had no H_3PO_4 added showed a total value of available P_2O_5 contents as 10.43 % as shown in figure 3(a).

(b) After curing

After giving a curing time of two weeks to the samples to complete the chemical reactions taking place, the maximum available P_2O_5 contents reached a value of 19.90% with the sample having maximum amount of the H_3PO_4 and in comparison to it the other samples with lesser H_3PO_4 showed lower available P_2O_5 contents as shown in figure 3(b).

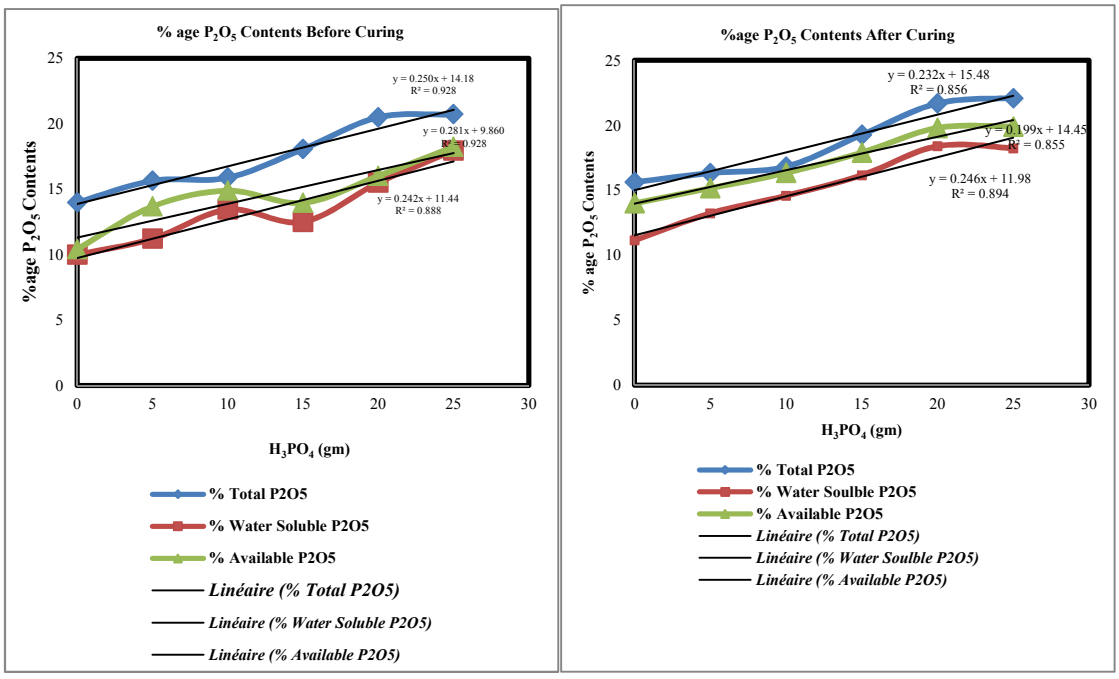


(a) (b)

Figure-3: Relation between single super phosphate samples with % Available P_2O_5 contents (a) Before curing (b) After curing

3.4 LINEARITY OF DATA

Figure 4(a) and 4(b) show the best fit lines for the curved data. And the R squared values for these lines. The R squared values being very close to "1" shows that the data is presenting closer to linear relationship of the observed parameters.



(a) (b)

Figure-4: Technical analysis of the data. (a) Before curing (b) After curing

The self-prepared SSP has an edge that it can contain up to 19.9% and even above available P_2O_5 contents (depending on amount of H_3PO_4 added) while the SSP commercially available when analyzed showed only 16% P_2O_5 content.

The self-made SSP with 18% available P_2O_5 content costs Rs. 878/50 Kg of fertilizer which is quite low than the price of same grade SSP available in market.

4 CONCLUSIONS

This study aims to examine the possibilities of the phosphates of low grades valorization in the manufacture of good quality SSP. The results demonstrate the possibility of production of market grade SSP from the low grade phosphate rocksat lower price rates. A fine quality SSP can be prepared by using the inferior quality local rock phosphate by the addition of H_3PO_4 to the conventional formulation of SSP. By increasing the concentration of H_3PO_4 the available P_2O_5 contents of the resulting SSP increases from 14% (without H_3PO_4) to up to 19.9% (by adding 25 gm. H_3PO_4). SSP of market grade or having 18% available P_2O_5 content can be manufactured from the same low quality rock phosphate with lesser cost than the same grade SSP available in market made from expensive imported rock.

ACKNOWLEDGMENTS

The valuable inputs from my colleagues and friends during the compilation of this review are highly appreciated.

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Production of Hydrogen and Carbon Nanotubes using Ni SBA-15 Catalyst

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ABSTRACT: Thermo Catalytic Decomposition of Methane Using Ni/SBA-15 catalyst was tested in a fixed bed reactor to simultaneously produce hydrogen and carbon nanotubes. SBA-15 nano catalysts were successfully been synthesized using p123, tetraethyl ortho silicate and Ni $(NO_3)_2.6H_2O$ as template, silica source and Nickel nano particle precursors respectively under acidic hydrothermal conditions. The BET surface area, pore size distribution and low angle X-ray Diffraction (XRD) studies revealed that the retention of hexagonally ordered behaviour in the catalysts. Wide angle XRD study divulged the crystalline behaviour of Nickel oxide species and these Nickel oxide species are in nano range. The catalytic activity experiments were preceded by blank tests intended to ascertain that the reaction did not take place to an appreciable extent in the absence of the catalyst. With SBA-15 alone and Ni alone reaction has not been taken place. Even with 50Ni-SBA-15 and 70Ni-SBA-15 catalysts reaction was not occurred. Only low loading Ni-SBA-15 catalyst was found to be active towards the conversion of methane into the corresponding hydrogen. Among all other catalysts, 30Ni-SBA-15 we observed to produce high yield of hydrogen produced 20% to 50% of H_2 at a moderate temperature of 1123 K (850ºC) and the catalytic activity of the catalyst remains stable for 5hrs.

KEYWORDS: Thermo catalytic decomposition, methane, hydrogen, carbon nanotubes, Ni/SBA-15.

1 INTRODUCTION

Hydrogen is expected to become an important energy carrier for sustained energy consumption with reduced impact on the environment. A hydrogen-based energy system is regarded as a viable and advantageous option for delivering high-quality energy services [1]. Traditionally, hydrogen is synthesized through steam reforming and/or partial oxidation of methane. Methane decomposition into hydrogen and carbon is of current interest as an alternative route of hydrogen production [2, 3]. Methane decomposition produces hydrogen only as a gaseous product. It is well known that supported Nickel (Ni) catalyst is one of the most effective among the catalysts tested so far [4-6]. We have already examined the catalytic performance of Ni catalysts supported on different supports and obtained the highest yields of hydrogen. The catalyst decomposed methane actively at the early period of the reaction. However, the activity of the catalyst decreased gradually with time on stream and finally the catalyst was deactivated completely. Thus, the catalysts having a longer life should be explored. In addition, the supported Ni catalysts cannot decompose methane efficiently at temperatures higher than 923K because of a very rapid deactivation after contact with methane, while they are very active for the reaction in the temperature range from 773 to 873K [7].

SBA-15, discovered as an ordered mesoporous silica a few years ago, presents some advantages as a catalyst support, such as high surface area (600-1000 m2/g) and a hexagonal structure of mesopores with size 4.6–30 nm and thicker walls (3.1-6.4 nm) [8]. Unfortunately, few investigations of Ni/SBA-15 catalysts prepared with the deposition precipitation method were reported [9]. Therefore, it is interesting to employ SBA-15 as a support in combination with advantages of deposition precipitation method for preparing highly active methane decomposition catalysts with high dispersion, narrow particle distribution and high thermal stability. A series of Ni/SBA-15 catalysts have been prepared by the deposition precipitation method and used to produce COx-free hydrogen from methane decomposition in the present work.

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SBA-15 materials have been prepared in acidic conditions with poly (alkaline oxide) tri-block co-polymers. They usually have wider pores than MCM-41, with the reported SBA-15 pore diameters up to 300A. Both solids have periodically ordered structures, which consist of two-dimensional hexagonal arrays of uniform mesoporous.

SBA-15 is a far the largest pore size mesoporous material with highly ordered hexagonally arranged meso channels, with thick walls, adjustable pore size from 3 to 30nm, and high hydrothermal and thermal stability. SBA-15, which possesses larger pores, thicker walls and higher thermal stability as compared other mesoporous silica may be used a promising catalyst support, particularly for reactions occurring at high temperatures. The base mesoporous materials have often been modified by adding noble metals or metal oxides in order to improve their physical and chemical properties. Recently, there are various studies carried out by using SBA-15 as support.

According to the IUPAC notation, a mesoporous material can be disordered or ordered in a meso structure. The first mesoporous material, with a long-range order, was synthesized in the late 80s/ early 90s, by a research group of the former Mobil Oil Company .Since then, research in this field has steadily grown. Notable examples of prospective applications are catalysis, sorption, gas sensing, optics, and photo voltaics. Mesoporous materials are those with pores in the range 20-500Å in diameter. They have huge surface areas, providing a vast number of sites where sorption processes can occur. These materials have numerous applications in catalysis, separation and many other fields. The synthesis of these materials is of considerable interest and is constantly being developed to introduce different properties.

In this paper we discuss about the hydrogen production on various Ni/SBA-15 catalysts using thermo catalytic decomposition of methane. Among all, 30Ni-SBA-15 catalyst showed highest percentage of Hydrogen as 50%. Ni/SBA-15 catalysts were characterized by BET surface area, pore size distribution, X-ray diffraction (XRD) and scanning electron microscopy (SEM).

2 EXPERIMENTAL

2.1 MATERIALS

All the chemicals used for this work are purchased from Ni $(NO_3)_2.6H_2O$ (98wt% purity; M/s Fenar Reagents, India); Conc. HCl (35 wt. %; Make: M/s Qualigens, India), Tetra ethyl ortho silicate (TEOS), Tri block co-polymer (Sri Sudhi Chemicals, Hyderabad) and deionized water.

Gases: Nitrogen and Methane (Purity: 99 vol %) from BOC India Ltd.

2.2 CATALYST PREPARATION

2.2.1 SBA-15 SYNTHESIS

SBA-15 support has been prepared in accordance with the literature reports [10]. In a typical synthesis, approximately 20g of tri block copolymers (P123) was dispersed in 460ml of deionized water in a 1000ml glass beaker at ambient temperature for 4-6h. About 102 g of 35% hydrochloric acid was added under constant stirring. Stabilizing the reaction temperature at 35 - 45ºC, 44g of silica source, i.e., tetraethyl orthosilicate (TEOS) was added drop by drop within a single stretch of 10min under continuous stirring. The color of reaction mixture changed into milky white with certain suspension within a half hour time. The reaction is continued for a period of 12h for the completion of TEOS hydrolysis. The hydrolyzed gel was transferred to an autoclave and subjected to heat treatment (aged) in an oven at 100ºC for 12h. Latter on the white precipitate that formed was separated by filtration under reduced pressure in hot condition followed by drying at 100ºC for 12h. This dried white powder is generally called as 'as made SBA-15'. The occluded P123 template in the as made SBA-15 was removed by calcination using a muffle furnace under static air condition by gradual increase of temperature from ambient to 550ºC with a heating rate of 1ºC/min and maintained the constant temperature of 550ºC for 8 h.

2.2.2 NI-SBA-15 SYNTHESIS

Ni-SBA-15 synthesis is prepared by pH adjustment method. In this method tri block copolymer, P123 was used as a structure directing agent, TEOS as a Si source, Nickel nitrate taken as a Ni precursor and HCl as an acidic media. First 20gm of P123 polymer was taken in to 1L beaker and then 390ml of distilled water was added and stirred at RT (30ºC) for 3-4 h until attainment of clear solution. Latter on 9ml of HCl (35%) was added and stirred for one hour and then required quantity of TEOS was added at 40ºC in different molar ratios. This solution was stirred at 40ºC for 12h. Then the mixture was aged at 100ºC for overnight without stirring and then obtained solid product was washed and dried for 12h at 100ºC. Finally the

catalysts were calcined at 550ºC in air for 6h for complete removal of template. The Ni-SBA-15 catalyst samples were designated as xNi-SBA-15 (x refers to the mole percent of Ni in SBA-15).

2.3 EXPERIMENTAL SET UP

2.3.1 CATALYTIC ACTIVITY MEASUREMENT

The stainless steel reactor is filled with ceramic beads of size 5mm X 5mm up to the centre of the reactor. A thin bed of quartz wool is created on the top of ceramic beads. 2.5g of various Ni wt% supported on SBA-15 [x Ni-SBA-15, where x = 10, 30, 50 and 70 wt%] has been placed on quartz wool to make 2g of x Ni-SBA-15 catalysts. NiO can be completely reduced to Ni by treating it with methane at 998K [12, 13]. The metal reactor is heated up to the nickel oxide reduction temperature of 998K under nitrogen flow rate of 54cm3 (STP/min). The nitrogen is slowly replaced with high purity methane (99.99 vol %) on the attainment of 998K and the flow is maintained at 54cm3 (STP/min). The reduction process is carried out for 15min. Methane reduces NiO to Ni as per the following reaction [19]

$$4NiO + CH_4 \rightarrow 4Ni + CO_2 + 2H_2O \quad (1)$$

After 15min, methane gas is replaced with nitrogen and the reactor temperature has been raised to 1123K. On the attainment of reaction temperature (1123K), nitrogen is once again replaced with methane. The methane gas flow rate is set at 54cm^3 (STP/min) (VHSV: 1.62 L/hr g) using rota meter. The initial gas samples have been collected immediately after 5min in a 1L Teddlar bag. By maintaining the methane flow rate at 54cm^3 (STP/min) and reactor temperature at 1123K, reactor effluent gas samples have been collected in Teddlar bags at an interval of 1h for 4h. The initial gas sample and gas samples collected at the end of each hour in 4h duration have been analyzed for methane decomposition products using Agilent Gas chromatography (GC) equipped with thermal conductivity detector (Oven Temperature: 80ºC; Detector Temperature: 100ºC; Injector Temperature: 100ºC) and porpak Q column. Nitrogen has been used as carrier gas. The calibrated data of hydrogen and methane have been obtained using the standard gases, hydrogen (99.99 vol%, BOC India Ltd) and methane (99.99 vol%, BOC India Ltd). AIMIL GC data sheet has been used in the analysis of GC data. The concentrations of hydrogen and methane in gas samples have been determined using the calibrated data. In all the experiments no methane decomposition products other than hydrogen and unconverted methane have been detected in the effluent gas.

2.4 CATALYST CHARACTERIZATION

The Catalysts were thoroughly characterized by different techniques such as Brunauer-Emmett- Teller (BET) surface area, Barrett-Joyner-Halenda (BJH) Pore size distribution, X-ray diffraction (XRD), Scanning Electron Microscopy (SEM).

The N_2 BET surface area measurement has been carried out after catalytic test using surface area analyzer SMART SORB93 by pre-treating the samples at 473K for 2h under nitrogen purging. Nitrogen adsorption/desorption isotherms obtained at 77K have been used to calculate BET surface area. Total pore volume (PV) has been estimated according to the BJH method from the adsorption data [14].

XRD patterns of all the catalysts in this study were obtained on a Rigaku Miniflex X-ray diffractometer (M/s. Rigaku Corporation, Japan) using Ni filtered Cu K_α radiation.

The Surface morphology of 30Ni-SBA-15 catalysts after the catalytic activity has been analyzed using Hitachi S-3700 variable vacuum SEM at an accession voltage of 15.0KV, using a carbon conducting tape adhered on aluminum stub.

The initial gas sample and gas samples collected at the end of each hour in 5h duration have been analyzed for methane decomposition products using GC equipped with thermal conductivity detector (Oven temperature:80ºC; Detector temperature:100ºC; Injector temperature: 100ºC) and porpak Q column. Nitrogen has been used as carrier gas. The calibrated data of hydrogen and methane have been obtained using the standard gases, hydrogen (99.99 vol%, BOC India Ltd) and methane (99.99 vol%, BOC India Ltd). AIMIL GC data sheet has been used in the analysis of GC data. The concentrations of hydrogen and methane in gas samples have been determined using the calibrated data.

3 RESULTS AND DISCUSSIONS

The Hydrogen production is observed in only in 10Ni-SBA-15 and 30Ni-SBA-15 catalysts. With SBA-15 and Nickel we did not observed any hydrogen production and also in high Ni metal loading of 50Ni-SBA-15 and 70Ni-SBA-15 catalysts also did not produced any hydrogen. Among 10Ni-SBA-15 and 30Ni-SBA-15 catalysts, 30Ni-SBA-15 catalyst produced high hydrogen production. Because of this reason 30Ni-SBA-15 catalyst is used for further study.

The catalytic activity of 30Ni-SBA-15 catalysts is as follows: The initial hydrogen production within a 15min is 20% of H_2; for 1hr, it has been slightly decreased to 18% of H_2; again from 2hr to 5hr, it has been increased to 30% H_2, 45% H_2, 48% H_2 and 50% H_2 is observed.

3.1 CATALYST CHARACTERIZATION

3.1.1 BET SURFACE AREA

The BET surface areas of different Ni-SBA-15 catalysts were shown in Table 1. As the molar composition of Ni increase in/ on SBA-15 from 10 to 70, there is a gradual decrease in surface area was observed. The decrease in surface areas with increased loading of Ni prepared by direct synthesis method may be due to diminishing of mesoporous silica ratio particularly at higher loading Ni-SBA-15 catalysts.

Table 1: BET surface areas Ni-SBA-15 catalysts

S.No	Catalyst	BET Surface Area (m^2/g)
1	10Ni-SBA-15	726.98
2	30Ni-SBA-15	668.99
3	50Ni-SBA-15	515.32
4	70Ni-SBA-15	415.83

N_2 adsorption–desorption isotherms for Ni-SBA-15 catalysts were shown in Fig. 1: All the nitrogen adsorption-desorption isotherms are found to be of Type IV in nature as per the IUPAC classification and exhibited a H1 hysteresis loop, which is typical of mesoporous solids. The adsorption branch of isotherm obtained for 10Ni-SBA-15 showed a sharp inflection. This is a characteristic of capillary condensation within uniform pores. The position of the inflection point is clearly related to a diameter in the mesopore range, and the sharpness of these steps indicates the uniformity of the mesopore size distribution. There is a small deformation in shape of the hysterosis loops, which is an indication of the partial collapse in the hexagonal mesoporous ordering. This kind of behavior is seen in higher Ni loading catalysts.

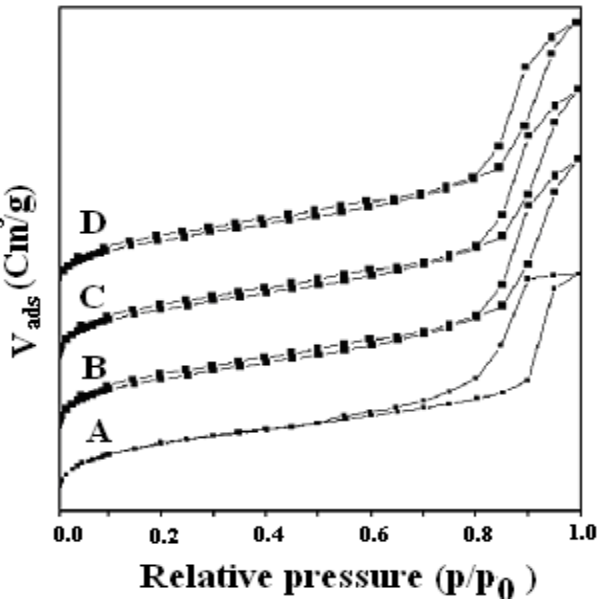


Fig.1. N_2 adsorption-desorption isotherms of different Ni- SBA-15 catalysts. (A) 10Ni-SBA-15, (B) 30Ni-SBA-15, (C) 50Ni-SBA-15, (D) 70Ni-SBA-15

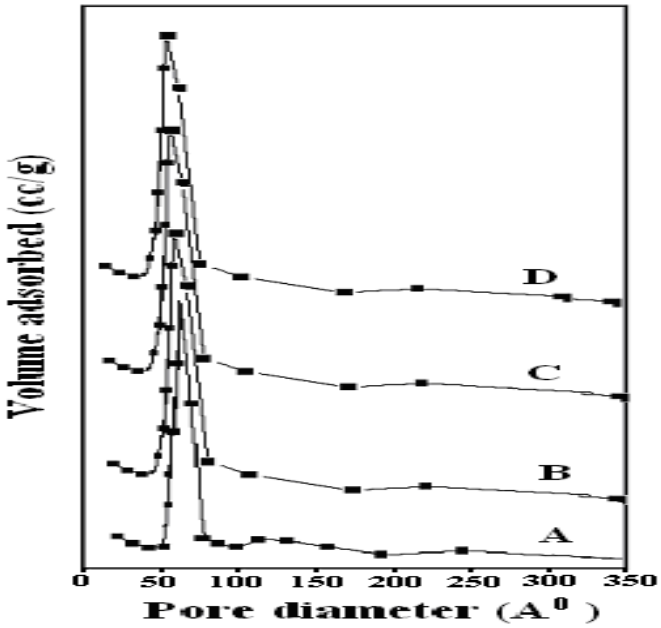


Fig.2. Pore size distribution of different Ni- SBA-15 catalysts. (A) 10Ni-SBA-15, (B) 30Ni-SBA-15, (C) 50Ni-SBA-15, (D) 70Ni-SBA-15

The pore size distribution curves of all the Ni-SBA-15 catalysts are shown in Fig. 2, which shows an average pore size of about 70Å for all the catalysts. Furthermore, a narrow pore size distribution is observed for all of the catalysts. Interestingly, an increase in the mesopore size is noticed with an increase in Ni loading. Such a trend may correspond to a decrease in wall thickness of the crystallized samples with an increase in Ni loading. These results indicate that the Ni-substituted SBA-15 could be crystallized without any decrease in mesopore size via a direct synthesis approach under hydrothermal conditions.

Determining the specific surface area, pore volume, and pore size distribution, as well as the surface properties. The adsorption isotherm provides an enormous amount of information about the surface properties. There are six types of isotherms possible, but only five apply to materials.

Type I isotherms indicate micropores. Neither type II nor type III isotherms contain hysteresis loops. These designate macroporous solids. Type IV and V isotherms possess hysteresis loops and are indicative of mesoporous solids.

The pore size distribution of a material is usually determined via the Barrett Joyner, and Halenda (BJH) method. The BJH method utilizes an algorithm that depends on the accuracy of the relation between pore size and capillary condensation/evaporation pressure, the correct t-curve(s), and the aptness of the adsorption/desorption curves.

3.1.2 POWDER X-RAY DIFFRACTION ANALYSIS (XRD)

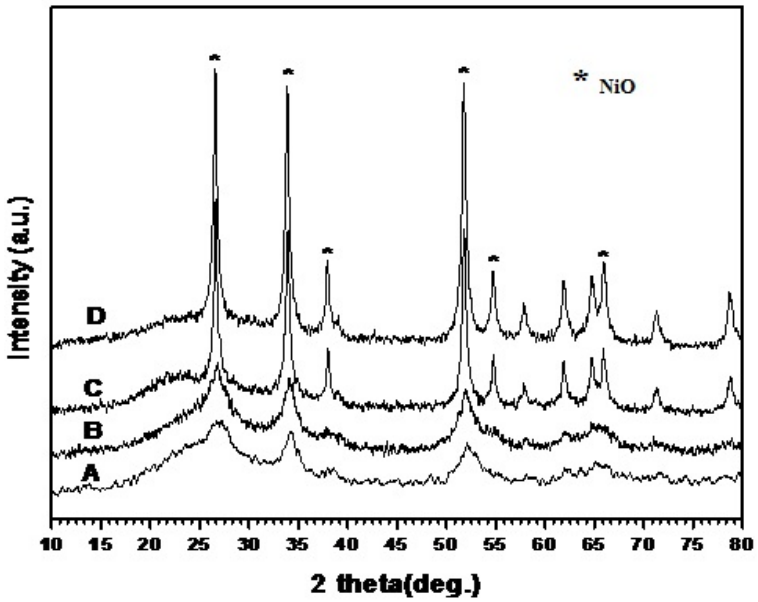


Fig.3. X-ray diffraction patterns of different Ni- SBA-15 catalysts. (A) 10Ni-SBA-15, (B) 30Ni-SBA-15, (C) 50Ni-SBA-15, (D) 70Ni-SBA-15

The XRD patterns of different Ni-SBA-15 catalysts are shown in Fig. 3. Poorly resolved XRD reflections were observed for the low Ni loaded samples, viz., 10Ni-SBA-15, and 30Ni-SBA-15 catalysts. The crystalline behavior of casseterite phase of Nickel oxide was clearly seen from the Fig. 3. There is a sequential enhancement in the Nickel oxide phase from lower to higher loadings of Ni. Except Nickel oxide phase, no other phases of Ni oxides or metallic Nickel were observed. i.e., phase purity is the importance of this direct hydrothermal synthetic route, particularly for the synthesis of Ni-SBA-15 catalysts. XRD patterns of all the catalysts in this study were obtained on a Rigaku Miniflex X-ray diffractometer (M/s. Rigaku Corporation, Japan) using Ni filtered Cu K_α radiation.

3.1.3 SCANNING ELECTRON MICROSCOPY (SEM) ANALYSIS

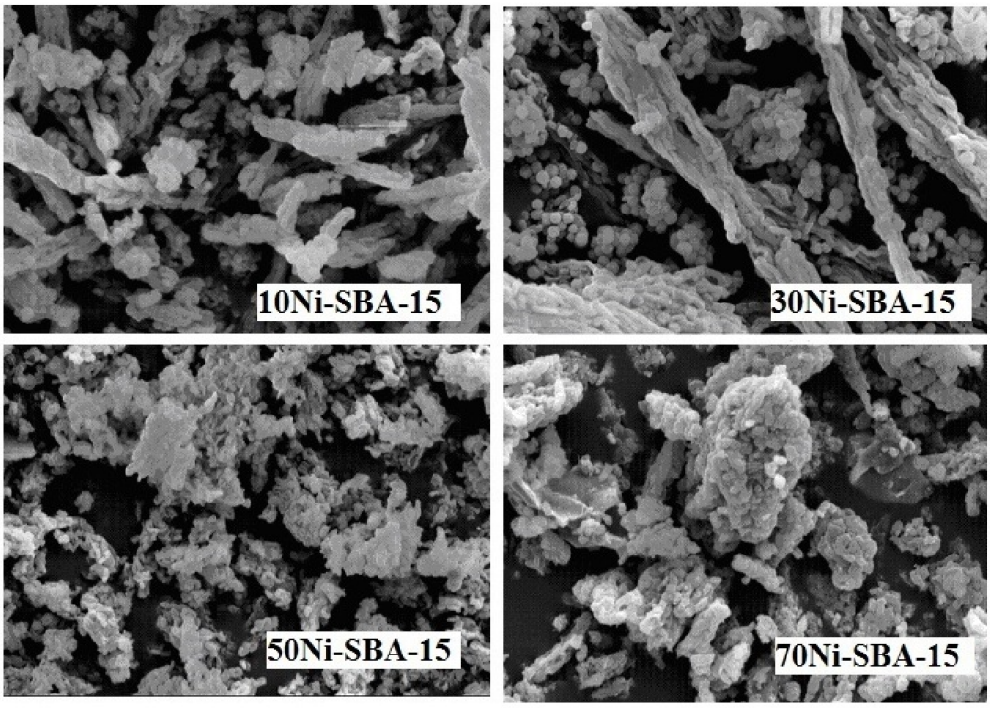


Fig.4. SEM Images of different Ni- SBA-15 catalysts. (A) 10Ni-SBA-15, (B) 30Ni-SBA-15, (C) 50Ni-SBA-15, (D) 70Ni-SBA-15

Scanning electron microscopic images are shown in Figure 4; these SEM images of mesoporous materials with different loading of Ni have different morphologies. 10Ni-SBA-15 and 30Ni-SBA-15 catalysts are more less having the morphology of original SBA-15. As the loading of Ni increases, mesoscopic order has been diminished. Only the aggregate of Ni is seen in both 50Ni-SBA-15 and 70Ni-SBA-15catalysts.

The catalytic activity of Ni-SBA-15 catalysts can be seen from the Table 2. The catalytic activity experiments were preceded by blank tests intended to ascertain that the reaction did not take place to an appreciable extent in the absence of the catalyst. With SBA-15 alone and Ni alone reaction has not been taken place. Even with 50Ni-SBA-15 and 70Ni-SBA-15 catalysts reaction was not occurred. Only low loading Ni-SBA-15 catalysts were found to be active towards the conversion of methane into the corresponding hydrogen.

Table 2: The Catalytic Activity of different Ni-SBA-15 catalysts

S.No	Catalyst	H_2 Production (%)
1	SBA-15	Nil
2	Nickel	Nil
3	10Ni-SBA-15	10
4	30Ni-SBA-15	20
5	50Ni-SBA-15	Nil
6	70Ni-SBA-15	Nil

High hydrogen production is observed in 30Ni-SBA-15 catalyst among all other catalysts. Because of this 30Ni-SBA-15 is selected for further study.

Table 3: The Catalytic Activity of 30 Ni-SBA-15 catalysts

Time	H_2 Production (%)
15min	20
1 hr	18
2 hr	30
3 hr	45
4 hr	48
5 hr	50

The catalytic activity of 30Ni-SBA-15 catalysts is as follows: The initial hydrogen production within a 15min is 20% of H_2; for 1hr, it has been slightly decreased to 18% of H_2; again from 2hr to 5hr, it has been increased to 30% H_2, 45% H_2, 48% H_2 and 50% H_2 is observed. The catalytic activity of 30Ni-SBA-15 for H_2 production is shown in figure 5. The graph is plotted between Time and Hydrogen Production (%); where on X-axis Time is plotted and on Y-axis Hydrogen Production (%)

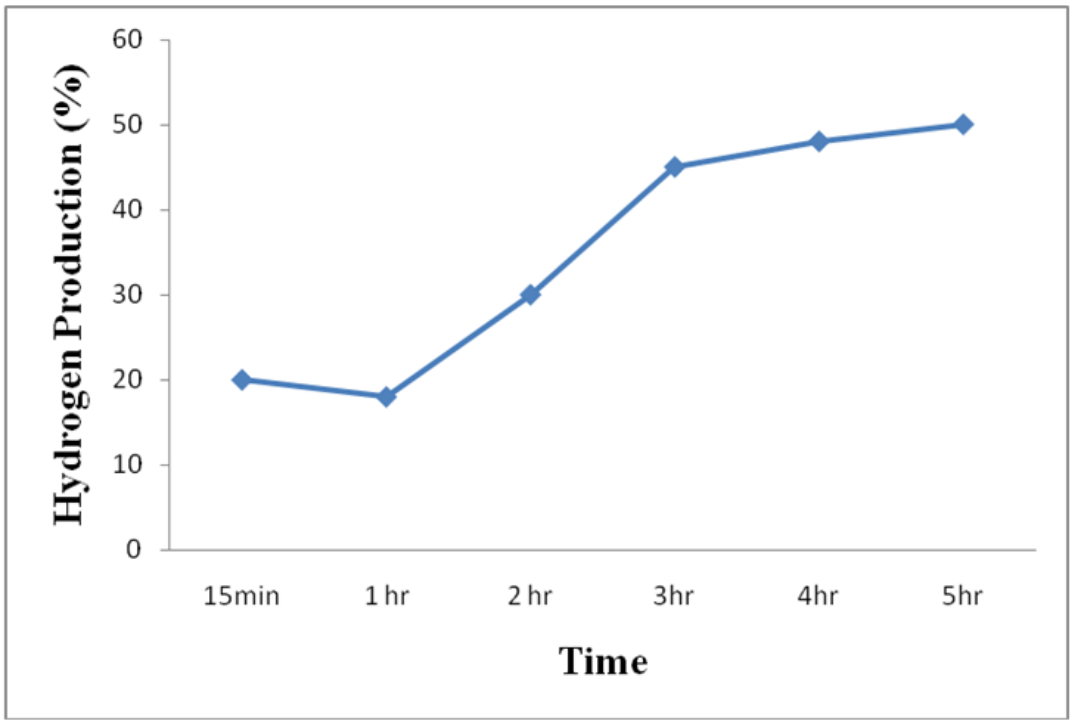


Fig.5. Catalytic Activity of 30 Ni- SBA-15 catalyst for H_2Production

4 CONCLUSION

SBA-15 nano catalysts were successfully been synthesized using p123, tetraethyl ortho silicate and Ni $(NO_3)_2.6H_2O$ as template, silica source and Nickel nano particle precursors respectively under acidic hydrothermal conditions. The BET surface area, pore size distribution and low angle XRD studies revealed the retention of hexagonally ordered behavior in the catalysts. Wide angle XRD study divulged the crystalline behavior of Nickel oxide species and these Nickel oxide species are in nano range. The catalytic activity experiments were preceded by blank tests intended to ascertain that the reaction did not take place to an appreciable extent in the absence of the catalyst. With SBA-15 alone and Ni alone reaction has not been taken place. Even with 50Ni-SBA-15 and 70Ni-SBA-15 catalysts reaction was not occurred. Only low loading Ni-SBA-15 catalysts were found to be active towards the conversion of methane into the corresponding hydrogen. Among all other catalysts, 30Ni-SBA-15 we observed high percentage of hydrogen production.

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