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# Exploring Child Rights Clubs potential on promoting Child Protection Education in Schools

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## Abstract

*The purpose of the study was to document the child protection knowledge that children are able to acquire through the child rights clubs in schools which often helps them in coping with the appalling conditions in which they continue to live. A total of 68 respondents were purposively selected for the study, who included 60 children who are members of child rights clubs in schools and 8 key informants. The study findings indicated that child rights clubs are important avenues for encouraging child protection education in schools. Through these child rights clubs, children are well versed with information on child rights, child abuse and reporting child abuse cases. The paper recommends infusion of the child protection component in the country's education policies for extensive child protection information dissemination, education and communication and thus improved child protection outcomes. To have a greater impact on children, child protection should become a priority.*

**Key words:** Child Rights Clubs, Child Protection, Schools, Uganda

## 1. Introduction

Like in many developing countries, violence against children in Uganda has taken its stroll regardless of the absence of accurate information about the prevalence (Devrie et al., 2013). In overwhelming numbers, children have described the rampant use of violence against them in their homes, in schools and in the wider community (Naker, 2005). Although schools provide an environment in which children are able to interact and play (Atkins et al., 2010), most of the physical and psychological violence inflicted on children happens within the school setting (ACPF, 2011). Male teachers are the main perpetrators of beating in Uganda (ACPF, 2006). Many schools in Uganda have not prioritized child protection (CP) education as an important component for children's' safety in and out of schools (Ayebazibwe, 2013). It is safe to say, moreover, that child protection education in schools is often overlooked, and such information is very important for both the students and the schools authorities at large. The introduction of child rights clubs in schools has been believed to help bridge this gap although these clubs at the moment in Uganda are largely dependent on NGO projects for funding, supervision and sustenance. There is need of educational reforms in Uganda to include such innovative programs. It has been proved that incorporation of child protection knowledge and other child protection activities into educational research can provide a well - rounded secure learning environment for

children. Chigunta (2005) concluded that the Child Rights Clubs in Zambia have had a positive impact on the awareness and knowledge of the rights of the child in the schools where the clubs operate. According to Gillmore (2014), Child Rights Clubs help kids to help themselves. They provide children with information and experiences that bring real - world relevance of own protection in and out of school which is as paramount as academic excellence in learning (Gillmore, 2014; UNICEF, 2007). But few schools based interventions include the child protection component (Ayebazibwe, 2013). Most school - based programs target academic excellence (Evans-Winters, 2005). Researchers have called for greater attention to internalizing issues, such as abuse and exploitation of children (Collin-Vézina, Daigneault and Hébert, 2013; UYDEL, 2011; Lansford et al., 2007). This paper focuses on documenting the child protection knowledge that children are able to acquire through the child rights clubs in schools which often helps them in coping with the appalling conditions in which they continue to live. The OVC Situational Analysis report (2010) places the level of vulnerability among children in Uganda at 96% with 8% (1.4 million) critically vulnerable, 43% (7.4 million) moderately vulnerable and 45% generally vulnerable (7.7 million) (Kalibala and Elson, 2010). This implies that the living conditions of children in Uganda are still far from desirable. Improving children protection will lead to increased student academic achievement and higher enrollment and completion rates, which will result into lowered abuse and exploitation of children and increased economic activity.

## **2. Methods**

The study employed largely qualitative techniques in data collection, analysis and presentation. The qualitative approach to research was used because it deals with human conduct and motivation which cannot be captured by the quantitative approach. The study was conducted in Busega village, Kampala District, Uganda. The purposive selection of Busega village was due to the proximity and familiarity of the locale to the researchers. A total sample of 68 respondents were involved in the study. These included 60 in - school children (30 primary students and 30 secondary students ) who were purposively selected because they were members in the child rights clubs in their respective schools. The key informants included 8 school authorities who consisted mostly the teachers/patrons of the child right clubs in the selected schools. The total sample was drawn from four (4) schools (2 primary schools and 2 secondary schools) which were purposively selected because of the existence of child rights clubs in these schools. Data collected involved use of in - depth interviews and focus group discussions (4 focus groups were conducted) with the primary respondents, and key informant interviews for the school authorities. Content and thematic analysis were used for qualitative data. Transcriptions and translations were made, edited to ensure completeness and logical flow, and critically read by the researchers. Content and thematic analysis enabled the researchers to identify and isolate the major themes, meanings, common explanations, patterns, trends and understandings in the respondents' responses. Quantitative data analysis was done using a computerized programme SPSS to provide descriptive summaries and more manipulations were done by use of Ms Excel.

## **3. Results**

### **3.1 Socio-Demographic Characteristics of the Respondents**

#### **3.1.1 Age of Respondents**

The age of the children varied according to the level of education. In the primary schools, the age was much younger and narrower, mostly between 11 - 12 years as shown in Table 1. This is because at primary level, this age group is normally believed to have developed sound reasoning and understanding and can easily

nominate themselves in different school activities, usually in primary six and primary seven as opposed to children in the lower grades. In the secondary schools, the age was much higher and broader, from 13 - 18 years as shown in Table 1. At this level, children are deemed to be mature enough, to be able to make own life choices. This is normally a transition period from childhood to adult hood where children normally exercise their rights and responsibilities. Key informants included teachers/patrons of the child right clubs in the selected schools. These are the advisors of children at school, on whom students can rely for proper direction.

**Table 1: Age of Respondents**

Category	Age (Years)	Frequency	Per cent
Primary school child rights club members	09	02	2.9
	10	03	4.4
	11	14	20.6
	12	11	16.2
Secondary school child rights club members	13	3	4.4
	14	4	5.8
	15	7	10.3
	16	8	11.8
	17	5	7.4
Key Informants	18	3	4.4
	26	02	2.9
	29	03	4.4
	31	01	1.5
	34	01	1.5
Total	36	01	1.5
		68	100

### 3.1.2 School Grade

The grade range of primary children was Primary four - Primary seven while for secondary children was senior one - senior six. There was equal representation for both primary and secondary children. This follows the fact that all are still children under parental care and guidance, no matter the level of education.

### 3.1.3 Gender of Respondents

Of the 60 children selected for in - depth interviews and FGDs, 31 or 51.7 percent were female while 29 or 48.3 percent were male. There was almost equal representation of female and male children because both the

primary and secondary schools were all mixed schools. The study was also gender sensitive. The Key informants included 5 male teachers and 5 female teachers.

### **3.2 Child Rights Clubs: Overview on Formation and Management**

In the four (4) schools visited, the Child Rights Clubs were formed under the NGO projects running in these schools. The school authorities occasionally mentioned about the existence of this idea before the NGO's came in. The researchers learnt that NGOs first orient the teachers about the concept of the child rights clubs. The NGOs then delegate the responsibility of marketing this idea to the rest of the school children to the teachers in - charge of children affairs in the respective schools, who officially become the child rights club patrons, with selected assistants' just in case of absence or in need of suitable replacements. The study discovered that the child rights club patrons in all the schools visited were males. This was because women in Busega village have not been well established in the leadership roles. The child rights club patrons are responsible for guiding school children through this innovation. The NGOs are supposed to oversee the activities of these child rights clubs through offering technical assistance such as funding, training, monitoring and support supervision. Child participation is at the fore front in the establishment of the child right clubs. Participation in these clubs is always voluntary. Membership is open to all children in the schools.' The children willingly choose to participate in these clubs as opposed to being chosen by the facilitators. The child rights clubs are directly run by the school children. The club activities include debates, music, dance and drama and sports undertaken mainly in the school environment. In almost all the schools visited, an executive comprising a president, a vice-president, secretary and treasurer, typically runs a child rights club for a period of one year. Executive members are mainly children in higher grades. All child rights clubs meet at least once a week. The club members brought to the researcher's attention that the level of attendance in the club meetings was high. The child rights club members described the club meetings as an important source of learning. The study observed that the size of the child rights club membership was too large in all the schools because there were no restrictions to membership. The researcher's view is that at the inception of such new innovations, it is crucial to include all members for a solid foundation. This explains the absence of club registers in all the schools visited. In the FGDs and key informant interviews, the researchers learnt that not all children are actively participating in these clubs but the size of the club membership in all the schools visited ranged from 30 in primary schools to over 70 in secondary schools. Active support of the initiative by the school administrations' was noted although instances of reluctance on the part of some teachers to participate in the club activities were also recorded.

### **3.3. Child Rights Clubs potential on promoting Child Protection Education in Schools**

Studies have indicated that the school environment in Uganda is a source of child abuse. But important to note is that the same environment can be used to prevent abuse on children. Child Rights Clubs are important avenues important avenues for encouraging child protection education in schools.

#### **3.3.1 Awareness of Children's Rights**

The findings indicate that the child rights clubs have improved the knowledge and understanding of children rights for both children and teachers. Children got to know the different types of rights they are entitled to such as the right to education, the right to freedom of speech and the right to good health among other rights. At least all club members could mention at minimum two child rights they are entitled to. One of main

activities that NGOs undertake in schools under these child rights clubs is to offer trainings for teachers and club members. Discussions with club patrons in schools visited indicated that, as a result of such trainings, teachers are not only aware of their roles and responsibilities to protect children but they have also become important actors in the protection of children.

## Case Study

I was one of the teachers who used to seriously beat students. Some students even used to report me to the school administration but of course, the school administration could do nothing by then. But with the establishment of these child rights clubs coupled with the trainings we receive from NGOs, my punishment approach has changed. For senior five and senior six school children for instance, counseling is done because these are mature students. For senior one – senior four, small punishments are given because they are still young. But these punishments depend as well on the offense the student has committed. Not every wrongdoing by a student is punishable unless it is an aggravated abuse on a teacher. These punishments are done after classes such as sweeping a certain class, picking part of the school compound, fetching water, etc. For sure, they are just very simple punishments to teach other students not to do the same. My fellow teachers have also changed. In fact, students are now acknowledging that teachers are not beating them like they used to do before. Teachers meetings are all rounded now. We no longer talk about only those things which affect us as teachers but we have started including issues that affect children in our meetings agenda, talking about them and findings solutions for them. There is always a unanimous decision to attend to issues of children. This is such a great change in our school because before, teachers could not allow issues of children to be included in their discussions. (Child Rights Club Patron, Secondary School, Busega village, Kampala District)

The child rights club members bear witness to child protection awareness in and around schools. Some of them had this to say;

*We normally utilize the general assembly every Monday of the week as a platform to share with the rest of the school children messages on child protection. Our topics normally come from those child protection issues we identify at school or even in the communities where we live. We have concentrated a lot on sexual violence and corporal punishments because these are the child abuse concerns we have identified repeatedly. The child rights clubs have helped us deal with child protection problems in and around schools. They have also boosted our self confidence and especially talking to people.* (FGD, Child Rights Club Members, Secondary School, Busega village, Kampala District)

From the above information, it is clear that the child rights clubs have helped to increase children's and teacher's awareness about child protection. Children have become more confident in reporting abuse to the relevant authorities. The teachers/child rights club patrons the researchers talked to acknowledged that there is a general sense of responsibility on the part of children with regard to capacity to reporting abuse. This is a notable achievement registered by the existence of the child rights clubs in schools.

### **3.3.2 Awareness of the different forms of Child Abuse**

Child Rights Club members seemed aware of the different forms of child abuse. In the in - depth interviews and FGDs, club members identified domestic servitude, defilement, corporal punishment in schools, sexual relationships by teachers, early marriages, psychological abuse, child neglect and abandonment, conscription in armed conflict, child sacrifice, subjection of children to hazardous work such as scrap collection, selling in the streets and working in stone quarries as examples of child abuse. Children appreciated the knowledge acquired about child abuse (through the child rights clubs) and how it has helped them learn how to stay safe. At one primary school, one child rights club member demonstrated knowledge on how to stay safe as follows:

*I often refuse free transport and gifts from strangers, I avoid bad groups, I desist night movements, and I always refuse bad touches. This is how I protect myself from bad people not to take advantage of me.* (Child Rights Club member, 12 years, Primary School, Busega Village, Kampala District)

Discussions with teachers also highlighted an improved capacity among teachers in handling child abuse in schools and beyond.

### **3.3.3 Awareness of the different stakeholders responsible for children affairs**

Child Rights Clubs have helped children know where to get help. Club members were able to single out the different entities in charge of children affairs in the communities and these included the police, local leaders, court, NGOs and the teachers in schools. Children are aware that the perpetrators of child abuse are punishable by law. Children had started using these child protection systems as the school patron of one secondary school confirmed that,

*Children normally report teachers to police, for the corporal punishments suffered.* (Child Rights Club Patron, Secondary School, Busega village, Kampala District)

Another teacher made the following observation:

*Children never used to report cases of child abuse to us. But with the introduction of the child rights clubs in schools, children are now able to talk to us about issues affecting them. The local leaders in one of the parental meetings we had at school also recognized that there is a increase in the number of children reporting cases of abuse to them in the community.* (Child Rights Club Patron, Primary School, Busega village, Kampala District)

The greatest achievement in building the capacity of children as well as the relevant stakeholders is the change in attitude. Teachers have the right attitude to handling child protection issues. Children have the right attitude in participating in their own protection. One club member made the following compliment.

*We are now able to express our problems because our teachers now allow room for interaction with students.* (Club Member, Secondary School, Busega Village, Kampala District)

Another teacher added that:

*We normally hear these children telling their friends to sit properly in case of any indecent disclosure such as peeping under wears and sometimes commenting on the dressing of their fellow friends and especially those that might come at school shabbily dressed.* (Child Rights Club Patron, Secondary School, Busega village, Kampala District)

#### **4. Discussion**

Child Rights Clubs have positive effects on enhancing, children's knowledge and awareness of their rights, awareness of the different forms of child abuse and awareness of where to report in case of any abuse. Schools are often successful in improving the child protection outcomes of children if they carefully integrate child protection education in their academic programs. Children in schools are always eager to learn new things. Working with schools was found to be the most effective means of addressing the issues of child protection at the school level. Child Rights Clubs are a vital means of mobilizing schools around children's protection and wellbeing. It was found that these child rights clubs can make it possible and contextually appropriate to: identify, prevent and respond to significant child protection risks; mobilize schools around child protection issues; and provide a base of school support and action that can be taken to scale through links with other community groups such as the police, local leaders, and child protection committees in the community. Child participation is at the forefront of the operation of these child right clubs. This is paramount for any successful child protection intervention. Children need to be involved right from the initial stages of any child protection activity designing, planning and implementation. The Child Rights Clubs have proved that children can participate in their own protection. For example, if a child can report a case to any relevant authority, it shows that children can participate in their own protection. When you engage children often, then you are able to get good results from them. It was good to enable club members to come up with initiatives of their own such as 'utilizing the general assembly as a platform to share with the rest of the school children messages on child protection,' as earlier reported in the study findings. Engaging teaching staff and school children is important to bridge the gap between the school - led activities and the student - led activities. The study showed improvements in teacher - student relationships, suggesting that child right clubs may be helpful even in building social bonds among children and teachers in schools. Child Rights Clubs have the potential to benefit many children, improve the school environments, and reduce burden on the schools' limited resources for handling child protection issues. For instance, even though there is little consensus on what defines a "vulnerable" child or household eligible for receipt of support services in Uganda (Kalibala et al., 2011), there are so many children in Uganda assessed to be in need of immediate care and protection (Walakira, 2013; Kalibala et al, 2011; Kalibala and Elson, 2010). The formal child protection system in Uganda is often under resourced to address the child protection needs of children in the country (Sematya, 2012). Teacher - student dialogues as encouraged through the child rights clubs, is a promising child protection intervention component, as it can offer self esteem development for children and it embodies an effective model for behavioural change through information sharing. Although potentially costly, the trainings offered by NGOs in schools preceding the establishment of the child rights clubs promotes the sustainability of child rights clubs outcomes, as the skills and capacities acquired will remain in the school and support continued activities beyond the life of the club. Increased awareness and sensitization on child protection among the school communities has helped to increase reporting of abuse and violence against children. There is increased willingness of the teachers as well as school children to support children facing abuse and violence in the school communities.



## Conclusion

Efforts towards addressing child abuse and enhancing child protection are a welcome development nationally. The findings of this study indicate that child rights clubs have made significant steps in promoting child protection education in schools. In particular, the evidence from the study indicates that the child rights clubs have made attempts at encouraging information sharing on child protection. The school children and the school authorities have been sensitized on child protection issues through the club activities at the schools. From the evidence gathered through discussions and interviews with the study respondents, there is a right attitude to handling child protection issues. There is an increased awareness about child protection among children and teachers in schools. Relationships among teachers and school children are critical in making the child rights clubs maintained in schools. Child protection is not a one day activity. It takes time and requires significant commitment from all the stakeholders. The paper recommends infusion of the child protection component in the education policies of the country for extensive child protection information dissemination, education and communication and thus improved child protection outcomes of the country.

## References

- African Child Policy Forum (ACPF), (2011), Violence Against Children in Africa. A compilation of the main findings of the various research projects conducted by the African Child Policy Forum (ACPF) since 2006. [Online] Available: [http://www.africanchildforum.org/site/images/stories/ACPF\\_violence\\_against\\_children.pdf](http://www.africanchildforum.org/site/images/stories/ACPF_violence_against_children.pdf) (June 13, 2015).
- African Child Policy Forum (ACPF), (2006), Violence Against Girls In Africa: A Retrospective Survey In Ethiopia, Kenya and Uganda. The African Child Policy Forum.
- Atkins, M. S., Hoagwood, K. E., Kutash, K., & Seidman, E. (2010). Toward the integration of education and mental health in schools. *Administration and Policy of Mental Health*, 37, 40 - 47.
- Ayebazibwe, Agatha, (2013), Teenage pregnancy: A big threat to Uganda's girl-child. [Online] Available: <http://www.monitor.co.ug/News/National/Teenage-pregnancy--The-pain-of-child-mothers/-/688334/1910850/-/h55g0dz/-/index.html> (April 18, 2013).
- Chinguta, Francis, (2005), Report on the Evaluation of the Child Rights Clubs Project in Zambia. [Online] Available: [http://www.unicef.org/evaldatabase/files/Zambia\\_Child\\_Rights\\_Clubs\\_2005.pdf](http://www.unicef.org/evaldatabase/files/Zambia_Child_Rights_Clubs_2005.pdf) (May 15, 2016).
- Collin-Vézina, D., Daigneault, I., & Hébert, M. (2013). Lessons learned from child sexual abuse research: prevalence, outcomes, and preventive strategies. *Child and Adolescent Psychiatry and Mental Health*, 7, 22. <http://doi.org/10.1186/1753-2000-7-22>.
- Devries, K. M., Allen, E., Child, J. C., Walakira, E., Parkes, J., Elbourne, D., ... Naker, D. (2013). The Good Schools Toolkit to prevent violence against children in Ugandan primary schools: study protocol for a cluster randomized controlled trial. *Trials*, 14, 232. <http://doi.org/10.1186/1745-6215-14-232>.
- Evans-Winters, Venus E, (2005), Teaching Black Girls: Resiliency in Urban Classrooms. [Online] Available: <https://books.google.com.sg/books?isbn=0820471038> (May 13, 2016).
- Gillmore, Christy, (2014), Child rights clubs in Ghana help kids help themselves. Available: <http://www.freetheslaves.net/fts-partner-launches-child-rights-clubs-in-ghana/>
- Kalibala S., & et al. (2011). Examining dimensions of vulnerability among children in Uganda. *Psychology, Health and Medicine*, 17(3): 295 - 310. doi: 10.1080/13548506.2011.597771.

- Kalibala, Samuel, & Elson, Lynne, (2010), Protecting Hope: Situational Analysis of Vulnerable Children in Uganda. [Online] Available: [http://www.popcouncil.org/uploads/pdfs/2010HIV\\_UgandaProtectingHope.pdf](http://www.popcouncil.org/uploads/pdfs/2010HIV_UgandaProtectingHope.pdf) (April 30, 2014).
- Lansford, J. E., Miller-Johnson, S., Berlin, L. J., Dodge, K. A., Bates, J. E., & Pettit, G. S. (2007). Early Physical Abuse and Later Violent Delinquency: A Prospective Longitudinal Study. *Child Maltreatment*, 12(3), 233–245. <http://doi.org/10.1177/1077559507301841>.
- Naker, Dipak, (2005), Violence Against Children: The Voices of Ugandan Children and Adults. A study commissioned by Save the Children in Uganda and Raising Voices. [Online] Available: [http://raisingvoices.org/wpcontent/uploads/2013/03/downloads/resources/violence\\_against\\_children.pdf](http://raisingvoices.org/wpcontent/uploads/2013/03/downloads/resources/violence_against_children.pdf) (March 13, 2016).
- Ssembatya, James, (2012), An Overview of the Child Protection System in Uganda. [Online] Available: <http://www.mglsd.go.ug> (May 14, 2014).
- United Nations Children’s Fund (UNICEF), (2007), A human rights-based approach to education for all. New York.
- Uganda Youth Development Link (UYDEL), (2011), Commercial sexual exploitation of children in Uganda: A critical review of efforts to address CSEC. A study commissioned by Action for Life/Air France. [Online] Available: [http://www.uydel.org/details.php?category=cuydl&eid=27&ca=CommercialSexualExploitation of Children \(CSEC\)&Uganda Youth Development Link](http://www.uydel.org/details.php?category=cuydl&eid=27&ca=CommercialSexualExploitation%20of%20Children%20(CSEC)&Uganda%20Youth%20Development%20Link) ( March 23, 2015).
- Walakira, Eddy, (2013), Baseline Survey on Community Child Protection Systems in Uganda. [Online] Available: <http://www.crin.org/docs/Survey%20on%20Community%20Based%20Child%20Protection%20Systems%20in%20Uganda,%2> (February 21, 2014).

# **Traditional Chieftainship in Peace Building and the Ethnic Conflict in Kosofe Local Government Area of Lagos State, Nigeria**

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## **Abstract**

*In- spite of the traditional avenue for reconciliatory mediation that truly assuages rancor, it is ironical to note the depth of damages that take place during ethno-religious conflict such as that of Zango/Kataf, Mango/Bokkos, Tiv/Jukun, Aguleri/Umuleri and even Ife/Modakeke. This paper therefore interrogates the decline of the traditional chieftaincy institution unlike that of modern courts in the provision of social order and conflict resolution. It takes a look at the recent violence re-enacted among the cosmopolitan residents of mile 12 in the Kosofe local government area of Lagos State between the Hausa/Fulani and the Yoruba people. The survey research method was adopted with sample questionnaire on 1000 respondents administered through a simple random sampling across the 10 wards in the Local Government Area. In addition, an in-depth interview was conducted on 9 residents of the area. The findings show a deep leaning towards ethnic national divide that can only be controlled through formal responsibility of our chieftainship, and accountability of same.*

**KEY WORDS:** Chieftainship, State Mediatory Agents, Ethnic Conflicts, Peace Building, Kosofe Local Government.

## **Introduction**

The chieftaincy institution is one of leadership in the traditional societies which may be attained through heredity or by turn. This kind of political leadership metes out a stewardship to its people through upholding the beliefs, customs, norms, values and maintenance of social order and stability among the membership of the group of people. Although, there is a growing interface between the prosperity and opposition of the chieftaincy institution, it is an expression of the dynamics of culture change. For instance, during the long years of military government in Nigeria, traditional rulers largely had a preserve of their status, except for a major change in 1967-68 when their powers over judicial affairs were significantly reduced. However, with the reintroduction of Democracy in 1999, and the need to establish a more sustaining constitutional framework for peace building, the importance of traditional rulers has come again to the fore. Although, as the traditional ruler ship have evolved and flourished, so has its opposition especially in the Northern Nigeria where the tendency for people to divide into sects has been noted of the 1970s onward with an obvious characteristic of the new groupings to challenge the older order of Emirs and brotherhood.

Thus, there is an interface between the prosperity and opposition of the institution of chieftaincy ruler ship, especially as recent concerns about the role of Islam in worldwide political instability calls for a current review of the status and role of traditional rulers and their role in peace making and conflict resolution for their relevance to Nigeria.

### **Statement of the Problem**

The area of conflict resolution is now largely dependent on the western institutions of little or no input from the traditional institutions. Some of the western institutions used in resolution of conflict are the courts, the military and police, panels of inquiry among others. However, these strategies for resolving dispute or conflicts have been known to have usually recorded short comings especially when the event involves riots and civil disturbances like that of Aba women riot of 1929.

Green (1947) noted that the colonial government deployed the military as usual in response to quelling the Aba women riot to the embarrassment of the whole world. In the post colonial Nigeria the case has degenerated entirely. The response to civil disorder in Nigeria has been quite disturbing following the enormity in the recurrence of violent confrontations which is accompanied loss of lives, desecration and destruction of properties. Moreover, when a commission of enquiry as a matter of state apparatus is instituted to chat a way for the resolution of a particular crisis, it usually sit for very long time with an attendant high cost. In addition, when the report is eventually produced, it may be swept under the carpet or distorted. It goes to disabuse one's mind that the bases of most of the crisis are ethnic or religious. Thus, the mechanism of checks and balances as a formal institution traditionally thought to regulate the activities of leaders among a population has remained rather weak (Beattie,1967).

Although, the level of the check and balances and accountability differ widely from place to place, the feature in Nigeria is obviously not comparable with those of many African countries. For instance, the checks and balances among the Ashanti of Ghana, the Lesotho, the Tswana of Botswana, and the Uganda were better constitutionally defined with council of elders, religious leaders, and administrative staff of the chiefs keeping the modern leaders accountable (Coplan, 1997). Thus, it is an aberration that the inadequate positioning of traditional leaders in conflict resolution is what leads to the deadly conflicts as that of mile 12 in Kosofe Local Government Area of Lagos State between Hausas and Yorubas. It was with a lot of bloodshed and wonton destruction of life and properties occurring in 2012 barely a decade away from an earlier carnage in the same area. The lack of formal institution for checks and balances in Nigeria Chieftainship is in- spite of the minimum standard already existing in the administrative structure of the Ashanti of Ghana, where lineages, villages are allowed to manage their own affairs including settling of disputes through arbitration by elders (Busia, 1968). Other notable ethnic and religious crisis of contemporary interest in Nigeria include those of the Zango and kataf 1989; Mango and Bokkos feud in Plateau state, 1992 and 1995; Aguleri and Umuleri in Anambra state 1995 and 1999; Ife and Modakeke 2000 among others cutting across the country.

### **Literature Review**

Perrot and Fauvelle Aymar (2003) observed that a recent review of the situation in other countries of the West Africa has found that there has been resurgence on the prestige of chiefs in the neighboring countries. This is interesting to learn in spite of the ideological reasons given for the elimination of their authorities such as

being backward looking and subservient to the colonialist. This negative aspect of the features of the chiefs was so that, Miller (1968) noted that Tanzania passed a law that relieved the traditional rulers of their authority. Even the Convention People's Party in Ghana which was the contemporary of the National Convention of Nigeria citizens in Nigeria wrestled authority of chiefs in Ghana (Brempong, 2001).

However, it is appreciable that resurgence in the chieftaincy authority is likely, as it is a function of the enduring ethnic identity. Thus, it is little wonder that the size and population of Nigeria at the beginning of the colonial era and even during the military regimes has an influence on the prominence of chieftainship.

As it happens, that contingencies of history were already reframing academic interest in traditional rulers and institutions. In the early 1950s of Nigeria, the native authorities were developed as agencies of democratic local government to be integrated into a parliamentary system of government (Yahaya, 1980). This system was designed to meet the aspirations of emerging regional elites and the new political parties they were joining. In the process, the authority of traditional rulers was seriously undermined. The wider literature on traditional rulers and their institutions reflected the same set of political processes where post-war analyses of chieftaincy structures were initially dominated by the now largely discredited mid-century modernization paradigm. Premised on positivist and evolutionary assumptions, these earlier studies of the nation-state project predicted the imminent demise of chieftaincy structures in African politics.

Moreover, analyses in the context of third world decolonization, the Cold War, and global capitalism, got modernization theorists to emphasize the erosion of chieftaincy power in the post-colonial African state. These dominant post-war social science perspectives drew heavily from Max Weber's notion that power is legitimate only when the political community expresses voluntary consent. However, this erroneous conceptualization is based on the assumption that rational human behavior is best mediated by the agencies of the modern state and civil society.

Arguably, indigenous African state structures were widely held to be dysfunctional in this post war political context as modernization theorists contend that their marginalization is an essential precondition for the sociopolitical and economic development of African states (Vaughan, 2000). However, the modernization paradigm of international economic development received a battering from the neo-Marxist dependency theorists in the 1970's and 1980's. Even the dependency paradigm was noted by Vaughan (2000) as a radical alternative to modernization theory, but was equally short-sighted as it was preoccupied with the advance of global capitalism, the marginality of third world economies, and the role of comprador classes in the economies of new states leaving out the critical role that indigenous structures, most notably the traditional institutions might play in the transformation of African states.

Nevertheless, it is evident with Whitaker (1970) and Yahaya (1980) and others, as used in their case studies that these traditional structures remained resilient and in many respects competitive with the modern state. Thus, when analysts turned to interrogate the legitimacy of failing African states in the 1980s and 1990s, most of them continued to employ notions of governance and civil society that were based on western models and paid little attention to the possible relevance of the traditional political institutions.

Nevertheless, the on-going political significance of traditional structures does attract the attention of some political scientists working in Nigeria. For example, Miles (1987) picked up on earlier studies and argued that

Hausa chieftains in both Nigeria and Niger had been co-opted by the nation-state and owed their survival and continuing legitimacy to this source rather than to traditional royalties. Thus, there was a duality in government that was only to serve the initiative of the colonial government.

However, Sklar(1993; 2003) noted in particular a concept of mixed government which described the dualism and symbiotic relationship between traditional and state-derived institutions that characterizes government. It argues that the durability of traditional authority in Africa cannot be explained away as a relic of colonial rule. Instead, it emphasizes the role of local initiative as African agency in the construction of colonial institutions, and largely responsible for the adaptation of traditional authorities to modern systems of government and the legitimacy they continue to enjoy among ordinary people.

The traditional authority was mediatory in the virtual conflict between the government and the people. It is along this line for instance, that Nwoye(2011) noted that ‘Chieftaincy titles among the Igbo constitute a form of reward or social control model designed to support acceptable norms and values by rewarding those who have upheld them. Such titles or rewards make the recipients advisers to the political leadership of the village’. Thus, such research questions arise such as:

1. Is it not obvious that the Traditional chieftaincy institutions are better equipped with indigenous and cultural knowledge of the people for brokering a sustainable dispute resolution?
2. Is there possibly other dimension by which the Modern Jurisprudence could edge out its traditional counterpart in dispute resolution?
3. What are the challenges faced by the Traditional Chieftaincy Institution?

**The objectives of the study include:**

1. To examine the extent that the Traditional Chieftaincy Institution has been explored for the resolution of conflict in Kosofe Local Government Area
2. To determine the acceptability of decisions made by the Traditional and Modern Institutions respectively in past disputes in Kosofe Local Government Area.
3. To determine the challenges that are faced by the chieftaincy Institution in Kosofe Local Government Area

**Research methods**

The research methods for this study include the sampling and in-depth interview methods. These sampling methods are necessary to enable a full coverage of the issues and ideas around the study. Though, representation of the population is of germane consideration, much more is the intent to explore all the categories of issues in the conflict, even to their less popular ones since the study is focused on the role and the usability of the Traditional Chieftainship and not judgmental. This was so, for it was a research on such issue as may be considered security risk. Thus, the accidental and purposive sampling methods were adopted in the research. However, the sampling frame for the study was adapted along the existing 10 wards in the Local Government Area. In this Local Government Area, the Population of study is 665,393(2006 National Population Census), and from this Population a sample size of 1000 was targeted with 100 samples from each of the 10 wards. This ensured that every willing eye witness who was ready to participate was given a chance,

until the number of participant in a ward is made up to 100. The administration of the questionnaires was carried out by 10 Research Assistants. In the bid to get inventory of all the varying and diverse opinion on the conflicting situation, the Research Assistants were trained and they employ other convenient means of safe and reliable data collection including employing translation Assistants where respondents cannot write, and speak only their native language. Thus, the structured interview session for one respondent lasted for between 30 minutes to 1hr, and the 100 samples in each ward lasted for 2 to 4 days (i.e.) 21-25 May, 2013. There were 3 categories of questions in the interview sessions (i.e.) pre-interview or oral question; demographic questions, and thematic questions. The pre-interview question is oral (i.e.) Did you witness the 2012, January Hausa/Yoruba conflict? This determines either or not the individual would be a respondent. The demographic questions are included in the structured questionnaire (i.e.) what is your age bracket, sex, marital status, and education. Finally, the thematic questions were on the efficiency of the kinds of intervention that were meted on the conflicts in Kosofe area of Lagos State. These were measured by asking the respondents (1) to identify the cause of conflict in the area, (2) to identify the mode of resolution of conflict in the area, (3) to indicate the level of obedience given to the decision of the traditional Chieftains as against that of modern institution, and finally, the competence of the chieftaincy personality is measured by their level of relevance to the society. The qualitative perspective of the study was undertaken through the in-depth interview of a total of 9 respondents that were evenly drawn from the 3 dominant ethnic groups in the area (i.e.) Yoruba, Hausa/fulani and Igbo, and evenly distributed among the 3 major troubled spots (i.e.) Nuhu Oluwo, Oniyanrin and Adeyeye streets.

## Oral Interview

In-depth interview was conducted among 9 (nine) eye witness who are residents of the troubled community comprising the streets of Nuhu Oluwo, Oniyanrin and Adeyeye all in the south axis of the mile 12 area of Kosofe local government area of Lagos state. The 9 residents include 3 each of the Hausa, Igbo and Yoruba ethnic groups respectively. The interview was recorded with audio tape in Broken English language, and transcribed into English language

The major themes in the interview include (1) The cause of the conflict in the area (2) The nature of the conflict (3) The parties affected (4) The modes of intervention or resolution (5) The aftermath state of order.

Respondent 1:

A Hausa trader along Adeyeye Street

“The crisis was started by the Okada man when he attempted to snatch money from an Hausa man.... And they got into a fight and incidentally he was killed....it shows that the Hausa is stronger and cannot succumb to the threats of violence or manipulation of the law by the Yoruba’.(Mile 12, 22 may 2013)

Respondent 2

A Hausa /Fulani trader along Nuhu Oluwo street

‘Yoruba youths in this area think that because this is their homeland every other people especially Hausa are malu (cattle) people, have no sense and therefore have no right. Thus, they (Yorubas) bully us and make away with our properties and market goods.... In this particular event we thought we should show them that we are braver, but for what the general public would say of us as noted by our elder (Gambo Liman)’.(Mile 12, 23 may 2013)

Respondent 3:

A Fulani sugar- cane seller along Oniyanrin street

‘it is the Yoruba people that always cause the conflict. They love to cheat us by collecting undue tolls from us.... When the Hausa man refused to pay the duplicated toll the Yoruba man started to molest the Hausa with all sorts of threats. Hence, the Hausa had to fight back’. (Mile 12, 24 may 2013)

Respondent 4

A Yoruba indigene and trader along Nuhu Oluwo street

‘if you look everywhere, you would see how the Hausa people has taken over all the available pieces of land beyond their legitimately allocated portions for their business, and they mess up everywhere without control and not paying for due tolls. Moreover, they walk about everywhere carrying weapons like knife and juju (voodoo).... Thus, without provocation they killed a Yoruba okada rider (commercial motorcyclist) only to allege that he was a thief.... I ask as always why moving to bury in a hurry the Yoruba person they killed if he was a thief. Nobody has answered that question.(Mile 12, 23 may 2013)



## Respondent 5

A Yoruba indigene and commercial motorcyclist along Oniyanrin area of mile 12.

‘The conflict was borne from the long standing grudge against the Yoruba. The Hausa share the thought that the Yoruba people are not godly and thus they should not live. The guy that was killed rides okada (commercial motorcycle)...he had a fall out with an Hausa man who killed him alleging that he was a thief and then hurriedly went to bury him...though we could not hear the deceased’s side of the matter, the hurry to bury him before public notice, and the breaking into people’s shops at the time of eventual commotion even in the presence of anti-riot policemen consistently show their flagrant disregard for order and peace. It is something of their traditional volatility against other ethnic groups’. (Mile 12, 24 May 2013)

## Respondent 6

A Yoruba and trader along Adeyeye Street

‘I was away to a neighboring quarter early that morning, only to be told on phone that the Street was on fire. I quickly rushed down and found that the Hausa youths are at it again. They had killed one Yoruba Okada rider (commercial motorcyclist) whom it was alleged had had misunderstanding with them few days ago. The killing sparked crisis between the Hausa and some Yoruba youths....and there was total chaos....even the security agents could not contain it’. (Mile 12, 22 May 2013)

## Respondent 7

An Igbo and trader along Adeyeye street.

‘Ethnic conflict in this area is common. The March episode was a rampage by the Hausa youths who usually feel uncomfortable under the political domination of the Yoruba.... In this event they had a disagreement with a Yoruba okada rider (commercial motorcyclist) but in the eventual struggle the okada man was killed and thus they decided to bury him before notice. Unfortunately, the act was noticed and degenerated into ethnic crisis.... It was devastating with destruction of properties and disruption of normal activities even with the presence of anti riot policemen until the intervention of some Hausa elders who calmed their wards’. (Mile 12, 22 May 2013)

## Respondent 8:

An Igbo and trader along Nuhu Olowu street

‘The crisis was caused by ethnic rivalry between the Hausa/ Fulani and the Yoruba area boys. In the recent crisis there was the killing of a Yoruba commercial motorcyclist by some Hausa youths for which the Yoruba youths were determined to revenge....unfortunately, the Hausa youths were too fierce for them, and even the police Rapid Response Squad could not contain them....but for the though belated intervention by some Hausa Sarkin(elders)’ (Mile 12, 23 May 2013)

## Respondent 9

An Igbo trader and along Oniyanrin Street

“The crisis is following from the long history of grudges between the Yoruba and the Hausa/Fulani youths over the moral antecedents of each other....and a Yoruba youth was slaughtered in the process along the Oniyanrin Street of mile 12 and was to be dumped in a nearby river.... This triggered a fierce clash between the youths of both ethnic groups that even the arrival of the police could not stop the violence....and the Hausa elders were nowhere to be found to intervene until after hours of damages’.(Mile 12, 24 may 2013)

### **Data Analysis and Discussion**

The survey sample of 991 was successful of the 1000 questionnaires that were distributed. The remaining 9 were nullified on grounds of abandonment by presumed respondents and illegible responses.

The result was able to show respondents awareness of the prevalence of conflict in the area, and that it was among the Yoruba and Hausa residents and traders in mile 12 area of Lagos State. Using simple percentage analysis, the result showed that 18.3% of the respondents witnessed conflict in the area for only once, while 81.7% witnessed it for about twice or more. The in-depth interview as captured by one of the informant also noted that:

‘ethnic conflict is common in this area’ (Research interview may 2013)

The implication is that the area has been harboring people living together only on such sentiments as the pursuit of daily economic upkeep but with mutual areas of ethnic disaffection that occasionally come to the fore as violence. This is in consonance with Alubo(2006) observation that it is the minor skirmishes of rancor that leads to occasional conflict.

The survey result further reveal that 77.7% of the respondents are residents, and 11.9% are resident traders, while 10.4% are just traders in the area. The in-depth interview also shows that mile 12 is populated with traders, residents and resident traders who are grounded in the sociopolitical and economic activities of the area. An informant described the situation as: ‘...a rampage by the Hausa youths who usually feel uncomfortable under the political domination of the Yoruba...’ (Research interview, may 2013)

Another informant puts it as:

‘...it is the Yoruba people that always cause conflict in the area....they love to cheat us by collecting undue tolls from us...’ (Research interview, may 2013).

Yet another informant noted:

‘I was... called on phone that the street was on fire. I quickly rushed down, and found that it was the Hausa youths at it again. (Research interview, May 2013).

These statements suggest again that there is a sense of mutual suspicion that is prevalent amongst the population irrespective of their affiliation.

It is also clear from the result that the cause of the conflicts in the area is determined by the ethnic rivalry as opined by 74.3% of the survey respondents, and 24.3% opined religious rivalry, while 1.4% opined that economic struggle is what leads to conflict in the area. The thematic content of the In-depth Interview also point to ethnic rivalry as the root cause of conflict in the area. This was captured clearly by some informants who noted:

‘...yoruba youths in this area think that because this is their homeland, every other people especially the Hausa are malu(cattle) people and have no sense and therefore have no right...’(Research Interview , May 2013).

The implication is that ethnic sentiments are being upheld over and beyond others sentiments including socioeconomic and political affiliations. This is for the simple reason that the ethnicity of a person goes a long way to define the personality and self-esteem of the person. Consequently, this inverse effect touches on the existence of the person. It is so vicious that it does not leave out any ethnic member from the common..... Thus, Alubo (2006) noted in the case of the Tiv/Jukun conflict in 1991, that the Tiv elders treated the resolution with lukewarmness.

Further, the result of the Survey Sample also show the mode of dispute resolution in the area. It showed that 11.2% of the respondents favor settlement by the use of anti-riot Police Squad, and 9.1% favor the use of legal and panel of enquiry, while traditional diplomacy is most favored with 79.7% of the respondents. However, the thematic outcome of the in-depth interview does not clearly show believe in the use of Traditional Chieftainship for conflict resolution nor disbelieve to it but it clearly show the State Agent intervention as inefficient in resolving ethnic conflict in the area. This is captured in some of the words of the informants:

‘...the Hausa is stronger and cannot succumb to the threats of violence or manipulation of the law by the Yoruba’. (Research Interview, May 2013).

Another noted:

‘ethnic conflict was devastating with destruction of properties and disruption of normal activities even with the presence of anti-riot Police men until the intervention of some Hausa elders who calmed their wards’ (Research Interview, 2013).

Yet another noted:

‘even the Police Rapid Response Squad could not contain them (Hausa youths), but for the though belated intervention by the Sakin ( Hausa elder)’. (Research Interview, May 2013).

The scantiness of categorical opinion by informants on the viability of the traditional module of conflict resolution is not unconnected to the coloration of ethnic diversity and distrust, but there is a clear categorical opinion on the inefficiency of the State Agents in the task of conflict resolution management. For instance, in the case of the Tiv and Jukun, Avav (2002) noted that the Police and Army were even accused of taking side and assisting the Jukun. It was a clear case of loss of confidence on the State agent. However, the issue of compliance to the decision made by the Chieftains in the sample survey stands at 88.8%, and non-compliance stands at 11.2%, while compliance to state agent decisions stands at 20.3% and non-compliance at 79.7%.

Furthermore, the in-depth Interview on the issue showed a thematic division into two thoughts. For the compliance to Chieftains decisions the expressions as put by a respondent is:

‘...the intervention of some Hausa elders... calmed their wards’.(Research Interview May 2013).

Another informant puts it as:

‘...we thought we should show them that we are braver, but for...our elders’ (Research Interview May 2013).

For non-compliance to the Chieftains intervention, the in-depth interview shows no notable indication. However, it showed notable aversion against compliance to State agents decision as well as non-compliance to State agents decisions. An informant puts it thus:

‘...Hausa is stronger and cannot succumb to the threats of violence or manipulation of the law by the Yoruba  
(Research Interview May 2013).

However, aversion to non-compliance is put by an informant as:

‘...the arrival of the Police could not stop the violence’. (Research Interview May 2013).

Yet another informant put it as:

‘...even the security agents could not contain it (the violence)’.

The implication is that the state agents including the police are seen as partial and prejudicial, and the breakdown of law and order cannot be seen as an offence, while on the other hand the various chieftains share in the sentiments of their youths and only put up a hypocritical posture so as not to be found culpable by the state. Nevertheless, it goes on to suggest that the potentials of the Chieftains are not adequately instituted.

## **Conclusion**

There is a longstanding mutual suspicion and disaffection among the ethnic groups in Mile 12 area of Lagos State. This is happening because the ethnic groups find themselves interacting within the same economic and political landscape set by the Nigerian Nation. The situation is pivotally aggravated by the insensitivity to the interest of the Masses who are in an unfortunate political exclusion by the Elite traditional and State agents alike. Although, the people identify more with their various traditional rulers, the inadequacy of authority and responsibility displaces the traditional rulers against their attempt at any diplomatic intervention in ethnic conflict.

## **Recommendations:**

1. It is imperative to have a House of Chiefs or Conference of Chiefs in itself alone under the paradigm of government agency;
2. This House of Chief should be vested with oversight authority and responsibility on both intra and inter ethnic and cultural matters, and accountability rendered to the state. This would not only help in pre-empting, tracking and tackling ethnic conflict, it would help in peace building.

## References:

- Alubo, O. (2006)' Nigeria Ethnic Conflicts and Citizenship Crises in the Central Region. Ibadan : PEFS.
- Avav, I. (2002) Refugees in our own country (The Tiv-Jukun Crises 1990- 93. Abuja: Supreme Black communications.
- Beattie J.M.(1967) English Court Reign George 1. Cambrigde: University Press.
- Brempong, Arhin. (2001)Transformations in traditional rule in Ghana (1951-1966) Accra: SEDCO Enterprises.
- Coplan,D.B.(1997), Moving away from silence: Music of the Peruvian Altiplano and the Experience of the Urban Migration. *American Ethnologist*,24:948-949
- Green, M.M.(1947) Igbo Village Affairs. London: Frank Cass and Company Ltd.
- Miles, Williams F.S.(1987) "Partitioned Royalty: The Evolution of Hausa Chiefs in Nigeria and Niger" *Journal of Modern African Studies*, Vol. 25 No. 2.
- Miller, N.N.(1968) The political survival of political leadership. *The Journal of Modern African Studies*, 6 (2) 183- 201
- Nwoye Chinwe M .A. (2011) Igbo Cultural and Religions world view: An Insiders perspective. Internationa Journal of Sociology and Anthropology. Vol. 3 No. 9.*
- Perrot, Claude-Helene, Fauvelle-Aymar, Francois-Xavier (eds) 2003 *Le retour des Rois. Les autorites traditionnelles et l'Etat en Afrique comtemporaine.*
- Sklar, R.L. (1993), *The African Frontier for Political Science.* In: *African and the Disciplines*, R.H. Bates, V.Y. Mudimbe and J.O'Barr (eds.) 83-110. Chicago & London: The University of Chicago Press
- Sklar, R.L. (2003) *The premise of mixed Government in African Political Studies.* In O. Vaughan (ed) *Indigenous Political Structures and Governance in Africa.*3-25. Ibadan: Sefer Books Ltd.
- Vaughan, O.(2000) *Nigerian Chiefs: Traditional Power in Modern Politics, 1890's-1990's.* Rochester: University of Rochester Press.
- Whitaker, C.S.(1970) *The Politics of Tradition: continuity and Change in Northern Nigeria 1946-1966.*Princeton, New Jersey: Princeton University Press.
- Yahaya, A.D.(1980) *The Native Authority System in Northern Nigeria.* Zaria: Ahmadu Bello University Press.

# **The Role of Social Media on Student Unrests in Kenyan Public Universities**

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## **Abstract**

*The internet and its tools of social media have been heralded as instrumental in facilitating the unrests in most African universities. This paper looks at the extent to which students use social media networks as tools for organizing for strikes in Kenyan universities. A content analysis design was used. Using social media data from WhatsApp, of the various university student groups content analysis was done and the discussions over time were analyzed and grouped on the following themes: description of events, giving instructions, spreading information, mobilizing as expressions of solidarity, hate messages, asking questions and miscellaneous dialogue. The findings indicate that social media is an inherently dialectical force that university students use to organize, mobilize and spread unrest plans in Kenyan universities. The paper concluded that with the increasing use and spread of the internet in the country the platform of social media will increasingly be used as an organizational infrastructure. Recommendations were made that university management should fine-tune their strategies in handling students' behaviours and interaction in social media networks, the university curriculum should also be reviewed so as to integrate this emerging issue and that members of staff and stakeholder should join these student social network groups and act as moderators and mentors to the youth since this may help to avert these strikes at the planning stage.*

**Keywords:** *Role, Social Media, Student Unrest, Kenya, Public Universities*

## 1. Introduction

The phenomenon of student unrest in African universities has persisted since the inauguration of universities in the early 1960s and has defied ideological boundaries and university site, such that each year resources are wasted due to recurrent cessation of teaching and learning, which sometimes results in the closure of universities. Apart from the damages to the university image as a source of inspiration and service, the recurrent crises have resulted in the massive destruction of university and public property; loss of life for both students and the public; increase in costs of running universities due to stoppages of instruction; creeping deprofessionalization of the academia, loss of public esteem and respect for the teaching staff; unnecessary changes in the staffing of higher education; dislocation in the planning for human resources development and deployment; loss of funding, consultancies, and intellectual contacts (Omari and Mihyo 1991). The intermittent closures of the universities has cost years of study and research and shaken public confidence in universities.

It is easy to attribute these crises to immaturity of university students, pubertal rites of passage, conflict of generations epitomized by an unconscious hatred and rejection of authority (the famous Freudian Oedipal complex), and the seemingly unpatriotic nature of university communities. Yet all these are an over simplification of a quite complex phenomenon which, at times, seems like an irresolvable paradox that teases and frustrates those who attempt to grasp its essence. To start with, there are the social contexts in which the crises manifest themselves. There is no doubt that the current period of African history is volatile, characterized by both a sense of hope and despair, a sense of change that will unravel new possibilities in terms of life styles, morals, politics, and consciousness (Omari and Mihyo 1991). The issue of immaturity of students needs to be raised. It is true that students have little experience in operating with bureaucracies and that their demands often lack realism may appear spontaneous or badly timed. Yet one has to ask the question as to why they do things as they do? It could be that their actions are based on their perception of opportunities and cracks in the system. These kinds of spontaneous and instantaneous revolts may reflect the fluidity in political values, boredom, meaninglessness of experiences, a lack of morals and the existence of a power vacuum. As one student put it that `Having no prescribed channel to air their grievances leaves students simmering with their anger and frustrations until they boil over and the social media becomes an avenue that students can vent this anger. It is at such a venue that incitement, hate speech and plan for strikes are executed. In Kenyan universities, some of the stated causes of student unrests are: degeneration of discipline, morals, cultural norms, social cohesion and authority; emergence of gangsters based on class, study areas, faculties, ethnicity and academic performance in university work; lack of recreational facilities, counseling and health services; breakdown of communication between and among students, staff and administration; lack of maintenance services, poor residential facilities and insecurity (Kiboy 2013). Moreover, solutions being articulated to these unrests at the universities include: improvement in funding, management, revamping of the curriculum and retention of quality teaching staff. However, the broader issues of the social context of higher education, especially the social role of social media networks as tools for organizing, generating and spreading awareness of strike plans, hate messages and mobilization of most of the uprisings and the qualitative impact of these social media in the improvement of the climate in the delivery of quality higher education have not been adequately addressed. In reference to Kenyan Universities, very little has been done on the social well being of the teenage students who join universities with very little knowledge on how to manage personal freedom and interaction with social media. The freedom many at times is abused as research indicates that an average university student spends six hours in the internet either chatting, watching movies, blogging etc. This



avenue provides room for students to air their views, state their frustrations, use hate speech and all manner of bad morals. It is on this background that this paper examines the role of social media in student unrests in Kenyan public universities.

## **1.1 Background**

The world has been in a process of structural transformation for over two decades. This process is multidimensional, associated with the emergence of a new technological paradigm, based on information and communication technologies, which emerged in the 1970s and are spreading around the world. Society shapes technology according to the needs, values, and interests of people who use the technology: “Technology does not determine society: it expresses it. But society does not determine technological innovation: it uses it” (Castells, 2000, p.15). Technology appears as a key tool in social processes, “it is people’s usage of technology not technology itself that can change social process” (Earl & Kimport, 2011, p.14). Furthermore, changes in the technologies and social practices of production in this networked world have shaped new opportunities for how we create and exchange information, knowledge, and culture. Castells (2000) also asserts that technology is society, and society cannot be understood or represented without its technological tools. Therefore the changes in technology have had an impact on the changes in society.

These changes have shaped the mode of communication in the Kenyan society today especially among the youth. Today social media is the most used mode of communication in relation to newspapers, radio and television. The tools of social networking such as Twitter, Facebook, and YouTube, personal blogs, Instagram and WhatsApp that have previously had a reputation strictly for socializing are now being used as sources for information and play a big role in contemporary social and political mobilization in the world. It is now widely acknowledged in both the international media and academic circles that social media tools did play a role in the Egyptian uprising of 2011 (Madeline Storck 2011), in the protest in Iran following the highly controversial election of President Ahmadinejad in 2009, in organizing and generating awareness of political mobilisation, in the uprisings that took place in India on January and February 2011 (Surnitra 2013) and more so the networking capabilities of social media were utilized in the riots that took place in London during the summer of 2011. In addition, many parts of United Kingdom have in the past witnessed student led protests against tuition fees and the end of grants in further education (9<sup>th</sup> December 2010) but what is beyond doubt is that social media played an important role in anti-cuts demonstrations

In Kenya the post election violence of 2007/2008 was propagated by social media and this seems to be the trend in other places. Kenyans are known to use hate speech and messages on social media be it on tribal, race or gender in nature. However, Social media is playing an increasing role in public awareness to educate, impart knowledge and skills to members of the society. Today, social media has gone beyond being facebook friends and sharing funny videos to a platform with the ability to change the world. In Kenya, twitter community is particularly active, using this social media platform for on line activism, a platform such as this can be used for good of the society or conversely. Social media is playing an increasing role in public awareness of issues and information that was known to only a few well connected people in the past. Therefore, in this paper we describe the basic network topology of the student groups and explore how they accelerate, coordinate and enact collective reasoning.

## **1.2 Statement of the problem**

In the 2014-2015 academic year there were many student unrests in Kenyan public universities. Statistics indicate that there were several strikes in the academic year and the most affected universities were: Rongo university college, University of Eldoret, University of Kabianga, Moi university, Jomo Kenyatta university of Agriculture and technology, Chuka university just to mention a few. These strikes resulted to the closure of the Universities and this has a lot of impact on university curriculum. Therefore, in as much as the problem of strikes among university students has been contained; there still remain pockets of student unrests in Kenyan institutions of higher learning, particularly the public universities. The main causes of these strikes have been looked into by many scholars but the aspect of the role of social media in these unrests has not been exhausted. The aspect of social media seems to play a big role and this paper will examine its role in planning, organizing, and executing student unrests in Kenyan public universities. The paper will further provide suitable remedies with the aim of pre-empting future occurrences of the said unrests.

## **1.3 Objectives**

The main objective of this study was:

- 1) To establish the extent to which students use social media networks as tools for organizing, generating and spreading awareness of strike plans, hate messages and mobilization in most of the unrests that have taken place in Kenyan universities.

## **2. Literature Review**

This paper examines some of the literature in these topics:

### **2.1 Information Communication Technology (ICTs)**

Information Communication Technology (ICTs) is defined by Manuel Castells (2000) as the converging set of technologies in microelectronics, computing (machines and software), telecommunications/broadcasting, and optoelectronics.

### **2.2 Network society**

The network society is a social structure based on networks operated by information and communication technologies based in microelectronics and digital computer networks that generate, process, and distribute information on the basis of the knowledge accumulated in the nodes of the networks. A network is a formal structure (Monge & Contractor, 2003).

### **2.3 Social Network**

A social network is a finite set of actors and the relationship between them, represented by a system of interconnected nodes (Wasserman & Faust, 1994). Following the Internet design, societies, organizations and movements have evolved from centralized to decentralized and distributed networks. This decentralization and democratization of decision making has impacted

businesses, governments and society at large (Malone, 2004). As the network society diffuses, and new communications technologies expand their networks, there is an explosion of horizontal networks of communication, quite independent from media business and governments, that allows the emergence of self- directed mass communications, cultures and collaborative innovation networks (Castells, 2005). It is mass communication because it is diffused throughout the Internet, so it potentially reaches whole

countries and regions and eventually the whole planet. It is self-directed because it is often initiated by individuals or groups, bypassing the official media system. The explosion of user generated content, often referred to as web 2.0, includes blogs, wikis, video blogs, podcasts, social networking sites streaming, and other forms of interactive, computer to computer communication and sets up a new system of global horizontal communication networks.

## **2.4 Social Media**

The Merriam Webster dictionary defines social media as forms of electronic communication (as Web sites for social networking and blogging) through which users create online communities to share information, ideas, personal messages, and other content (as videos). Social media is a phenomenon that has transformed the interaction and communication of individuals throughout the world. However, social media is not a new concept it has been evolving since the dawn of human interaction. In recent times, social media has impacted many aspects of human communication and social networking has become daily practice in some users' lives.

## **2.5 Social media tools**

For the purpose of this study social media tools are websites that interact with the users, while giving them information. It is this two way nature of social media networks (SMNs) that is central to this argument, and the role they play in the student unrests in Kenyan public universities. The following section will define the four most widely and effectively used SMNs, WhatsApp, Facebook and Twitter,

### **2.5.1 WhatsApp**

WhatsApp messenger is a propriety cross-platform instant messaging client for smart phones. It uses the internet to send text messages, images, video, user location and audio media messages to other users using standard cellular mobile numbers. In addition to basic messaging, WhatsApp provides group chat and location sharing. It was founded in 2009 by Brian Acton and Jan Koum, As of February 2016, WhatsApp had a user base of up to one billion, making it the most globally popular messaging application (WhatsApp inc. 2016).

### **2.5.2 Facebook**

Launched in 2004 as a social networking website exclusively for Harvard students, Facebook users interact with other users or "Facebook friends by updating their "status", writing on other members "walls" or sending direct personal messages. Users are able to create and join interest groups, 'like' pages, import and search for contacts, and upload photos and videos. Over 75% of users are located outside the United States, despite its American origins. It is significant to note that more than 350 million Facebook users access their accounts via their mobile phones; a crucial aspect to the role social media can play in planning and organizing students' unrest having in mind that almost all Kenyan university students own mobile phones that can enable them access these SMNs.

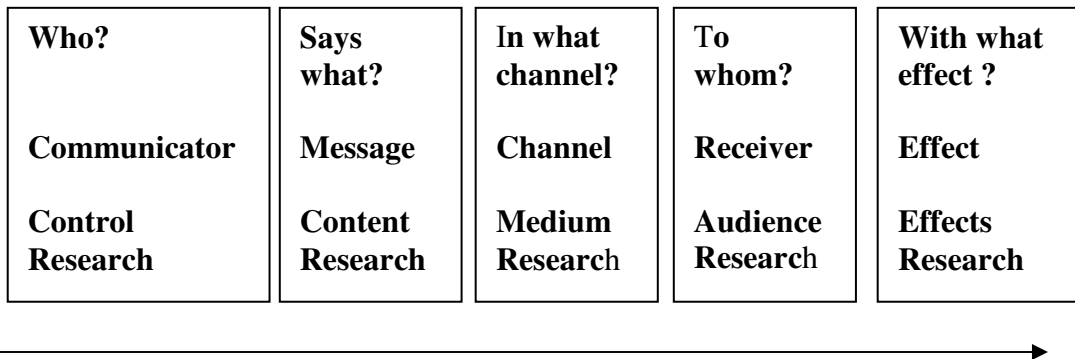
### 2.5.3 Twitter

Twitter, launched in 2006, is a real time information network that connects you to the latest information about what you find interesting. Users communicate via “Tweets” which are short posts limited to 140 characters, also allowing for embedded media links. Twitter users can “follow” or essentially subscribe to the updates of other users.

### 3. Theoretical framework

The theoretical framework for this study is Harold Lasswell’s communication framework (1948). The formula provides an analytical framework for the study of communication. Lasswell’s formula is based on the multi-faceted question “who says what in which channel to whom with what effect?” (See figure 1). This framework favours a content analysis approach; a research technique that aimed to achieve an objective, systematic and quantitative description of the manifest content of communications of WhatsApp messages collected within the period of the strikes then analyzed and discussed.

Lasswell was concerned not with interpersonal communication, but with the effects of the mass media. The question of whether the media have any effect or not and, if so, how they affect their audiences, is not just a large chunk of most communication and media courses, it's also a question that the researchers want to establish by investigating the effects of social media tools on student unrests in Kenyan public universities.



**Figure 1: Lasswell Framework**

### 3.1 Methodology

The specific research objective was addressed through qualitative content analysis of the WhatsApp messages which were categorized based on the purpose of their message, and classified as either providing a description of events taking place, as giving instructions for demonstrating comrades, spreading information, mobilizing as expressions of solidarity, as asking questions, hate speech or as miscellaneous dialogue. Generally, Krippendorff (2004:18) defined content analysis as “a research technique for making replicable and valid inferences from texts (or other meaningful matter) to the context of their use”. Hsieh and Shannon (2005:1278) offered an elaborate definition of qualitative content analysis as “a research method for subjective interpretation of content of text data through the systematic classification process of coding and identifying themes or patterns”.

#### **4. Results and Discussion**

The researchers tracked the volume of daily WhatsApp messages throughout the time period of the strike and the peaks in the messages revolving around major events in the strike in the period of the student strike at university of Eldoret. The messages were collected from three student groups on the period of the strike. It was noted that these student groups were mainly made up of cohorts of students from one school/ faculty but there were other members who were from other schools from the same institution while others were from other universities. The analyzed messages were for a day to the strike and the day of the strike. A total of 300 messages from group one and 250 messages from group two and 150 messages from group three making a total of 800 messages. It should be noted that these messages were highly coded and slang language was used and it required members of the groups to help interpret some of the messages for accurate coding. A content analysis was done and the messages were categorized based on the purpose and classified as either providing a description of events taking place, as giving instructions for demonstrating students, spreading, mobilizing as expressions of solidarity as asking questions, or as miscellaneous dialogue as shown in Figure 2 below.

The breakdown of WhatsApp messages from the sampled groups indicate that this social media tool was used mainly as a platform for discussion of what was going on amongst WhatsApp users as a way of providing firsthand accounts of events on the ground. As WhatsApp is a mobile phone-enabled social media with embedding capabilities, users could send updates by the minute and include other forms of media such as photographs and video. They sent photographs of the broken windows, the destroyed buildings and of colleagues demonstrating.

Figure 2: Analyzed data from the WhatsApp messages

The findings in Figure 2 above indicate that 160 (20%) of the messages were on description of events taking place. Most of the messages were on updating the comrades on what was taking place. Most of the messages were descriptions of what was happening in the hostels, administration block, the road and the different campus sites. Some messages were also accompanied by pictures showing what was happening in the various areas. Also 120 (15%) of the messages were on giving instructions for the demonstrating comrades. These were messages giving instructions on what to and what not to do because it was realized that there were certain aspects that the students were telling colleagues not to do for example for this particular case they asked comrades not to destroy the library. It was further noted that 120 (15%) messages were on spreading information. These were mainly updates on where the police were, the no go zone, the supporting and non supporting groups. 112 (14%) of the messages were on mobilizing comrades as expression of solidarity. These messages were mainly from those who were not participating directly and it was interesting to note that even students from other universities and those who were not in session sent messages to show solidarity and to support their colleagues on their grievances. 80 (10%) were mainly on asking questions on what was happening, what is to be done next, how should they operate. The answers to these questions were those on description of events taking place, giving instructions and spreading information. Also 144 (18%) messages were hate messages. Some of these messages were directed to the administration while others for this particular case showed tribal hatred amongst the students. These hate messages were mainly exchanged amongst students from different tribal backgrounds. It was also interesting to note that these messages tended to target members from different groups and these researchers also established that despite the fact that the groups were formed by cohorts of the different schools these groups also had sub groups which had tribal composition. 16 (8%) were miscellaneous dialogue and touched on academics, assignments, religion, and other diverse topics.

## **5. Conclusion**

This paper has examined the role of social media on student unrests in Kenyan public universities using a content analysis of primary sources of WhatsApp messages. It has been argued in this paper that its main roles were in providing an organizational infrastructure, by providing a description of events taking place, giving instructions for demonstrating comrades, spreading information, mobilizing as expressions of solidarity and asking questions,. By analysing the way the students utilized this tool of social media through established theories of communication, one can see how the inherent characteristics of social media and the Internet were able to foster the necessary requirements for collective action.

### **5.1 Recommendations**

This paper recommends that university management should fine tune their strategies in handling students' behaviours and interaction in social media networks, the university curriculum should also be reviewed so as to integrate this emerging issue in our society and that members of staff and stakeholder should join these student social network groups and act as moderators and mentors to the youth since this may help to avert these strikes at the planning stage.

## References

- Castells, Manuel (2000). *The Rise of the Network Society*. Oxford: Blackwells
- Earl, J. and Kimport, K. (2011). *Digitally Enabled Social Change: Activism in the Internet Age*
- Hsieh, H., & Shannon. E. S. (2005). Three approaches to qualitative content analysis. *Qualitative Health Research*, 15 (9), 1277-1288.
- Kiboiy, L. K. (2013). *The Dynamics of Student Unrests in Kenya's Higher Education: The Case of Moi University*. PHD Thesis University of Pretoria.
- Krippendorff, K. (2004). (2nd ed.) *Content analysis: An introduction to its methodology*. CA, Thousand Oaks: SAGE.
- Madeline Storck (2011). *The Role of Social Media in Political Mobilisation: a Case Study of the January 2011 Egyptian Uprising*. M.A. Thesis University of St Andrews, Scotland.
- Malone, Thomas (2004). *The Future of Work: How the New Order of Business will Shape your Organization, your Management Style and your Life*. Boston: HBS Press
- Monge P. and Contractor, N. (2004). *Theories of Communication Networks*. Oxford University Press
- Omari M. Issa and Paschal P. B. Mihiyo (1991). *The Roots of student Unrest in African Universities* Man Graphics Limited. Nairobi.
- Sumitra Ahlawat (2013). Role of Social Media in the changing face of Indian Politics *International Journal of Enhanced Research in Educational Development (IJERED)*, ISSN: 2320-8708 Vol. 1, Issue 5, July-August, 2013 pp 611.
- WhatsApp inc.(2016) (n.d.). "WhatsApp Messenger. Google pla. Google. Retrieved 13 February 2016
- You tube.com site info. Alexa internet. Retrieved January 9, 2016
- Wassermann, S, Faust, K.(1994). *Social Network Analysis: Methods and Applications*, New York: Cambridge University Press.

# **ESTIMATION OF RETENTION VOLUMES TO MITIGATE OVERFLOW OF RAIN WATER HARVESTING SYSTEMS IN TROPICAL COUNTRIES**

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## **ABSTRACT**

*Rain Water Harvesting (RWH) is a useful proposition for medium and large scale suburban housing schemes where the service water demand can be partially met reducing the investment on reticulated supply. Particularly ideal for tropical countries where sufficient rainfall is available throughout the year the individual housing units with optimum capacities for their rainwater storage tanks, can gain further advantage through economies of scale in reducing the overall system cost. At the same time, increased impervious surfaces have made the urban areas susceptible to flash floods during storm events with severe strain on the local drainage system. Since the rain water storage tanks retain a percentage of roof collection during a storm event and only the excess flowing into the drains, collectively the tanks can be used to reduce the peak load on the drainage system by judiciously increasing the retention volumes. If an inter-relationship between the storage volume of a RWH system and the overflow quantities for a given climatic region, with service water demand and storage capacity as system variables, can be developed, such a relationship, once graphically presented, could be a significantly useful design tool to estimate rainwater storage capacities for a given scenario.*

*Key Words: Rainwater, Rainfall, Reticulated, Overflow, Flash floods, Drainage systems*

## **1.0 INTRODUCTION**

Rain Water Harvesting (RWH) is well accepted as a source of potable and non-potable water for domestic dwellings, particularly in tropical environments, where high rainfall frequencies and depths are experienced and spread throughout the year. It can also be a useful concept in sustainable residential developments for urban and suburban areas (Jayasinghe et al, 2001).

With the renewed interest in RWH in the last two decades, attempts have been made to reduce the overall cost of systems by optimizing the storage capacity. On the premise of constant daily service water usage in a typical household (Hermann et al, 1999), generalized curves for Water Saving Efficiency (WSE), independent of spatial and temporal variations in rainfall, have been developed (Fewkes, 1999b) and validated for tropical countries (Sendanayake et al, 2014).

As RWH systems trap a certain amount of roof collection in rain events, increasing of retention volumes can be effectively used to mitigate the overflow thus reducing the design peak load on the local drainage system while enhancing the overall WSE. In this scenario it is useful to investigate the impact of increasing the storage capacity on both the overflow quantities and WSE and select the optimum capacity for the overall viability of the system.

## 2.0 OBJECTIVE

The objective of the study is to establish a relationship between the annual overflow quantities of a RWH system with its storage capacity for given system parameters of annual demand (D), roof collection area (A) and annual average rainfall (R). When graphically presented such a relationship could be a useful design tool to select optimum tank capacities for a given scenario to minimize overflow quantities and thereby allowing the designing of the local drainage system for lower peak demands while enhancing the overall WSE of the RWH system.

## 3.0 CALCULATIONS

The overflow quantity of rainwater ( $Q_{OF}$ ) from a RWH system on a given  $i^{\text{th}}$  day can be given by,

$$(Q_{OF})_i = (Q_{AVL})_i + (Q_{IN})_i - (Q_{USE})_i \quad (1)$$

Where,  $(Q_{AVL})_i$ ,  $(Q_{IN})_i$ , and  $(Q_{USE})_i$  are the balance quantity of rainwater available in the storage tank after the yield of the previous day, the roof collection during the day and the amount of rainwater drawn from the tank (yield) respectively on the  $i^{\text{th}}$  day.  $Q_{IN}$  in fact is the product of the effective roof collection area (A) and the average rainfall depth of the day  $(R)_i$  and therefore can be taken as  $(AR)_i$ .  $(Q_{USE})_i$  which is the daily yield and can be indicated as  $Y_i$ .

Therefore, for annual quantities (1) can be modified as,

$$(\sum Q_{OF}) = (\sum Q_{AVL}) + AR - \sum Y \quad (2)$$

where 'R' is the annual average rainfall depth.

Further, the overall WSE of the system can be defined as,

$$WSE\% = \sum Y_i / \sum D_i \quad (3)$$

By simulating (1) with daily rainfall values, daily overflow quantities can be obtained for a given demand, storage capacity and roof collection area.

A hypothetical case of a RWH system of storage capacity  $1 \text{ m}^3$  installed at a house in Ratnapura, in the tropical island of Sri Lanka ( $6^{\circ}54'N$ ,  $79^{\circ}15'E$ ) where the mean annual rainfall depth is 2500 mm, is selected for the simulation. For a roof collection area of  $25 \text{ m}^2$  and a daily service water demand of 200 liters, daily overflow quantities are calculated for rainfall figures from year 2001 to 2010 (National meteorological department of Sri Lanka).

The simulations are repeated for storage capacities of 1.5, 2 and  $2.5 \text{ m}^3$  and the corresponding overflow quantities obtained. Similarly, the process is repeated for a daily demand of 100 Liters. The annual overflow

quantities are calculated for each scenario and tabulated as a percentage of roof collection (AR) corresponding to storage fractions S/AR (Table 1).

Table 1: Annual average overflow percentages for storage fractions at given daily demands

Daily Demand (L)	Storage Capacity (m <sup>3</sup> )	S/AR	$\sum Q_{OF}\%/AR$
200	1	0.016	41
	1.5	0.024	31
	2	0.032	29
	2.5	0.04	28
100	1	0.016	74
	1.5	0.024	64
	2	0.032	62
	2.5	0.04	61

#### 4.0 RESULTS AND DISCUSSION

Plotting overflow as a percentage of roof collection ( $\sum Q_{OF}\%/AR$ ) against storage fraction (S/AR) for constant daily demands of 100 L and 200 L (Fig. 1), it is seen that for a given roof collection area (A) and rainfall depth (R) overflow quantities drop with the increase of storage capacity. However, the percentage overflows show only a marginal drop for an increase of storage fraction beyond 0.02 indicating that increasing of the storage capacity beyond that of S/AR = 0.02 for a given A and R is not having a substantial mitigating effect on the overflow quantities for a given RWH system.

From the equation for calculating overflow quantities (1), it is seen that for a given A and R,  $Q_{IN}$  is a constant and  $Q_{USE}$ , which is the yield from the system, is depending on the demand and the WSE of the system. Further, it can be seen that  $Q_{AVL}$  for a given day is a function of the yield and the roof collection related to the previous day and therefore essentially is a function of the WSE of the system for a given A, R and D. Therefore, it can be deduced that  $\sum Q_{OF}\%/AR$  varies with the WSE of a RWH system for a given D and storage capacity (S) with the overflow quantities reducing with the increase of system efficiency.

Comparing the two curves for the daily constant demands of 100 L and 200 L, it is clear those higher demands having profound impacts on the overflow quantities. This can be explained by (2) and (3), in which the yield (Y) is given by  $WSE \cdot D$ , thus showing that any decrease in WSE as a result of increasing daily demand (d) is offset by the increase in total demand (D). In fact the drop in WSE, and thereby the percentage annual overflow quantities with the decrease of S/AR, can be explained by the behavior of the generalized curves developed for WSE for RWH systems (Fewkes, 1999b), in which WSE values dropping with decreasing storage fraction (S/AR) for a given demand fraction (D/AR) value.



Figure 1: Annual average overflow percentages for storage fractions at given daily demands

## 5.0 CONCLUSION

The graph depicting the variation of overflow percentages with storage fractions (Fig. 1) shows optimum values for  $S/AR$  of around 0.02 for both daily service water demands of 100 L and 200L. For  $S/AR$  values greater than 0.02, the drop in the overflow percentage for a given  $D$ ,  $A$  and  $R$  are marginal and hence it can be concluded that increasing the storage capacity beyond 2% of the annual roof collection ( $AR$ ) will not have any significant impact on the overflow quantities and therefore on the local drainage system.

From the graph (Fig. 1) it can also be seen that the daily demands having a high impact on the overflow quantities. In fact doubling of the daily demand has reduced the overflow percentages by as much as 30% for  $S/AR$  values greater than 0.02, showing that the load on the local drainage system can be more effectively reduced by increasing the use of rainwater for most of domestic service water needs.

It is also important to note that since the overflow quantities and storage capacities are divided by the roof collection ( $AR$ ), the impact of spatial and temporal variation of rainfall on system performance is avoided and therefore allowing the determining of required storage capacities for any given combination of  $A$  and  $R$  values.

Therefore, it can be concluded that the curves can effectively be used as a design tool to determine the optimum storage capacity of a RWH system for a desired overflow quantity at a given service water demand. In the simulation, system losses are considered as negligible.

## REFERENCES

- Fewkes, A. (1999a), "Modeling the performance of rainwater collection systems towards a generalized approach", *Urban water*, 1, 323-333.
- Fewkes, A. (1999b), "The use of rainwater for WC flushing: The field test of a collection system", *Building & Environment*, 34, 765-772.
- Hermann, T., Schmida, U. (1999), "Rainwater utilization in Germany: efficiency, dimensioning, hydraulic and environmental aspects", *Urban water*, 1, 307-316.
- Jayasinghe, M.T.R., Jayawardene, A. I., Attalage, R. A. (2001) "Concepts for sustainable residential developments for urban and suburban areas in Sri Lanka", *Engineer, Journal of Institution of Engineers, Sri Lanka*, vol xxxiv, No.2, pp 63-77.
- Jenkins, D., Pearson, F., Moore, E., Sun, J.K., Valentine, R. (1978), "Feasibility of rainwater collection system in California", Contribution No. 173, Californian water resources center, University of California.
- Sendanayake, S., Miguntanna, N.P., Jayasinghe, M.T.R., "Validation of design methodology for rainwater harvesting for tropical climates", *Asian Journal of Water, Environment & Pollution*, vol. 11, no. 1, pp. 87-93, 2014.

# THE EFFECT OF SERVICE DELIVERY APPROACH OF MICROFINANCIAL INSTITUTIONS ON THEIR PERFORMANCE: A CONCEPTUAL PAPER

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## Abstract

*Access to financial services has been identified as potential tools that spout economic growth and improves the lives of the poor. Microfinancial Institutions have globally been accepted as institutions that proved capable of developing methodologies (approaches) that extend financial services to the hitherto un-bankable. The core of Microfinancing as such is to extend financial services to the un-bankable. The rampant collapse of Microfinancial institutions in Ghana in this recent time calls for investigation into the effect of the core mandate on their performance. The study therefore links services offered by Microfinancial Institutions and credit implementation process (credit methodologies) to both their financial and social performance.*

*The focus of this paper is to provide theoretical underpinnings of the study as well as conceptual framework that guide the approach and analytical framework adopted in the study which is a requirement for a PhD work. This paper does not only guide the main study but is important for both Microfinance practitioners and policy makers on how approach to service delivery of Microfinancial institutions affects their performance.*

**Keywords:** Microfinancing, credit methodologies, microfinance performance, service delivery approach, Microfinancial institutions

## 1. INTRODUCTION

Microfinance has generally been accepted as developmental tool (Augsburg, 2009; Ibtissem and Bouri, 2013). The success story of the Grameen Bank of Bangladesh which had brought to light that MFIs can operate profitably has attracted profit- seeking institutions and individuals to invest in the sector. Microfinance has therefore become part and parcel of the financial system of most country. The critical issue now is to find best practices which will improve both the social and financial performance of MFIs (Ibtissem and Bouri, 2013). The core business of MFIs is to develop methods that can enable them to extend financial services to the hitherto un-bankable; there is the need to research into the core financial services and credit implementation processes to assess the influence they exert on their performance.

The purpose of this paper is to present theories and the conceptual framework that underpin the main study of assessing the effect of approaches to service delivery of Microfinancial institutions on their performance. This framework is not only a summary of the entire research but, will as well provides direction for the entire study

(literature review, methodology, analysis and conclusions) on how to address the knowledge gaps identified in which is relevant for PhD work.

### **1.1 Statement of Problem:**

The performance of Microfinancial institutions has been of great concern to all stakeholders. This is because Microfinancing has not only gained reputable acceptance from all sectors as a development tool (Boateng & Adjei, 2013) but has also become part and parcel of the financial system of Ghana. The rampant collapse of MFIs in the country is therefore a great worry to all stakeholders and has attracted several national debates. The importance of having sustainable MFIs has been affirmed by Nyamsogoro (2010) cited by Gashayie and Singh (2015) that it is better not to have MFIs than having those that are unsustainable. In Ghana, the regulatory framework of micro financial institutions limits the kind of core financial service various categories of Microfinancial Institutions can undertake. Meanwhile, the findings of Nyamsogoro (2010); Khachatryan (2013) and Rossel-Cambier (2012) Hartarska, Parmeter and Mersland (2011) established that Product types affect the sustainability of MFIs.

Though, some studies have been done, they were mostly into determining either factors affecting performance of MFIs or assessing the effects of other varied variables such as age, capital structure, corporate governance, legal status and outreach just to mention a few on the financial performance of MFIs services (Sekabira, 2013; Quayes, 2012); Kipesha and Zhangji, 2013; Zerai and Rani, 2012; Rai, 2012; Nyamsogoro, 2010 and Kipesha, 2013). Only limited studies have been conducted into the core products of MFIs and credit implementation process (credit methodology) on the sustainability of MFIs (Hartarska, Parmeter and Mersland, 2011; Khachatryan, 2013; Rossel-Cambier, 2012 and Kinde, 2012). The study of Hartarska, Parmeter and Mersland (2011) stated that financial performance of MFIs varies across the type of services and country where the MFIs operate. This calls for further studies into the area, more especially when such studies are limited in the MFIs literature of Ghana.

In addition, studies which assessed both financial and social performances using non- quantitative variables as a proxy for social performance of Microfinancial institutions are rare in microfinance literature. The popular proxy used has been outreach (Khachatryan, 2013). Though Kipesha (2013) used the balance scorecard, it was not on the delivery approach of the MFIs. Others like Olayombo (2012); Shirazi (2012); Taiwo (2012); Kamau and Kolio (2012) considered the actual effect but the focus was on whether MFs has being able to achieve its social goal or not and not towards improving the system. Again most of these studies concentrated only on services offered without considering the credit implementation process (Khachatryan, 2013; Rossel-Cambier (2012) and Kinde (2012).

The purpose of this study therefore is to assess the effect of micro-savings and micro-credit on both the social and financial performance of MFIs using actual social performance indicators proposed by Nelson (2000) also used by Oluyombo, 2012 and Yeboah, 2010) . Also, to compare the performance of MFIs which are into deposit taken to those, which do not accept deposit to establish the differences in their sustainability. In addition, to establish the effect of credit implementation processes on the social performance of MFIs.

Addressing these gaps therefore is to make argument for service diversification to achieve economies of scale by MFIs. Also, it brings to light which of the core services and credit methodology need much consideration by MFIs institutions in their quest to attain double- bottom- line. It will also bring to the attention of policy

makers to formulate policy and strategies that will enhance contribution of approaches to the sustainability and social and goal of MFIs.

## **1.2 Definition of Terms**

### **1.2.1. Approaches to Service delivery of Microfinancial institutions**

The concept Approaches to Service delivery of Microfinancial institutions have often been applied to the kind of interventions introduced to their clients (Woolcock 1999; Charitonenko et al. 2004; Christen et al. 1995 (cited in IFAD, 2006)

For the purpose of this study the approach to service delivery of Microfinancing refers to type of services/ products and implementation processes (the channels of reaching their clients and the savings and credit methodologies) involved in extending these services to the clients. Though MFIs extend varied financial services like micro- credit, micro-savings and micro-insurance and other non- financial services, study limits itself to only the two core financial service (micro-credit and micro-savings) which provisions are under stringent regulation and supervision by the regulator. In case of the implementation processes, the study considers only credit methodology since interest charges and repayment schedules of MFIs in the country have generally been considered as too exploitative.

### **1.2.2 Performance of MFIs**

It is the outcome attributed to managements' decision on the resources of an organisation and the implementation of those decisions by the members of the organisation (Hofer, 1983 cited in Kipesha, 2013). Kipesha (2013) viewed performance of MFIs to encompass contribution to the welfare of the intended community and financial performance of MFIs that can guarantee their sustainability. This study like that of Kipesha (2013), also defines the performance of the Microfinancial Institutions to encompass both financial and social (transformation in the lives of service users) outcome associated with implementation of microfinance interventions.

## **2. REVIEW OF ON-GOING DEBATES ON APPROACH TO MICRO FINANCING**

This section features on-going debates on some alternate approaches to MFs.

### **2.3. Institutionists versus Welfarists Approach to micro financing**

“Institutionists” advocate that a microfinance approach should focus on the commercial viability and sustainability of the MFIs. Woolcock 1999 (cited in IFAD, 2006) pointed out that “an institution’s ability to operate on a cost-covering basis without any external subsidies, domestic or foreign, is the key to its sustainability. It was further argued that external sources of funding is becoming increasingly difficult to secure, only viable institutions will be able to provide financial services on a long-term basis and achieve the necessary economies of scale. This notion primarily was highly favoured by scholars based at Ohio State University, CGAP, the World Bank, and US Agency for International Development (USAID) and other major donors. In a nutshell, the financial systems approach focuses on sustainability of the microfinance institutions themselves. The advocates of the financial systems approach to microfinance argued that MFIs are most effective when they stick to their core competency of providing financial services. In this view, the financial health of institutions is seen as a reasonable measure of (or more important measure than) the impact of loans on recipient livelihoods. Proponents of this approach argued that financial institutions need to be financially sustainable before they can continue to provide the best possible financial services to clients which will enhance their economic/ social status. This belief is based on the key assumption that if they (MFIs) are



financially self-sustaining, they will be able to reach more clients and help more people than what they could do if they continue to depend on donor-supported programs.

The critics of this approach argued that the approach sacrifices the needs of borrowers for that of MFIs. As a result, microfinance providers end up looking more like debt collectors than service providers. They pointed out that if microfinance is considered as major tool for development and is to have a major impact on poverty reduction, the overwhelming focuses on their financial sustainability will be detrimental to the poor.

Another concern had also been raised about the belief that lack of credit is the primary structural condition of poverty. What these assumptions failed to realise is the reality that conditions of poverty, such as hunger, lack of business know-how or restricted market opportunities and over dependence on credit often prevent recipients from effectively using their loans for entrepreneurial ventures. According to Yeboah (2010) recipients who live on the margins of extreme poverty struggle to repay such loans and often find themselves entangled in cycles of debt and credit dependency rather than breaking out of cycles of poverty.

This study is also of the view that, lack of access to credit is only one structural aspect of poverty. Failure to understand how all aspects of poverty work together can lead to disastrous outcomes for loan recipients. Credit only may work well for some clients but not for others. For this reason this study is of the view that the single product (credit) should not be applicable to all end-users of MFs. Combined products of micro-savings and credit may prove more useful.

## **B. The Welfarists or Poverty-Lending Approach**

The Welfarists approach unlike the institutional sustainability approach put social concerns at the forefront. Microfinance experts such as Mitlin (2002), Johnson and Rogaly (1997) (cited in Yeboah, 2010) argued that the commercial approach, will lead to a ‘mission drift’. Consequently the poorest of the poor will be denied access to financial services, because they pose higher risks and cost. They argued that Institutions focusing on servicing the poorest should not focus attention on their financial sustainability. They call on such institutions to remain dependant on external grants and donations to compensate for the shortfall in revenue which is a consequence of the welfarists approach. The advocates of the poverty-lending Approach argued, since the approach focused on clients and sustainable transformations in their livelihoods of the poor, providing only financial services, is not enough. Bearing this in mind the advocates of the poverty-lending approach rightly argued that chronic poverty is insufficiently addressed through increased financial assets alone. A delivery model of micro financing mostly used through the poverty-lending approach is known as “credit-plus,” which refers to the provision of additional services alongside microcredit programming.

This approach is also not free from criticism. The critics of this approach pointed out, MFIs which adopt poverty-lending approach are likely to be faced with the risk of over-dependency on donors. In some instances, individuals who are interested in a MFI’s complementary services but who have no need for a loan may end up borrowing simply to have access to programs which meet their other needs. Indeed, the concentration of a number of such services under one roof may increase recipient exposure and risk rather than improving access and support.

Also, such institutions will hardly secure the necessary capital to reach the millions who could benefit from micro-lending services.

This study is also of the view that Micro financing is gradually becoming an industry which has gained investors’ attention and as such MFs must seek the interest of all stakeholders. In addition, donor support in

recent times to MFIs is limited. There is therefore the need to move from pure poverty-lending approach to approaches that guarantee sustainability of both the MFIs and their beneficiaries.

## **2.2. The Minimalist versus Integrated approach:**

**A. The minimalist approach:** This approach is based on the premise that access to affordable, accessible short-term credit is a single “missing piece” for economic growth among the poor. The advocates of this approach consider the provision of microcredit to low-income people as a development strategy on its own. Minimalist approaches normally offer only financial intermediations, such as savings, credit, insurance, and payment systems. Minimalist programmes advocates often are aware that the poor may need other development and social services, but they have assumed that other agencies will provide those services, because provision of such services is not their core business. To the Minimalist it is better for the MFIs to concentrate in the financial needs of their client and deliver it better than become a “jack of all trade and a master of none”. This study points it out that, financial service only is not the sole ante-dote to the problems of low-income people. Certain factors contribute to the current financial predicaments of these low income groups. Avoiding the costs of additional development-oriented and “mental liberation” services may drag the poor into more serious debt than before. They need to be empowered so as to make the most use of the financial products given to them. However, this cannot be done by MFIs alone; especially in the area when these institutions are owned by profit seeking investors. There is therefore the need for collaborative efforts by all development agencies.

## **B. The integrated approach**

This approach on the other hand, emphasizes the importance of providing not only credit but also a range of development-oriented services to the poor in order to attack the structural causes of poverty. Rutherford (2000) cited in IFAD, (2006) commenting on this approach pointed out that MFIs that provides full range of services, including a flexible money management or savings facility, would probably assist the poor people better to anticipate and plan for their financial needs more effectively than credit-only providers. It offers wider spectrum approach to solving the problems confronting the low-income people. It is however, characterised by high operating cost since money has to be spent on other services which does not lead to direct or immediate benefits to the MFIs.

This study also is of the view that this approach if properly managed taking into consideration socio-cultural, political, economic and the physical needs of the clients can result in efficient use of the financial services extended to the clients. There is the likelihood of the few clients whose life has been improved to impact on the life of others and the community as a whole. Default rate is also likely to be low since clients are likely to acquire other skills that will enable them make the most use of the credit extended to them.

## **2.3. Major Characteristics of micro financing**

Microfinance has its unique characteristics, which differentiate them from that of the formal banking institutions. The major features are presented below:

**Clients:** They are those who do not have access to formal financial sources. Though they are to bridge the financial gap, their main target clientele are the very poor.

Mostly it is collateral free: They do not rely on the traditional types demanded by the formal banks since their clients lack such securities. To provide developed second defends for their loan products, they developed collateral substitutes.

**Channels of delivery:** In most case MFIs go to clients rather than clients going to them. Clients for a long time do not access financial services from financial institutions. They therefore find it difficult to adjust to the new order of going to the MFIs to transact business. A number of them too are illiterates and lack the courage to go to the financial institutions. To overcome this, MFIs rather choose to go to them through their field officers.

**Simplified savings and loan procedures:** They adopt simple procedure of screening clients for example, screening of clients by group members, field officers empowered to approve credits, cash collection on the field and allowing withdrawal on the field.

**Small size of loans and deposits:** As a way of promoting savings habit among customers, they accept small amount as deposit, give loan amount that can fit into the repayment capacity of their clients.

**Repeat loans:** As a motivation to repay the loan, clients who pay their credit fully and promptly benefit from repeated loan. Loan size increases in the repeated loans or subsequent cycles (progressive lending): In order to reduce default risk, MFIs do not approve huge sums of money to their clients. They give out in small packages but as the customer pays fully and promptly, they are able to determine the credit worthiness of the client. This leads to increasing the loan size in the subsequent cycle.

**Charge market interest rates:** Interest rate is usually in between money lenders and formal banks bank. Their cost of extending services to the clients is high. Also the cost funds available are usually high. They therefore can only be sustainable if they charge interest rate that are higher than that of the formal banking institutions but lower than the traditional money lenders they came to replace.

**Free use of loans (no restrictions on specifies purpose):** The needs of the users of MFIs' services are varied. Restricting credit extended to them to only productive ventures may prevent the clients from meeting certain household emergency.

Repayment considers incomes from business as well as other sources. (GAAP, 2010)

## 2.4. Credit Delivery Methodology

This sub- section presents discussions on credit methodologies of micro- financial Institutions.

### **Group-lending mechanism:**

Group lending is one of the well-defined and well-known credit delivery methodologies among Microfinancing practitioners, users and academia. This methodology has largely been accredited to the work of Grameen Bank. It is an innovative credit delivery method that basically allows the borrowers to act as guarantors for each other (Ibtissem and Bouri, 2013). This lending methodology requires borrowers to form groups and the entire group is jointly and severally liable to repay the loan of any member who is unable to pay. The joint liability imposes responsibility on the group to self-select members. This is to guarantee peer monitoring, since each member in the group will have information about each other. The notion is that the interdependence among the borrowers will mitigate problems associated with information asymmetry and therefore may significantly result in high payment rates.

However, Ibtissem and Bouri (2013); Kono and Takahashi (2010) cautioned that group lending can best mitigate the problem of moral hazard effectively only if the group can coordinate its members' decisions.

This method however works best in rural settings since there is often strong social cohesion; adequate information about each other and demand for comparatively smaller amount of loan than the urban environments (Ibtissem and Bouri, 2013)

### **Dynamic incentives**

Another equally common credit delivery method used by MFIs is what is referred to in microfinance literature as dynamic incentives mechanism also known as progressive lending. It involves lending increasingly larger loans amount to borrower after successful completion of repaying the previous loan. Dynamics incentive mechanism is therefore used as precaution by the Microfinancial Institutions (MFIs) to borrowers that they will not refinance any borrower who defaults on her debt obligations but will reward faithful customer by increasing the loan size in subsequent request. It therefore has a great effect on the borrowers' behaviour since client may have considerable needs for future loans.). The strength of this method lies in the fact that group lending mitigates credit risk only in group loans but dynamic incentives is useful in managing credit risk both in group and individual loans. This is because the mechanism enables lenders to build long term relationship with borrowers. This eventually helps the lenders to screen out subsequent defaulters before expanding loan size. Dynamic incentives can enhance repayment if borrowers can anticipate a need for stream of increasingly larger loans. However, competition and increasing mobility of borrowers are threats to the power of this mechanism against defaulting since borrowers may have the opportunity to take a loan elsewhere. Another limitation of progressive lending is the possibility of the customer defaulting in the final period. Thankfully, the credit bureau can help address this problem if MFIs collaborate with each other.

### **Collateral substitutes**

In financing, the lender uses collateral as a second defence against default risk associated with lending. However, one of the major factors that contribute to poor access to credit by the low income group is lack of appropriate collateral. To solve this problem microfinance institution largely do not require their clients to provide any physical collateral that traditional banks demand. However, in order to reduce the risk of default and promote high payment rate, Microfinance Institutions use alternative mechanism known is collateral substitutes. Collateral substitutes takes different forms, for example, the Grameen Bank, a micro financial institution in Bangladesh, during its initial years of operation required borrowers to pay 0.5 percent of every unit burrowed (beyond a given scale) as emergency fund. This fund serves as insurance against loan default, death or disability (Morduch, 1999 cited in (Ibtissem and Bouri, 2013). The borrowers may also be required to pay an additional five percent of loan that is taken out as a 'group tax'. These amounts are usually deducted from the members' loans or form part of weekly contributions in addition to loan amortization. It is best described as forced savings. The forced savings can be made available to the borrower upon leaving, but after the banks have taken what they are owed. The collateral substitute can also be anything valuable to the borrower ranging from school certificate, driver's license, marriage certificate and such other documents as collateral substitutes in individual lending. In addition, MFIs may require guarantors agreeing to guarantee the borrower's loan. Indeed the requirement of a guarantor can reduce adverse selection problem since getting one or more guarantors may require costly efforts for the potential borrower. Besides, requirement of a guarantor serves as ex post sanction mechanism. This is because in case of default, the guarantor(s) who may lose his/their reputation to the same extent as the borrower can put pressure on the borrower to meet his obligation.

The guarantors may apply direct sanctions by revealing to the defaulter's neighbours or, more generally, to members of the community he or she belongs to about the conduct of the borrower.

### **Regular payment schedule**

Another mechanism used by microfinance Institutions is imposition of regular payment schedules. With this approach repayment starts immediately after loan has been disbursed. Depending on the lending policy of the MFIs, the repayment can be on daily, weekly, fortnightly or monthly. It is flexible and in most cases the client is allowed to choose the repayment regularity that best suits him. MFIs believe that the regular payment will guarantee high payment rate since it will restraint the clients from reckless spending; screens out undisciplined borrowers at an early stage; gives early warning to officers and peer group members about potential future problems; permits the banks to get hold of cash flows before they are consumed or otherwise diverted; offers client a credible commitment device, which enables them to form the habit of saving regularly; improves client trust in loan officers due to the frequent meeting (associated with this mechanism) with a loan officer which may enhance their willingness to stay on track with repayments and requires that the borrowers have an additional income source on which they rely since the payment process begins before investments bear fruit. This permits a positive selection of clients for the lender and for diversified households. However, regular repayment schedule may eliminate potential borrowers who have a single source of income from the market.

### **The provision of nonfinancial services**

Besides, MFIs sometimes use nonfinancial services also known as Business Development Services (BDS) or 'credit plus'. It involves provision of non-financial services such as health services, simple book keeping, business management skills, or training. The rationale for these services is to develop managerial and technical skills to client which goes a long way to improve their productivity. Microfinance researcher and advocates are of the view that the provision of non-financial services as a complement to credit and saving services do not only enhance the economic ability of the borrower to repay but also foster the relationship with the microfinance institution. Godquin (2004) and McKernan, (2002) (cited in Ibtissem and Bouri, 2013) have confirmed this, that the provision of non-financial services has positive correlation with repayment performance and may be an important component of the success of microfinance programs.

### **2.5. Micro-Saving**

Ledgerwood (2002 cited by Khachatryan 2013) define saving as putting aside a certain sum of money to be accessible in the future in exchange for a series of savings made now. Savings enable the poor to acquire certain stability and risk protection and increase productivity. On the whole, micro savings are grouped into two main types: compulsory and voluntary.

Compulsory savings are funds tied to access to credit through the mechanism of locking part of fund advanced to clients in a savings account. It is also known as compulsory savings. In reality it is considered as a loan product requirement rather than savings (Ledgerwood, 2002 cited in Khachatryan, 2013). In most cases these forced savings are not made available to borrowers (borrowers are not allowed to withdraw those savings) while they have a loan outstanding. They can only access it after they have fully repaid the loan. The main objective for mobilizing compulsory saving is to use it as an additional guarantee mechanism for Microfinance Institutions. Besides it proves as a tool to screen borrower to establish quality of borrowers in

terms of managing cash flow and making periodic contributions (Wisniewski, 1999; Ledgerwood, 1999; Aemendariz and Morduch, 2005 all cited in Khachatryan 2013).

The second type of savings is called Voluntary savings. This service is available to both borrowers and non-borrowers to choose from the various savings product. Voluntary savings (also known as flexible savings) is based on the assumption that micro-credit only may not guarantee financial freedom of clients. Savings should be considered as principal components of financial intermediation since savers already know why and how to save (Robinson, 1994 cited by Khachatryan 2013). Today various forms of savings are being offered by Microfinance Institutions ranging from daily susu to fixed deposit account. This type of saving is being offered by MFIs that are considered per regulation as deposit- taking institutions.

Though savings provides cheaper source of funding and enhances borrowers' ability to repay loan and is likely to promote the financial sustainability of the MFIs. It also serves as screening mechanism to determine potential borrowers which are creditworthy (Khachatryan 2013). There are however some disadvantages associated with deposit taking by MFIs.

Firstly, it has high operational and transaction cost to mobilise such small deposit from clients especially through door- to- door channel. Secondly, Market risk is likely to be high and required more sophisticated management skills to manage such highly liquid and small savings. Khachatryan 2013 cite the following scholars (Zeller and Shama, 2002; Dowla and Alamgir, 2003; Fiebig, Hannig and Wisniewski, 1999) who also point to this fact that savings mobilization costs and risk may pose additional difficulties in risk.

### **3. REVIEW OF THEORIES**

#### **3.1. Theories of Microfinancing**

There have been several debates on the place of Microfinancing as a tool for development. This study therefore review three notable theories put forward to justify the place of micro- financing as developmental tool.

##### **i. The Economic Theory:**

The economic theory states that microfinance supports the efficient use of labour and capital as factors of production and therefore contributing to economic growth and ultimately to sustainable development .This is because it enables the establishment of new micro-enterprises.

It is assumed that like the positive relationship between financial investment and economic growth, financial investment in the poor through microfinance services will lead to increased incomes of the poor and ultimately result in poverty reduction (Hulme, 1997 studies (cited in Yeboah, 2010). El-Solh (1999) (cited in Yeboah, 2010) like earlier researchers, emphasised that Microfinance institutions provide fund for micro- and small-scale enterprises which are vital to the private sector development which are being perceived as an engine of growth for economies of developing countries. It is from this economic point of view that MFs is considered developmental tools.

##### **ii. The Human Resources Theory**

The human resources theory is quite similar to the economic one. The advocates of this theory are of the view that MFs has the ability to improve upon the capacity of the poor to generate income leading to the subsequent improvement in their livelihood. Their argument is based on the fact that microfinance is generally accepted as being labour-intensive. Facilitating access to microfinance in effect is likely to result in the acquisition of new

skills and the upgrading of existing ones. It is for this reason that MFs is considered as a vital developmental tool for societal transformation. El-Solh (1999) (cited in Yeboah, 2010).

This study is of the view that the proponents of the theories placing emphasis on the credit as the most important component of micro financing in poverty alleviation is questionable. It is wrong to assume that microcredit extended to everyone will be invested into income generating activities. The poor has varied needs and therefore such funds may be diverted to other needs. Credit alone is like “giving knife to them to slash their own throat”. Credit only to the poor will worsen their situations so other services should be integrated for effective empowerment and transformation. Notwithstanding these weaknesses, the basic ideology these theories applicable to our study since our study also seek to measure the effect of micro-credit and savings on the social performance of MFIs (the effect on the service users).

### 3.3.2. The theory of planned behaviour

An important theoretical framework worth consideration in this paper is the theory of planned behaviour (TPB) propounded by Ajzen (1988). The theory of planned behaviour was derived from the Theory of Reasoned Action (TRA) which was propounded by Fishbein and Ajzen (1975) (cited in Ajzen 1991). Ajzen (1988) extended the TRA by introducing Perceived behaviour control to the variables in the TRA. The theory of planned behaviour is psychology based theory but has now been employed in social sciences in assessing intervention implementations (Ashraf & Ibrahim, 2013). The TPB is of the view that behaviour “can be deliberative and planned” and as such, can be predicted.

The central variable in the theory of planned behaviour is Intention. It is considered as the best predictor of one’s behaviour. It is actually the individual’s readiness to perform a given task. Intentions are “indications of how hard people are willing to try, of how much of an effort they are planning to exert, in order to perform the behaviour” (Ajzen, 1991). The theory indicated that the stronger the intention of a person to partake in a behaviour, the more likely he will succeed in the performance. Intention is viewed in the theory as the immediate antecedent of behaviour.

It was further assumed that a person’s intention to perform a given task is influenced by three main variables namely, attitude towards the specific behaviour, subjective norms and perceived behavioural control.

**Attitude:** Attitude has been defined as the evaluation one has for doing a task. That is, it shows how easy, interesting, difficult, or boring as well as how beneficial he perceived the performance of the task will be. It simply means a person’s attitude will impact on his readiness (intention) to perform the behaviour.

**Subjective norms:** It is a perceived social pressure to perform or not to perform the task. It referred to individual’s beliefs about how the people they valued in life will view their performance in task in question. The perceived social pressure can influence one’s intention to perform.

**Perceived behavioural control:** It refers to people's perceptions of their ability to perform a given task. The intention to perform is highly influenced by availability of requisite opportunities and resources. These resources are likely to make great differences in the extent to which the perceived behaviour control will impact on the person’s intention to perform the behaviour. An individual with negative attitudes may end up having stronger intention to perform a given task due to availability of resources (which will reduce his perceived difficulty to perform the task) as compared to the one with positive attitude but without the necessary resources to support. Perceived behavioural control plays an important part in the theory of planned behaviour. The existence or nonexistence of essential resources and opportunities are referred to in the theory

as **control beliefs**. The more resources and opportunities individuals believed they possess, and the fewer hindrances or obstacles they anticipate, the greater should be their perceived control over the behaviour.

This theory though has its root embedded in a psychology and used largely in qualitative studies, is now being used widely in social research (Ozmete and Hira, 2011) and quantitative studies (Sharaf and Ibrahim, 2013). The major weakness of this theory identified by this paper has to do with its focus on only the beneficiaries of the intervention without considering how the intervention should be sustainable. Also it did not take into consideration mediating variables which can prevent a person from achieving the intended outcome. Notwithstanding these weaknesses the ideology behind the theory is applicable to our study in the following ways:

The third variable in the theory of planned behaviour is the perceived behaviour control. The perceived behaviour is influenced by the absence or availability of resources. Since the core business of MFIs is to develop methodologies that can enable them extend financial service to the un-bankable, approaches to service delivery of the MFIs in this case constitute the resources and opportunities (control beliefs) that the theory identified which will enable the un-bankable to access financial services which boost development. It is considered as one of the theories which underpin the research objective which seek to assess the effect of the micro-credit and micro-savings and credit methodologies on household status and business of the clients of the MFIs.

### **3.2. The Theory of Economies of Scale**

The Theory of Economies of Scale is another theory which is of interest to the study. This theory has been accredited to the renowned Economist, Alfred Marshall who devoted several pages in his Book, Principles of Economics to the discussion on the Internal Economies of Scale (Marshall, 1910). Marshall postulated that there is positive relationship between scale of production and efficiency which ultimately translate to decreasing cost of production. According to him large scale production promotes different economies of scale such as economies of skills, economies of machinery and economies of material. With the economies of machinery, Marshall was of the view that firms which engage in large scale production will keep the utilisation of their equipment steadily high. Since such machines are fixed full utilisation will result in reduction in per unit cost of production. Such large scale firms also have more resources to spend and have easy access to credit and other related benefits. The economies of skill relate to large labour force and therefore stand to benefit from specialisation and division of labour.

He was quick to add that firms also do benefit from what he referred to as external economies as well. These are positive externalities shared by all firms in the industry. It is larger external changes in government policies, infrastructure, social amenities and technological development that are shared by all firms. He however, pointed out that internal economies of scale is firm specific and therefore gives greater competitive edge to firms.

He also touched on the age of the firm. To him firms that have existed for long can have better access to resources and have greater economies of scale.

His theory has been critiqued by writers like (Witaker, 1987) who were of the view that Marshall's theory can best be practised in imperfect or monopolistic market and not in modern perfect market (Lavizzi, 2001). Notwithstanding this criticism, Khachatryan (2013) applied this theory in linking the services of MFIs to their



performance. This theory is applicable to the study because objective one and two are to examine the relationship and effect of micro-savings and micro-credit on both the social and financial performance of MFIs.

### **3.3 The Industry Life Cycle Theory (Alfred Marshall)**

This theory has also been accredited to the work of Alfred Marshall. He postulated that the performance of industry should be viewed over time. The theory divides the life cycle of industries into five stages namely: the pioneering development stage; rapid accelerating stage; Mature growth stage; stabilization and market maturity and Deceleration of growth and decline stage. With this theory the first three stages (the pioneering development stage; rapid accelerating stage; Mature growth stage) of industry life experiences progressive increment in performance but decline in performance from the last two stages (stabilization and market maturity and Deceleration of growth and decline stage).

This theory is applicable to the study because, the age of the firms is included in the financial model as controlled variable.

### **3.4. The Credit Rationing Theory**

Another theory that is of importance to the study is the Credit Rationing Theory by Stiglitz and Weiss (1981). According to Stiglitz and Weiss (1981, the main cause of financial market malfunctioning is information asymmetry. They were of the view that the imperfect market condition coupled with competitive loan market will mean unequal access to credit facility. Those who do not have easy access to credit will be willing to accept credit facilities with interest rate higher than the prevailing market rate. According to them information asymmetry possesses great challenge to efficient functioning of the financial market and also exposes financial institutions to default risk. They also pointed out that interest rate is one of the measures used by the financial institutions to address the associated problem of information asymmetry. High interest rate will compel borrowers to invest in high risky ventures which will increase the probability to default. Rational investors (less risky borrowers) therefore will not go for such credit facility with high interest rate. They concluded that higher interest may lower the expected return of the banks. One main criticism this study has against this theory is the fact credit facilities with very low interest rate may be miss used since people which may not have any immediate productive or relevant use may be attracted by the low interest rate to go for such loans. Besides, there are instances where people with urgent need of funds to meet valid credit needs but could not obtain it from institutions which offer lower interest rate are compelled to go for such high interest rate. Therefore the notion that higher interest loans will not be accessed by rational investor may not be always be the case. Our study postulates that loans with lower interest rate is rather likely to be miss used and is likely not to have any significant effect on the lives of the users.

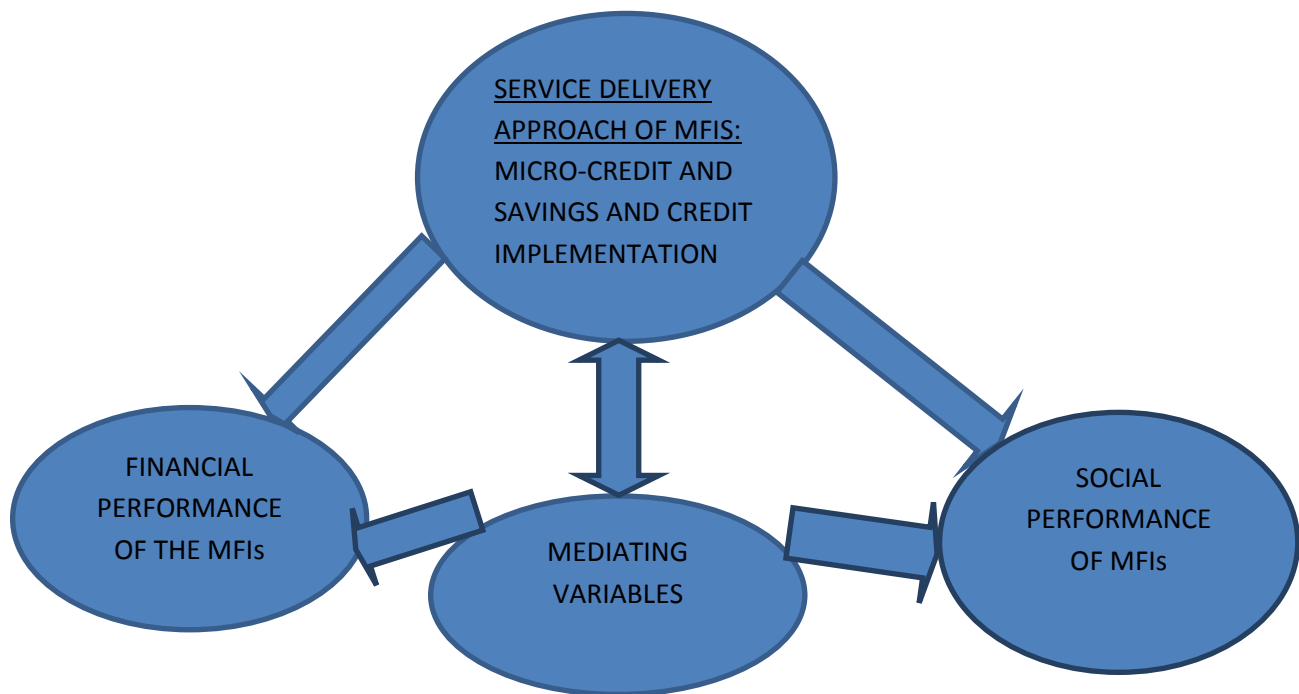
Notwithstanding, this weakness, this theory is applicable to our study since one of the objectives of the study is to assess the effect of credit methodology (credit implementation process) on the social performance of the MFIs. Interest rate is one of the proxies of credit methodology considered.

**3.5. Restriction of Opportunity Theory of Poverty (ROTP)** propounded by Apadurai in 2004 and improved upon by Chakravati (2006) cited by Omondi (2014). The proponents of this theory are of the view that poverty is caused by unfair environment, lack of social and economic capital. The theory emphasizes that the

environment the individuals find themselves exert great influences on their daily life. This is because the daily life of the individual is dependent on the opportunities, resources that are present or not in his environment. Absence of opportunities and the needed resources in the community may force the individual in such community to plunge into poverty (Omondi, 2014). The poor are poor because they lack the necessary resources or capacity which will inspire or change their mind set and position. This implied that the more resources are made available to the individual or better opportunity offered by his environment the better the position of the person ( Apadurai, 2004 and Omondi, 2014). This theory has been applied by (Omondi, 2014) and is applicable to this study since it also seeks to examine the effect of service delivery approach on the household and businesses of the service users the MFIs being under studied.

### 3.6. The conceptual framework

The conceptual framework of this study is underpinned by the theories of Planned Behaviour Theory; Restriction of Opportunity Theory of Poverty (ROTP); the Credit Rationing Theory and the stakeholder theory. In addition the philosophies of Hulme 2000 impact assessment framework have been factored into the conceptual framework. The conceptual framework is shown in figure 2.2 below. From the framework the service delivery approaches of the Microfinancial institutions is the predating variable.



**Fig.2.2 The conceptual framework**

**Source: Researchers, 2015**

Drawing from literature reviewed so far, Microfinancing is not just banking but a developmental tool. Approaches to Microfinancing therefore have to be geared towards promoting the interest of all stakeholders (Kipsha, 2013). The framework links the services offered (Micro-savings and Micro-credit) and credit

implementation processes (credit methodology) to financial and social performance of MFIs. The focus is to determine the kind of effect each of the core on the social and financial performance of the MFIs. The type of service offered by the MFIs is considered as one of the main predictor variables (independent variable) in the studies.

Another independent variable of concern to the framework is credit implementation process. The framework is of the view that MFIs due to their orientation and operational policies offer different loan size, interest rate, loan duration, loan repayment regularity and credit model (group or individual lending model). Each of these credit methodologies is likely to exert different impact on the social performance of MFIs. Another important variables (dependent Variable) identified in this framework are the financial and social performance of the MFIs. The framework points to relationship between the delivery approaches and the social as well as the financial performance of the MFIs. The framework also points to the fact that with increasing commercialization and growing competition in the sector, only MFIs which seek to balance their social performance and financial performance will stand the test of time (Kipsha, 2013). The framework therefore calls for “double bottom line” approach.

In addition, the framework points to the fact that in assessing the social performance, the immediate outcome (access to credit/ outreach) should not be the main focus. The main concern should be on the actual outcome (net effect). This is built on the assumption that certain prevailing conditions which compelled them to adopt copying strategies (Hulme, 2000); (Shankar, 2013); (Ashraf & Ibrahim, 2012) and (Ashraf, 2014). MFIs are to develop special methodology (delivery approaches) which should inspire the low income group to participate in the financial system (Shankar, 2011). However certain individual characteristic and environmental factors can interfere in transformation in the lives of the service users.

### **3.9 Concluding Remark**

The methodological implication for this framework is the need to move from using quantitative variables as proxy for social indicators to non- quantitative variables. It also calls for gathering both secondary and primary data.

The framework calls for relating microfinance interventions and implementation processes to the prevailing conditions of the clients. Assessing the effect of delivery approaches of MFIs from the both user and Institutional perspectives will generate greater understanding of the intervention and implementation processes of MFIs.

The framework calls for the shift from over dependence on secondary data obtain from the financial statements of MFIs to determine the financial and social performance of MFIs to combination of quantitative variables and non- quantitative variables. This approach generates more relevant information about financial performance of the MFIs as well as the actual effect of the intervention and the associated processes on the service users.

## References:

- Abrar, A & Javaid Y. A. (2014) Commercialization and Mission Drift — A Cross Country Evidence on Transformation of Microfinance Industry International Journal of Trade, Economics and Finance, 5 (1)
- Ajzen, I (1991). The Theory of Planned Behaviour. Organizational Behaviour and Human Decision Processes . Academic Press. Inc. 50, 179-211
- Ashraf, M. A. (2014). The Theory of Planned Behavior and Microfinance Participation: From the Perspective of Nonparticipating Rural Poor in Bangladesh. Research Journal of Finance and Accounting. 5 (7)
- Ashraf, M. A. & Ibrahim, Y.Bt. (2013). An Investigation Into The Barrier To The Rural Poor Participation In Mfis: The Case Of Bangladesh. International Journal of Research In Social Sciences. 1 (2)
- Augsburg, B. (2009). Microfinance- Greater Good or Lesser Evil? Thesis submitted in partial fulfilment of the requirement of Maastricht University for the Doctor of Philosophy.
- Beaudry, S. (2010). Microfinance: a guide for Grantmakers, Grantmakers without Borders, The Consultative Group to Assist the Poorest (CGAP) Available from <http://www.cgap.org/p/site/c/template.rc/1.26.1309/> (retrieved on 21 Feb. 2012)
- Boateng, I. A. & Agyei, A. (2013). Microfinance in Ghana: Development, Success Factors and Challenges. International Journal of Academic Research in Accounting, Finance and Management Sciences Vol. 3, No. 4, pp. 153–160
- Hartarska V., Parmeter, C. and Mersland, R. (2011), Should All Microfinance Institutions Mobilize Micro-savings? Evidence from Economies of Scope, Oxford Bulletin of Economics and Statistics
- Jayo M., Pozzebon M. & Diniz E.H. (2009). Microcredit and Innovative Local Development in Fortaleza, Brazil: The Case of Banco Palmas. Canadian Journal of Regional Science/Revue, vol.32 pg 115-128. Available from <http://www.questia.com/library/1G1-215842023> (retrieved on April 18, 2012)
- Kar, A. K. (2012). Does capital and financing structure have any relevance to the performance of microfinance institutions? *International Review of Applied Economics*, 26(3), 329-348. doi:10.1080/02692171.2011.580267
- Khachatryan, K. (2013). Managing microfinance institutions: linking performance with services and capital portfolio. Thesis Submitted in fulfillment of the requirements of the Degree of Doctor of Philosophy to the Department of Economics and Finance. University of Nice Sophia Antipolis.
- Kipsha E.P & Zhang, X. (2013) Sustainability, profitability and outreach Tradeoffs: Evidences from Microfinance Institutions in East Africa. European Journal of Business and Management, ISSN 22221905 (Paper) ISSN 2222-2839 (Online) Vol.5 Number 8.
- Kipsha E.F. (2013) Impact of size and size and age of firm's performance: Evidence from Microfinance Institutions in Tanzania, Research Journal of Finance and Accounting. ISSN. 2222-1697 (Paper) ISSN 2222-2847 (Online) Vol. 4, Number 5.
- Ibtissem, B. & Bouri, A. (2013) Credit risk Management in Microfinancing: The conceptual Framework.ACRA Journal of Finance and Risk Perspectives. Vol.2 Issue1 p. 9-24
- Marshall, A. (1910) Principles of Economics, Sixth Edition, London, MacMillan and Co.

- Olayombo, O.O. (2012). The roles of cooperative societies in Rural Finance: Evidence from the Ogun State, Nigeria. Thesis submitted in partial fulfilment of the requirement of Doctor of Philosophy. De Montfort University, Leke, United Kingdom.
- Omondi, O. R. (2014). Effects of Microcredit Facilities on the Welfare of Households in Suna East Sub-County, Migori County Kenya. Thesis Submitted in Partial Fulfillment of the requirements of Degree of Master of Business Management. Rong'o University College Moi University
- Rossel-Cambier, K. (2010), Do Multiple Financial Services Enhance the Poverty Outreach of Microfinance Institutions? CEB Working Paper N° 10/058 2010
- Sabhatu, K.T. (2011), "Management of Savings and Credit Co-operatives from the Perspective of Outreach and Sustainability: Evidence from Southern Tigray of Ethiopia." Research Journal of Finance and Accounting ISSN 222. 1697(Paper) vol.2. No. 2/8
- Shankar, S. (2011). An Analysis of the Role of Microfinance Programs in Promoting Financial Inclusion in India. A Thesis Submitted For the Degree Of Doctor Of Philosophy Lee Kuan Yew School Of Public Policy National University of Singapore
- Spohn, S.T. E (2010), Embedding Microfinance: Sustainable Delivery of Microfinance Services in Rural, Areas of Papua New Guinea: Thesis Submitted in fulfillment of the requirements of the Degree of Doctor of Philosophy. Institute of Land and Food Resources, The University of Melbourne. Available on <http://unimelb.edu.au/R/E> (retrieved on 18th, April, 2012)
- Stiglitz J. E. and Weiss A. (1981), Credit Rationing in imperfect Information, American Economic Review, Vol. 71 Issue3
- Yeboah, E.H.(2010), Microfinance in Rural Ghana. A view from below: Thesis Submitted in fulfillment of the requirements of the Degree of Doctor of Philosophy. University of Birmingham. Available on <http://ethesisbham.ac.uk/1198/> (retrieve on 18th April, 2012)

# **CONTRIBUTIONS OF PERKERRA IRRIGATION SCHEME TOWARDS THE GROWTH OF MARIGAT TOWN IN BARINGO, KENYA, 1963-2013**

By

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## **ABSTRACT**

*Marigat town is considered one of the commercial hubs of Baringo County, Kenya. Its rich history and development dates back to the establishment of Perkerra Irrigation Scheme in the formerly pastureland. The town's growth and development is pegged on the activities taking place in the irrigation scheme. This paper therefore, analyses the main contributions of the Perkerra Irrigation Scheme. This paper therefore, analyses the main contributions of the activities in the Perkerra Irrigation Scheme to the growth of Marigat town from a small collection center to a big town in 2013.*

**KEYWORDS:** Marigat, Perkerra Irrigation Scheme, Mau Mau, National Irrigation Board, Corporate Social Responsibility

## INTRODUCTION

Perkerra Irrigation Scheme is one of the schemes set up in Kenya by the colonial government in 1954. It derives its name from the Perkerra River which is the only source of water for the irrigation scheme. The irrigation scheme is situated in Baringo County, Kenya. Due to the limited availability of water, only 607 ha are cropped annually out of the possible 810 ha developed for a gravity furrow irrigation system. Perkerra River was dammed to create a water reservoir for the irrigation scheme since the area is arid and semi-arid hence rain water cannot be depended on.

Mau Mau detainees from central Kenya were the main source of labour during the initiation of the irrigation scheme. Mau Mau uprising was the independence fighting group for Kenya. The colonial government rehabilitated the detainees by utilizing their labour in the irrigation schemes within the country. Each province at the Emergency time was allocated a camp for detention and rehabilitation of the group's followers by the colonial government through the official administrator, Thomas Askwith and Marigat area was chosen in Rift Valley. The detainees worked on the irrigation scheme with the supervision of the colonial master in charge and in the evening they camped and rested at a location in the periphery of the irrigation scheme. This point of rest later developed into a small centre due to their daily needs.

Although Marigat area was mainly occupied by pastoral communities; Tugen, Ilchamus, Pokot and Turkana, there was less work in the area before introduction of the Perkerra Irrigation Scheme. It was just a grazing field and more of a reservoir for the dry seasons. A small cattle auction point was located at the area and it was just a once in two weeks affair with a few traders and the centre was not robust at all. Traders came from the neighbouring villages, bought and sold their cattle and went back to their villages the same day. This meant that the auction started by about mid morning and by late afternoon the whole area was vacated until the next market day. There were few varieties of goods exchanged in the market during the pre-irrigation time. The introduction of Perkerra Irrigation Scheme now brought in a new way of doing things. The traders began staying for some days in the centre during crop harvesting period and so trade took longer days than the one day auction as had been the norm in the area. Traders accumulated their produce for some days before transporting them to other towns like Kabarnet, Nakuru and Nairobi. These traders established makeshift structures to store their produce in the area. The structures increased in size with the increase in trade goods and this marked the beginning of Marigat Centre in the area. The County Council of Baringo came in to help in physical planning and demarcation of the centre. The local traders were allocated plots in the centre and order was established in the area. What was observed is that, Mau Mau detainees were not allocated plots since they were under rehabilitation. Those who owned plots did so after independence and they acquired them by purchasing from the locals.

Labour in the scheme was mainly from the Mau Mau detainees but there was a deficit in many times of manual labourers. The colonial government requested the local administration to seek for labour from neighbouring villages. These employees provided the much needed labour and were paid for their services. By 1968, it was indicated that the locals and neighbours provided 360 people working at the farm on casual basis. These employees worked on the farm from dusk to dawn and they settled down for the night in the upcoming Marigat town. The town acted as a residential area for employees. Since the plots had been allocated to the locals by the County Council of Baringo, there were structures in some plots constructed to

host the workers and they paid rent and others also put up small houses to act as homes after work. Historical records indicate that the Mau Mau detainees who were brought to work on the irrigation scheme were detained at a camp in where Marigat town is now located. The place accommodated the officers taking care of the detainees themselves. The need for goods and services of course widened and thus the growth of the centre was catapulted by the growing population.

Perkerra Irrigation Scheme is recorded to have contributed towards population increase in the Marigat area. Since the pastureland was converted into an irrigation scheme, the locals had new people living in the area. The locals decided to settle down and minimized the nomadic way of life. From the small number of traders who came for the cattle auctions, the area had large numbers of traders who came for the irrigation farm produce. The area began experiencing a better housing system, sewage system was also established by the National Irrigation Board and as an accompaniment clean water is provided to the locals. Although clean water provision has been a challenge up to now, its provision came with the introduction of the irrigation scheme and has contributed to the growth of the town a lot.

The main source of employment in Marigat area is the irrigation scheme. More than 400 people were employed by the scheme as of 2013 either on cashual basis or on permanents terms. These employees reside in the town and many have always invested their daily wages in infrastructure at the town. The employees have constructed rental houses in the town as well as business premises for the local traders. This proves that the wages and salaries from the irrigation scheme have contributed in a great way to the growth of Marigat Town.

Onions were first introduced in the irrigation scheme in 1964 as the main crop of farming. The locals planted the crop in their plots and there was a ready market facilitated by the government of Kenya. Traders came from far and wide within the country for the well-bred onions of Perkerra. Most of the produce were packed and transported by the traders who bought them directly from the irrigation farmers, stored them in their stores within the town or rented stores as they collected more. The act of collecting produce and accumulating them in the town area contributed to the ultimate growth of the town as the locals hosted the traders during harvest and got good returns from the traders. Surplus produce was also sold by the local traders in their shops to the travelers who made stopovers at Marigat town. Onions created jobs for the locals as they engaged in trade on the product as the main crop from the farm. Records indicate that the crop is the most successful product from the irrigation scheme since its inception. Since the area is hot and warm, onion storage is not much of a problem and its shelf life is extended by the climatic condition of the area. An average of approximately 200 Kilograms of onions are sold daily in the market at a price of Kenyan Shilling 300 per kilogram. All these onions are produced at the Perkerra Irrigation Scheme.

Kenya Wines Agencies Limited (KWAL) an alcohol producing company in the country set up a factory in Marigat Town at the periphery of the irrigation Scheme. The company established its small factory there so as to process pawpaw fruits from the scheme. Pawpaw plant was introduced to the farm in the year 1980 to a successful start. The plants did well in the irrigation scheme and this warranted the company to set base in the area. The factory continued processing the fruits up to 2006 when it closed down due to low supply of pawpaw fruits. The farmers in the irrigation scheme overtime changed from planting the paw paws to the less demanding crops like rice and onions which were fast to grow and harvest. This brought down the factory as it was not economically sustainable to maintain a factory without any paw paws to process. Although the factory



closed down, the impact it had on the town was great. In its full capacity running, it had employed 30 workers on permanent terms and about 400 people supplied their produce to the factory or had business dealings with the plant. Those workers and business partners lived in Marigat Town and at the end of working hours they always contributed to the growth of the town's economy.

Establishment of Perkerra Irrigation Scheme at the Marigat Valley also brought in the security issue. The land was initially a cattle grazing land as earlier indicated thus cattle rustling was rampant. The locals engaged in traditional cattle raids and thus the area was not safe to live in. The colonial government and also the independence government came up with ways of taming the raids and making the area safe and secure for farming all through the year. Ng'oroko raiders from Pokot community were always engaging in raids in the area. The local administration decided to petition the government to set up a police station in Marigat town. The government through the office of the District Commissioner who was the chairman of the District Security Committee took time before implementing the construction of a police station in the area. It took the intervention of NIB which manages the irrigation scheme for the police station to be established in Marigat town. The station minimized cases of theft in the area. The police station was set up in 1988 and since its establishment cases of disorder and law breaking have been minimized in the area as well as cases of theft in the scheme reduced. The town has expanded and due to that the police post has been elevated to a police station with a higher number of police officers. It also covers a larger part of the sub-county thus security is improved around the town and villages courtesy of the irrigation scheme.

Irrigation farming is financially demanding and the yields at the end depend on how much money one dedicates to the crops. The more the funds assigned to farming, the higher the yields at the end. This is informed by the fact that almost all the functions in farming require money for execution. From tilling the land to buying seeds, planting them, watering, weeding and harvesting. Given that most of the farmers in the irrigation scheme were pastoralists, accessing all those funds for the irrigation sector always proved tedious. The farmers were always hard to convince to sell their cattle for money to fund irrigation activities. The management of the scheme approached several financial institutions to help finance some of the farmers in the scheme. Kenya Commercial Bank (KCB), Horticultural Crops Development Authority (HCDA) and Marigat Farmers Cooperative Society (MFCS) established branches in Marigat Town. These financial institutions were set up in the town to help the irrigation scheme farmers access loans. They targeted the irrigation farmers but in their line of duty helped finance also the businessmen and women at Marigat Town. Records from the financial institutions indicate that the farmers have accessed loans and the uptake is increasing. The financial institutions also indicated that the town has benefitted in that there are several buildings which its construction is financed by the banks within the town. It is worth noting that the financial institutions especially KCB set base in the town to help the farmers but have since diverted some of their funds towards expansion of Marigat Town.

National Irrigation Board (NIB) which is charged with the daily running of Perkerra Irrigation Scheme is also involved in Corporal Social Responsibility (CSR) activities around the neighbourhood. This is the company's efforts that go beyond what may be required by the regulators or government norms to offer extra human services to the surrounding community. NIB is mandated by the government of Kenya to run the daily activities of Perkerra Irrigation Scheme and since it is a state parastatal it has several programs under it that help give back to the community. This involves incurring short-term costs to the parastatal that do not provide

an immediate financial gain to the parastatal but instead promote positive social and environmental change. NIB is allocated an annual budget by the National Government which is huge enough to sustain a CSR programs in every irrigation scheme they manage. Real time and money has been committed by NIB to the environmental maintenance in Marigat area at large. Marigat Sub-county Hospital in the fringes of PIS is the major hospital in the whole sub-county. The hospital was established in 1955 but it became fully operational in 1980s. It was inadequately equipped and the large number of patients visiting the facility made it worse. The hospital was always overwhelmed by the numbers as the population of the town increased. It was indicated that almost all the employees of the irrigation scheme and the town dwellers solely depended on this health facility as it is cheap and affordable. The importance of the hospital has prompted NIB management to chip in and donate always towards the hospitals running. It is indicated that between the years 1978 and 1980, the board supported the hospital to a tune of Kenyan Shillings 6 million. This amount did not include the equipment NIB donated to the hospital. In addition to funding the running of the hospital, the management also assists in mobile clinics. These clinics help to reach out to the town dwellers who are also customers of the irrigation scheme.

Due to the large population of workers on the scheme, there was need for establishment of a school for their children. As Rodney pointed out in his book, education is crucial in any type of society for the preservation of the lives of its members and maintenance of the social structure. NIB has supported Marigat Primary School in order to advance the vision of Rodney in a way whereby the locals have their children in school and they later come to develop the area after studies. Several classrooms in the school have been constructed with the aid of NIB. This has motivated many parents to take their children to Marigat Primary School and at the end set base in Marigat Town. The town has continually increased in size due to the support accorded to its core institutions by NIB.

The maize seed driers at Perkerra Irrigation Scheme are powered by electricity. This means there must be an assured availability of electricity during the harvesting period. The management of the irrigation scheme requested Kenya Power Company to provide them with electricity. The company set up a power sub-station at the fringes of the scheme. The substation now provides a stable electricity supply to the scheme as well as the town. With the availability of power, the town attracted more investors to the town and they settled there all through. In better terms, the company supplied electricity to the scheme but the town has grown more due to the availability of electricity in the area. Thus the electricity became an attractive element to the people to come and settle in the area.

## **CONCLUSION**

The paper has been a discussion on the contribution of Perkerra Irrigation Scheme on the growth of Marigat Town. It shows that the initial inhabitants of Marigat area were pastoralists and used the entire land as reserve pastureland. The establishment of Perkerra Irrigation Scheme at the area in 1954 by the colonial government brought in several changes discussed one being the growth of a town in the fringes of the scheme. Insecurity which was a major concern in the area was tamed with the introduction of a police station in the area. Residential areas were constructed to accommodate the workers at the scheme and an elaborate sewerages and water system was put in place courtesy of the irrigation scheme. Population increase was witnessed in the area with the growth of the town and improved services at the hospital were also witnessed. Onions and pawpaw

plants as commercial produce have enhanced the growth of the town as many traders engage in the sale of the produce in the town. The irrigation scheme is a major employer as many jobs are available to the locals and neighbours during harvest and planting season, the workers at the end of the day contribute towards the advancement of the town in one way or another. The irrigation scheme advocated for electricity supply for their machines, the Kenya Power Company set up a station in the area and thus it became beneficial to the irrigation scheme as well as the town. These factors which are directly from the irrigation scheme have contributed to the growth of Marigat Town.

## REFERENCES

Anderson, D. *Eroding the Commons: The Politics of Ecology in Baringo, Kenya, 1890-1963* (Nairobi: East African Educational Publishers, 2002), p. 40.

Boserup, E. *The Conditions of Agricultural Growth* (London: Allen and Unwind, 1953), pp. 30-46.

Carlsen, J. *Economic and Transformation in Rural Kenya* (Uppsala: Scandinavian Institute of African Studies, 1980), p. 16.

Chambers, R. *Learning from Project Pathology: The Case of Perkerra* (Nairobi: East African Educational Publishers, 1987), p. 36.

Guy, A. *Modern Kenya* (London: Longman Group Ltd, 1981), pp. 11-20.

Illife, J. *Agricultural Change in Modern Tanganyika* (Cambridge: Cambridge University Press, 1971), pp. 130-133.

Kandagor, D. *Rethinking British Rule and the "Native" Economies in Kenya* (Nakuru: Pangolin Publishers Limited, 2010), p. 23.

Kanogo, T. *Squatters and the Roots of Mau Mau* (Nairobi: East African Educational Publishers Ltd, 1987), p. 29.

Kjekshus, H. *Ecology Control and Economic Development in East African History* (London: James Currey, 1996), p. 39.

Mutiso, G. *Kenya: Politics, Policy and Society* (Nairobi: University of Nairobi Press, 2000), p. 300.

Rodney, W. *How Europe Underdeveloped Africa* (Harare: Zimbabwe Publishing House, 1981), pp. 377-379.

Zezeza, T. *A Modern Economic History of Africa* (Dakar: CODESRIA, 1999), P. 70.

# Length of stay and postoperative complications after spinal surgeries in relation to hyperglycemia among diabetic and undiagnosed diabetics

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## Abstract

**Objective:** to expose the effect of glucose level preoperatively and to compare between diabetics and non-diabetics with hyperglycemia preoperatively on the patient complications and length of stay in the hospital.

**Material:** 106 patients were enrolled in, and each of the patients' records underwent a comprehensive and complete review.

**Results:** 6 (46.2%) of the hyperglycemic patients had at least one post-operative complication, ( $P$  value .004), having most commonly infections and suboptimal wound healing (23.1%,  $n$  3,  $P$  value .094, .192, respectively), with an increase in length of stay by an average of 4.37 days ( $P$  value .256) and the incidence of complications among the hyperglycemic patients seen in 5 (55.6%) of the diabetics and in 1 (25.0%) of the non-diabetics ( $P$  value .343).

**Conclusion:** Diabetics with hyperglycemia showed to be prone for more adverse events compared to the euglycemic or the undiagnosed diabetics, while length of stay was markedly increased in the undiagnosed diabetics with hyperglycemia.

## Keywords:

Spine, surgery, orthopedics, diabetes, complications, length of stay

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## **Introduction:**

Hyperglycemia in diabetic patients (DM) is a well-known risk factor for many perioperative morbidity and mortality<sup>(1)</sup>, as it alters the normal physiology of the patients responding to many stressors like surgery, it therefore tends to increase the patients' costs and length of stay in the hospital. <sup>(1-5)</sup>

some studies have showed the relation between glycemic instability with the adverse events following spinal surgeries, showing as high as 19% non-diabetic patients (NDM) , had hyperglycemia though revealing that there might be a minority of underdiagnosed diabetics among them it ,however, didn't affect the results significantly nor change the view of the high percentage of hyperglycemia among the NDM, and considering it as an independent risk factor for many adverse events like surgical site infections, sub-optimal wound healing and for the increasing rates of surgical revision, concluding with the encouragement of further discussion of the burden of the problem and the possible use of the glucose lowering agents in the NDM with hyperglycemia. <sup>(6, 7)</sup> On the other hand, Guzman et. al. studies have provided that better glycemic control in DM patients perioperatively have led to better outcomes and less complications. <sup>(8, 9)</sup>

The purpose of this study was to expose the effect of glucose level preoperatively on the patient complications and length of stay in the hospital, and to compare between DM patients and NDMs with hyperglycemia preoperatively regarding complications and length of stay.

## **Material and Methods:**

Of the 129 patients who underwent spinal surgeries at King Saud University Medical City, Riyadh SA, during two years period (2013-2015) exclusion and inclusion criteria were applied including only the patients whom their preoperative glucose level was documented and a total number of 106 patients were enrolled in a retrospective analysis study design. Each of the patients' records underwent a comprehensive and complete review and the data where obtained using a standardized validated data collection sheet, no incentives were provided to the participants, and patients' confidentiality was ensured by separating the patients' basic information from the data collected in a different sheet kept with the main author.

Hyperglycemia was defined as a random blood glucose of > 11,1 mmol/l according to (Diabetic.org)<sup>(10)</sup>, and (my.clevelandclinic.org).<sup>(11)</sup>

Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) version 19 software (SPSS Inc., Chicago, IL, USA).

## **Results:**

Among the included 106 patients, 59 (55.7%) were females, 95 (89.6%) were Saudis, with a mean age of 49 years (ranging from 14 to 87 years) with a mean BMI of 30.4 (ranging from 18 to 54), 59 (55.7%) were evaluated as ASA score 2, 31 (29%) as ASA score 1, and 13 (12.3) as ASA score 3. The causes varied with 66 (62.23%) operations done for degenerative diseases, 18 for deformative and 17 traumatic (17% and 16% respectively), and .9% were due to other causes (inflammatory, tumoral and degenerative-deformative causes), involving most commonly the thoraco-lumbar vertebrae in 81 cases (76.4%), with the posterior approach being the commonest used in 92 cases (86.7%)

88 (83%) were non-smokers, and 5 (4.7%) patients were using corticosteroids, 34 (32.1%) were DMs, 13 (12.2%) of all patients had hyperglycemia, 6 (46.2%) of the hyperglycemic patients had at least one postoperative complication, compared to 9 (10.5%) among the euglycemics (P value .004), having most

commonly infections and suboptimal wound healing (23.1%, n 3, P value .094, .192, respectively), complications among hyperglycemic with an increase in length of stay by an average of 4.37 days length of stay between (P value .256) and the incidence of complications among the hyperglycemic patients seen in 5 (55.6%) of the DMs compared to 1 (25.0%) of the NDMs (P value .343) with an increase in the BMI among the DMs by 5.28 (mean in DMs 32.72, mean in NDMs 27.42) (P value .053).

Length of stay was more among NDMs by 2.92 days ( mean in DMs 12.33, mean in NDMs 15.25)(P value .315) , along with time of surgery by 147.31 minutes ( mean in DMs 184.44, mean in NDMs 331.75) (P value .031)

### **Discussion:**

Our study included 106 patients, mostly being overweight (with mean BMI of 30.4).

We found that among the total patients underwent spinal surgeries, only 13 were hyperglycemic preoperatively, and merely 6 had at least one post-operative complication, with the most common complication being related to the operated surgical site, having infections as the main encounter followed by delayed wound healing, and those findings are matching other published studies.<sup>(8, 12-14)</sup> Though it is worthy to know that as an applied protocol in the hospital, all our included patients received a pre-operative antibiotic prophylaxis (half an hour before anesthesia induction), and those whom their time of surgery exceeded 2 hours received a second dose, and one additional dose prior to catheter removal,

It is clear that diabetes mellitus is linked to many surgical adverse events, including osteoporosis<sup>(15)</sup>, nevertheless undiagnosed diabetic patients ,which Beagley, Jessica et al. have estimated it to be 45.8% of all adult diabetic cases<sup>(16)</sup>, could hold more danger than those whom already on treatment and managing their health<sup>(2, 17)</sup>, as it may deteriorate the patient's well-being without him/her knowing or taking the proper treatment to control it thus predisposing the patient to much more perioperative undesirable outcomes that may be of a higher severity.

in this study, we've noticed more complications appearing in the DMs with hyperglycemia than the NDMs along with a significant increase the BMI, this result was against our hypothesis and to what have been found in the literature<sup>(2)</sup>, and we could explain it with the fact that the percentage of DMs in Saudi Arabia is as large as 20.5% in 2014<sup>(18)</sup>, and the numbers examined in this study was not large enough to be statistically significant to represent the true burden of the problem. On the other hand, length of stay, and time of surgery were seen higher among the NDMs with hyperglycemia than DMs, which could be attributed to the longer time taken to evaluate and possibly diagnose NDMs prior to surgery as well optimizing their high blood glucose levels, and that adds to their hospital days as well as predisposing to more infections, these findings matches the literature's<sup>(19)</sup>, and it predicts that better glycemic control and early detection of DM patients could be linked to lesser hospital length of stay.

Though some results were not significant in this study, they could be re-evaluated broadly in future studies addressing the same issue.

### **Limitations:**

The number of diabetic patients examined in this study was limited, as well as the number of the spinal surgeries done in the hospital, along with the restricted access and inaccuracy of the paper-based patients' files.

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**References:**

1. Rollins KE, Varadhan KK, Dhatariya K, Lobo DN. Systematic review of the impact of HbA1c on outcomes following surgery in patients with diabetes mellitus. *Clin Nutr*. 2015. doi: 10.1016/j.clnu.2015.03.007. PubMed PMID: 25840840.
2. Kotagal M, Symons RG, Hirsch IB, Umpierrez GE, Dellinger EP, Farrokhi ET, et al. Perioperative hyperglycemia and risk of adverse events among patients with and without diabetes. *Ann Surg*. 2015;261(1):97-103. doi: 10.1097/SLA.0000000000000688. PubMed PMID: 25133932; PubMed Central PMCID: PMC4208939.
3. Frisch A, Chandra P, Smiley D, Peng L, Rizzo M, Gatcliffe C, et al. Prevalence and clinical outcome of hyperglycemia in the perioperative period in noncardiac surgery. *Diabetes Care*. 2010;33(8):1783-8. doi: 10.2337/dc10-0304. PubMed PMID: 20435798; PubMed Central PMCID: PMC2909062.
4. Menzin J, Korn JR, Cohen J, Lobo F, Zhang B, Friedman M, et al. Relationship between glycemic control and diabetes-related hospital costs in patients with type 1 or type 2 diabetes mellitus. *J Manag Care Pharm*. 2010;16(4):264-75. PubMed PMID: 20433217.
5. Smith DK, Bowen J, Bucher L, Hawkins T, Jurkovitz C, Reed J, 3rd, et al. A study of perioperative hyperglycemia in patients with diabetes having colon, spine, and joint surgery. *J Perianesth Nurs*. 2009;24(6):362-9. doi: 10.1016/j.jopan.2009.10.011. PubMed PMID: 19962103.
6. Langlois J, Bouyer B, Larroque B, Dauzac C, Guigui P. Glycemic instability of non-diabetic patients after spine surgery: a prospective cohort study. *Eur Spine J*. 2014;23(11):2455-61. doi: 10.1007/s00586-014-3489-2. PubMed PMID: 25103953.
7. Richards JE, Hutchinson J, Mukherjee K, Jahangir AA, Mir HR, Evans JM, et al. Stress hyperglycemia and surgical site infection in stable nondiabetic adults with orthopedic injuries. *J Trauma Acute Care Surg*. 2014;76(4):1070-5. doi: 10.1097/TA.000000000000177. PubMed PMID: 24662873.
8. Guzman JZ, Iatridis JC, Skovrlj B, Cutler HS, Hecht AC, Qureshi SA, et al. Outcomes and complications of diabetes mellitus on patients undergoing degenerative lumbar spine surgery. *Spine (Phila Pa 1976)*. 2014;39(19):1596-604. doi: 10.1097/BRS.0000000000000482. PubMed PMID: 24983935; PubMed Central PMCID: PMC4149698.
9. Guzman JZ, Skovrlj B, Shin J, Hecht AC, Qureshi SA, Iatridis JC, et al. The impact of diabetes mellitus on patients undergoing degenerative cervical spine surgery. *Spine (Phila Pa 1976)*. 2014;39(20):1656-65. doi: 10.1097/BRS.0000000000000498. PubMed PMID: 24983933; PubMed Central PMCID: PMC4161655.

10. "Diabetes Basics." Diabetes Basics. Web. 20 Sep. 2015. . Available from: [http://my.clevelandclinic.org/health/diseases\\_conditions/hic\\_diabetes\\_basics](http://my.clevelandclinic.org/health/diseases_conditions/hic_diabetes_basics).
11. "Diagnosing Diabetes And Learning About Prediabetes." American Diabetes Association. Web. 20 Sep. 2015. . Available from: <http://www.diabetes.org/diabetes-basics/diagnosis/?loc=db-slabnav>.
12. Marchant MH, Jr., Viens NA, Cook C, Vail TP, Bolognesi MP. The impact of glycemic control and diabetes mellitus on perioperative outcomes after total joint arthroplasty. *J Bone Joint Surg Am*. 2009;91(7):1621-9. doi: 10.2106/JBJS.H.00116. PubMed PMID: 19571084.
13. Lazar HL, Chipkin SR, Fitzgerald CA, Bao Y, Cabral H, Apstein CS. Tight glycemic control in diabetic coronary artery bypass graft patients improves perioperative outcomes and decreases recurrent ischemic events. *Circulation*. 2004;109(12):1497-502. doi: 10.1161/01.CIR.0000121747.71054.79. PubMed PMID: 15006999.
14. Kao LS, Meeks D, Moyer VA, Lally KP. Peri-operative glycaemic control regimens for preventing surgical site infections in adults. *Cochrane Database Syst Rev*. 2009(3):CD006806. doi: 10.1002/14651858.CD006806.pub2. PubMed PMID: 19588404; PubMed Central PMCID: PMCPMC2893384.
15. Hamann C, Kirschner S, Gunther KP, Hofbauer LC. Bone, sweet bone--osteoporotic fractures in diabetes mellitus. *Nat Rev Endocrinol*. 2012;8(5):297-305. doi: 10.1038/nrendo.2011.233. PubMed PMID: 22249517.
16. Beagley J, Guariguata L, Weil C, Motala AA. Global estimates of undiagnosed diabetes in adults. *Diabetes Res Clin Pract*. 2014;103(2):150-60. doi: 10.1016/j.diabres.2013.11.001. PubMed PMID: 24300018.
17. Stolar M. Glycemic control and complications in type 2 diabetes mellitus. *Am J Med*. 2010;123(3 Suppl):S3-11. doi: 10.1016/j.amjmed.2009.12.004. PubMed PMID: 20206730.
18. Saudi Arabia." International Diabetes Federation. Web. 20 Sep. 2015. . Available from: <http://www.idf.org/membership/mena/saudi-arabia>.
19. Freedman MK, Hilibrand AS, Blood EA, Zhao W, Albert TJ, Vaccaro AR, et al. The impact of diabetes on the outcomes of surgical and nonsurgical treatment of patients in the spine patient outcomes research trial. *Spine (Phila Pa 1976)*. 2011;36(4):290-307. doi: 10.1097/BRS.0b013e3181ef9d8c. PubMed PMID: 21270715; PubMed Central PMCID: PMCPMC4005359.



# Determination of Heavy Metals in Tilapia using Various Digestion Methods

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## Abstract

*Heavy metals are the naturally occurring elements that have high atomic weights. Most of them are toxic even at very low concentrations. This study aims to determine the most appropriate digestion method out of four different methods to analyze the heavy metal concentrations in muscle samples of Tilapia fish. Lead (Pb), Chromium (Cr), Cadmium (Cd), Copper (Cu), Zinc (Zn), and Iron (Fe) contents were determined by using Atomic Absorption Spectroscopy (AAS). The employed digestion methods were acid digestion with HNO<sub>3</sub>, Nitric-Perchloric digestion (HNO<sub>3</sub> + HClO<sub>4</sub>), digestion by using aqua regia solution (HCl: HNO<sub>3</sub>) and dry ashing in a muffle furnace followed by solubilization of residual ash in nitric acid. Results showed that the dry ashing method leads to the greatest recovery of Cd and Fe whereas aqua regia mixture extracts Cr in an efficient amount. All four methods were equally effective for the digestion of Cu.*

## Keywords:

Heavy metals, Fish, Digestion method, Wet digestion, Dry ashing, Aqua-regia, Atomic Absorption Spectroscopy

## 1. INTRODUCTION

The heavy metal concentrations in the environment increase due to various anthropogenic activities. This can be visualized especially in aquatic ecosystems (Abdel-Baki, Al-Quaraishy & Dkhil, 2011). Accumulation of heavy metals in fish is a clear indication for the pollution. Pollution of heavy metals in aquatic ecosystem is growing at an alarming rate and has become an important worldwide problem (Arena et al., 2013; Ikenakaa, Ishizukaa, Nakayamaa, Saengtienchaia & Yohannesa, 2013).

Fish is an important source of protein and it also provides essential omega-3 fatty acids (docosahexaenoic and eicosapentaenoic acids) that help to maintain cardiovascular health by playing a major role in the regulation of blood clotting and vessel constriction (Benade, Maris & Opperman, 2011). Nile tilapia (*Oreochromis niloticus*) is one of the most consumed species among the fresh water species. It is a major source of omega-3 polyunsaturated fatty acids (PUFAs) (Muinde, Nguu, Ogoyi & Shiundu, 2013). However, fish have been shown to absorb toxic metals from contaminated sediments and water through their gills and skin. High concentrations of heavy metals in fish cause mutation of inner organs disturb immune reactions and reduce body's adaptation qualities and resistance to diseases (Adei, Akoto, Darko & Eshun, 2014; Benade et al., 2011).

Although some heavy metals such as Cr, Mn, Co, Cu, Fe and Zn, in trace amounts, play important biochemical roles in many organisms, toxic effects are observed at high concentrations. These trace elements are regarded as serious environmental pollutants because of their toxicity, lack of degradability and persistence (Dobaradaran, Ghaedi, Naddafi & Nazmara, 2010; Jinadasa, 2013). Itai-itai disease of the Toyama Jintsu river area in Japan was a documented case of mass cadmium poisoning. Itai-itai disease is known as one of the four big pollution diseases of Japan (Sarojam, 2009). Further, Fe and Mn can cause pathological events such as the iron oxide deposition in Parkinson's disease (Sarojam, 2009). Excess Cu is associated with liver damage and Zn may produce adverse nutrient interactions with Cu. Also, Zn suppresses the immune function and reduces the levels of high-density lipoproteins (Jinadasa, 2013). Although Ni helps to form enzymes that

are needed in the formation of nucleic acids and DNA; it can also be highly toxic at higher concentrations. Pb induces renal tumors, reduces cognitive development and increases blood pressure in adults (Jinadasa, 2013). Due to these reasons, it is important to quantify heavy metal levels of food samples accurately, in order to prevent the consumption of contaminated foods by the population, thereby preventing the adverse health effects that may result from heavy metal accumulation. According to Hseu (2004), sample digestion processes are done prior to quantification of heavy metals. This includes closed or open digestion systems and the use of different combinations of acids, such as  $\text{HNO}_3$ ,  $\text{HCl}$ ,  $\text{HClO}_4$ ,  $\text{HF}$  as well as oxidants such as  $\text{H}_2\text{O}_2$ . The acid used in the digestion process depends largely on the nature of the matrix to be decomposed. Hydrochloric acid ( $\text{HCl}$ ) is useful for salts of carbonates, phosphates, some oxides and some sulfides. Nitric acid,  $\text{HNO}_3$  (boiling point  $122\text{ }^\circ\text{C}$ ) oxidizes many samples that cannot be dissolved by  $\text{HCl}$ . Hydrogen peroxide,  $\text{H}_2\text{O}_2$  (boiling point  $150\text{ }^\circ\text{C}$ ) is a strong oxidizer, which is used in combination with  $\text{HNO}_3$  to dissolve matter that is not fully decomposed by  $\text{HNO}_3$  (Amina, Ghanthimathi, Izzah, Salmijah & Ujang, 2012).

Digestion can be either wet chemical digestion or dry ashing. Wet chemical digestion can be carried out in either an open system or in a closed vessel (Muinde et al., 2013). Open systems work under atmospheric pressure, and the closed systems involve heating samples in convection or microwave ovens. Accordingly, these processes are described in the relevant literature as acid digestion and pressure digestion or microwave digestion (microwave decomposition) and microwave pressure digestion. Open systems reduce the analytical problems consequent to digestion by allowing the analysis of a larger number of samples. These systems also facilitate evaporation of acid and drying of the digests (Arena et al., 2013).

Microwave assisted acid digestion procedures are becoming popular due to the speed of the digestion process as well as the reduced risk of contamination and loss of volatile chemical elements. This is a closed system and the closed vessel can achieve a higher temperature and a pressure. The critical parameters in this procedure are the digestion temperature, time program and the type of chemical used (Amina et al., 2012; Bader, 2011). By using mineral acids and hydrogen peroxide, organic samples can be decomposed into carbon dioxide and completely mineralized. Decomposition of organic materials such as fats and oils with acids is exothermic. These types of samples can be safely decomposed by slow heating rates or by heating to different temperature levels (Muinde et al., 2013).

In dry ashing, the degree of volatilization loss is a limiting factor and it depends on the applied temperature, the form in which the analyte is present in the sample and the chemical environment in the ashing stage. Dry ashing could be done along 8 hours or overnight at a temperature of  $550\text{ }^\circ\text{C}$  (Bader, 2011).

There is no ideal method for maximum recovery of trace elements in fish species. Therefore, there is a great need to study the effect of different digestion methods on the extraction of heavy metals from fish muscles (Abbruzzini et al., 2014). This will require different combinations of acids and oxidizing agents, which often have a great variety of constituents.

The main objective of the present study is to evaluate the effect of four digestion methods on recovery of Zn, Cu, Cr, Cd, Pb and Fe contents in tilapia fish samples. The study aims to investigate the levels of heavy metal

concentrations in Tilapia fish by using four different digestion methods and determine the best method for the quantification of each heavy metal.

## **2. RELATED WORK**

Previous studies established favorable methods to measure the total concentrations of heavy metals in fish species. These were carried out by dissolving the samples in concentrated mineral acids at high temperatures. Many methods that have been discussed before were based on concentrated nitric acid digestion, dry ashing, nitric perchloric acids digestion and sulphuric acid digestion (Bader, 2011; Hseu, 2004).

AOAC (Association of Analytical Communities) official method 999.10 presented a microwave digestion procedure when analyzing the heavy metals Pb, Cr, Cu, Zn and Fe in foods. The digestion procedure is described as weighing 0.2-0.5g of sample into digestion tube and adding 5 ml of HNO<sub>3</sub> and 2 ml of 30% H<sub>2</sub>O<sub>2</sub>. This is placed under microwave oven by considering the power/temperature program (Arvidsson et al., 2000).

AOAC official method 999.11 was presented to determine the heavy metals such as Pb, Cd, Cu, Fe and Zn in foods by using the dry ashing method. Ashing is done in a programmable furnace. The temperature is increased to a maximum rate of 50°C/h up to 450 °C by placing the fish sample in the furnace at the starting temperature, which is not higher than 100 °C. This is kept in the furnace overnight or for 8h. Temperature is changed at pre-determined intervals by taking out the crucible and adding distilled water until the sample is completely turned into ash. For every batch at least two blanks are needed (Arvidsson et al., 2000).

In another method that uses dry ashing as a digestion method, compared to the AOAC 999.11 official method, after the sample is completely converted into ash, HCl was added to the crucible to completely cover the ash. Then it is re-dissolved in nitric acid (Sarojam, 2009).

Aqua regia digestion is an effective way of digesting under wet digestion. According to this method, a mixture of HCl acid and HNO<sub>3</sub> in the ratio of 3:1, which is known as aqua regia mixture, will be used for the digestion process. The sample in the digestion tube will be mixed with the aqua regia mixture and will be left to sit overnight under reflux conditions. The mixture will then be heated up to 180 °C and the samples will be processed until 1 ml of acid is remained. An additional 4 ml of aqua regia solution will be added and evaporated off, and when there is no clear colorless endpoint, the extracts will be filtered (Black et al., 2013).

USEPA (United States Environmental Protection Agency -1998) proposed an acid digestion method in which HNO<sub>3</sub> and H<sub>2</sub>O<sub>2</sub> were used. In this method, the sample (1.0 g) was weighed and transferred to the digestion tube to which 10 ml of HNO<sub>3</sub> were added. After placing in a digestion block, the samples were heated to 95±5°C for 10 min. After cooling, 5 ml of HNO<sub>3</sub> was added and evaporated off at 100 °C for 2 more hours. Then the samples were cooled, and 2 ml of double distilled water and 3 ml of 30 % H<sub>2</sub>O<sub>2</sub> were added. The samples were then placed in the block for 2 more hours at 100 °C. Finally, the digests were filtered and placed in plastic containers (Black et al., 2013).

Concentrated sulphuric acid ( $\text{H}_2\text{SO}_4$ ) can also be used in wet digestion.  $\text{H}_2\text{SO}_4$  is heated with the sample until the sample turns charred and subsequently into viscous oil-like black colour liquid. Two to three drops of analytical grade concentrated  $\text{HNO}_3$  is carefully added to complete the digestion process. The digestion is complete when the final solution becomes clear (Noik, Sakari, Seng & Tuah, 2015).

Pressure digestion is a prominent method used in sample preparation. In this method, heating takes place in special heater blocks and not in a laboratory oven and therefore, the digestion occurs at a specific external temperature. According to ZUNDEL Holding Enterprise, these systems are capable of completely digesting almost any sample and transferring them into solution. Another described method states that a small piece of fish tissue is mixed with potassium permanganate and  $\text{H}_2\text{SO}_4$ , and then digested on a hot plate. After digestion, the excess permanganate is reduced with hydroxylamine hydrochloride (Evans, Johnson & Leah, 2010).

### **3. MATERIALS AND METHODS**

#### **3.1 Sample Preparation**

Tilapia fish samples were purchased from a local super market and the fish samples were stored at  $-4\text{ }^\circ\text{C}$  until analysis. Before sampling the fish was weighed and the body length was measured. Then it was dried at  $65\text{ }^\circ\text{C}$  in a laboratory oven until the fish attained a constant weight.

#### **3.2 Chemicals**

All chemicals used were of the highest purity and all solutions were prepared using double distilled water.

#### **3.3 Instruments**

For the wet digestion methods magnetic stirrer/hot plates were used. For the dry ashing, muffle furnace (Advantec; KL-280, Toyo, Seisakusho, Ltd.) was used. To determine the metal ion absorbencies, Atomic Absorption Spectrophotometer (GBC 932 plus, GBC Scientific Equipment Ltd.) was used.

#### **3.4 Methods of Digestion**

The digestion methods employed in this study were acid digestion and dry ashing. Under the acid digestion methods three methods were performed. They were digestion with  $\text{HNO}_3$  acid, nitric-perchloric acid digestion ( $\text{HNO}_3 + \text{HClO}_4$ ), and with aqua regia solution ( $\text{HCl}:\text{HNO}_3$ ). In dry ashing, the sample was heated in a muffle furnace and the residual ash was dissolved in  $\text{HNO}_3$ .

##### **3.4.1 Acid digestion**

Acid digestion methods differ due to the chemical composition used in method. (Abbruzzini et al., 2014). The three acid digestion methods used in this study are described below.

##### **$\text{HNO}_3$ digestion**

Fish sample (1.0 g) was placed in a 25 ml beaker. Afterwards, about 10 ml of concentrated  $\text{HNO}_3$  (analytical grade, 69%w/w) was poured into the beaker. A watch glass was placed at the mouth of the beaker and the beaker was placed on a magnetic stirrer/hot plate. Initially, the temperature was kept at about  $40\text{ }^\circ\text{C}$  for one hour to prevent vigorous reactions. Then the temperature was maintained at  $140\text{ }^\circ\text{C}$  for another 3 hours. Once the digestion was completed all tissue samples were completely dissolved in the acid. Then the mixture was

cooled to room temperature. Double distilled water was added into the vessel to dilute the mixture for AAS detection of heavy metals. The sample was filtered by filter paper (Whatman No.1 grade). The filtrates were stored at 4 °C until the metal determination by AAS (Plessis, 2012).

#### **Nitric-Perchloric acid digestion (HNO<sub>3</sub>-HClO<sub>4</sub>)**

This was performed according to the method recommended by AOAC (1990). A sample of 1.0 g was taken into a 250 ml beaker and 10 ml of concentrated HNO<sub>3</sub> acid was added. The mixture was boiled for 45 min to remove all oxidizable matter. After cooling, 5 ml of HClO<sub>4</sub> was added and the mixture was boiled until a white fume was observed. Then 20 ml of distilled water was added and the mixture was boiled further to release any gas. Finally, the mixture was filtered using Whatman42 paper (Hseu, 2004).

#### **Aqua regia digestion (HCl-HNO<sub>3</sub>)**

A mixture of concentrated HCl and HNO<sub>3</sub>, in the ratio of 3:1 and 1 ml HClO<sub>4</sub> acid is used as the aqua regia mixture. According to Muinde et al. (2013), 1.0 g of fish sample was digested in 10 ml of aqua regia mixture in digestion tubes for 3h at 60°C.

#### **3.4.2 Dry ashing**

A sample (1.0 g) was weighed and transferred to a crucible, then dried at 105°C in an oven with assisted air circulation to remove all residual water before ashing. The vessels were then placed in the muffle furnace and gradually heated (50 °C every 30 min) from room temperature to 550 °C and ashed for 2 hr. After cooling, the residual ash was dissolved in 8 ml of HNO<sub>3</sub> and the digests were then solubilized and filtered. (Abbruzzini et al., 2014).

#### **3.5 Heavy metal Analysis**

The concentrations of Pb, Cr, Cu, Cd, Zn and Fe were determined by an AAS in the Department of Chemistry, University of Colombo. AAS determinations are made by furnace AAS when the concentrations are high enough, or by graphite furnace AAS (GFAAS) when the concentrations are low. As long as the flame results are above the detection limit both techniques basically give the same result.

#### **3.6 Statistical Analysis**

All experiments were performed in triplicate. One-way analysis of variance (ANOVA) was utilized to distinguish the digestion methods with respect to mean levels of each of the six heavy metals (Pb, Cr, Cd, Cu, Zn and Fe). A stepwise multiple comparisons procedure was used to identify sample means that are significantly different from each other. Whenever there was a significant difference between two sample means, post hoc test in one-way ANOVA was performed. The statistical difference was defined as  $p < 0.05$ . Statistical analysis of data was carried out using Statistical Package for the Social Sciences (SPSS) version 16.0 (SPSS, Inc., Chicago, IL, USA).

### **4. RESULTS AND DISCUSSION**

#### **4.1 Length and weight of the fish**

The average body length and weight of a Tilapia fish sample purchased from the supermarket are 28.6 cm and 326.4 g, respectively.

## **4.2 Heavy metal analysis**

Tilapia fish samples were analyzed and quantified for the heavy metals Pb, Cr, Cd, Cu, Zn and Fe using each of the four digestion methods.

Mean and standard deviation (S.D) of heavy metal levels obtained using the four digestion methods are shown in Table 1. Results of the post hoc test are given in Table 2.

## **4.3 Comparison of digestion methods**

### **4.3.1 Cadmium**

As shown in Table 1, there is a significant difference among some digestion methods in terms of recovery of cadmium from Tilapia. The dry ashing method was better ( $P < 0.05$ ) in recovering Cd compared to nitric-perchloric acid digestion method. Although statistically not significant compared to digestion using  $\text{HNO}_3$  and aqua regia mixture, the highest mean concentration of Cd was recorded in samples analyzed using the dry ashing method.

### **4.3.2 Chromium**

The mean Cr concentration of fish samples analyzed using the four digestion methods ranged from 0.154 to 1.285 with the highest recovery being obtained using method 3 (Table 1). There is a significant difference between methods 3 and 4 with respect to Cr concentration of fish samples. Digestion with aqua regia mixture gave the highest mean Cr value and hence, can be considered as an effective method to quantify Cr in Tilapia samples. However all four methods showed larger standard deviation as shown in the Table 1. This indicates a lack of repeatability of these digestion methods for the extraction of Cr from fish samples.

### **4.3.3 Copper**

Copper is one of the lowest recovered metals from all four-digestion methods. There were no differences ( $P > 0.05$ ) in the Cu concentrations obtained using all four digestion methods. However it has been reported that Cu can be recovered at a higher level by digesting with solutions such as  $\text{H}_2\text{SO}_4$  and  $\text{HClO}_4$  (Hseu, 2004).

### **4.3.4 Lead**

The concentrations of Pb in samples analyzed using the four digestion methods ranged from 0.826 to 1.226 ppm according to Table 1 and Figure 1. The lowest ( $P < 0.05$ ) Pb levels were observed in samples analyzed using nitric-perchloric acid digestion step. Pb recovery levels obtained using the dry ashing methods were higher than those obtained using nitric-perchloric and aqua regia digestion methods (Table 1).

### **4.3.5 Iron**

As shown in Figure 1 and Table 1, out of the heavy metals that were analyzed, iron was the metal that had the highest concentrations in all samples. The iron concentrations obtained using different digestion methods ranged from 1.436 to 3.694 ppm. Perchloric-nitric acid digestion method gave lower mean concentration values of iron among the four methods and it is proved to be unsuitable to recover Fe. Also the SDs of the Fe concentration in all digestion methods was greater, and this indicates the poor reputability of these digestion methods for the extraction of Fe.

### **4.3.6 Zinc**

Compared to all other methods, the highest concentrations of Zn were recorded in samples analyzed using the dry ashing method. According to results obtained (Table 1), there was a significant difference between the dry ashing method and nitric perchloric method with respect to mean Zn concentration, with higher mean concentrations belonging to samples digested using the dry ashing method.

## **5. CONCLUSIONS AND FUTURE WORK**

According to results, dry ashing method leads to a greater recovery of Cd, Pb and Zn in Tilapia fish muscle. Cr can be efficiently extracted from fish samples by means of aqua regia mixture. For Cu, all the four methods used for digestion were equally effective. Nitric perchloric method is not as effective as other digestion methods for the extraction of Pb from Tilapia. Thus, it can be concluded that the choice of the digestion method has a significant effect on recovery rates of the heavy metals in Tilapia fish muscle.

The work described in this paper has been focused on the concentration of some selected heavy metals in Tilapia. This can be continued by using more different digestion methods like microwave digestion method and HNO<sub>3</sub> with H<sub>2</sub>O<sub>2</sub> digestion (Balcerzak, 2002).

The detection instrument used in the study is Atomic Absorption Spectrophotometer (AAS). According to Amina et al (2012) when there are metal ions with lower detection limits, since inductive coupled plasma has higher sensitivity than AAS it can be used to measure many elements at the same time, which will save the time and energy.

In addition, two or more different fish species can also be used for further studies. Several samples of chosen fish species can be collected and the level of trace metals can be quantified using the same procedure to determine the best digestion method for each fish species.

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## **REFERENCES**

Abbruzzini, T. F., Andrade, D. A., Carneiro, W. J. O., Silva, C. A. (2014). Influence of digestion methods on the recovery of iron, zinc, nickel, chromium, cadmium and lead contents in 11 organic residues. *R. Bras.Ci. Solo*, 38, 166–176.

Abdel-Baki, A.S., AIQuraishy, S., Dkhil, M.A. (2011). Bioaccumulation of some heavy metals in tilapia fish relevant to their concentration in water and sediment of wadihanifah, Saudi Arabia. *African Journal of Biotechnology*, 10, 2541–2547.

Adei, E., Akoto, O., Darko, G., Eshun, B. (2014). Concentrations and health risk assessments of heavy metals in fish from the fosu lagoon. *International Journal of Environment Research*, 8, 403– 410.



- Ahmad, S., Edirisinghe, E. M. R. K. B., Jinadasa, B. K. K. K. (2013). Level of trace metal hg, cd, pb, cu, fe and zn in yellowfin tuna (*thunnus albacores*) and swordfish (*xiphiasgladius*) collected from srilanka. *Journal of the National Aquatic Resources and Development Agency*, 4.
- Amina, A., Ghanthimathi, S., Izzah, N., Salmijah, S., Ujang, T.(2012).Comparison of microwave assisted acid digestion methods for icp-ms determination of total arsenic in fish tissue. *SainsMalaysiana*, 41, 157–1564.
- Arena, G., Copat, C., Fallico, R., Ferrante, M., Fiore, M., Ledda, C., Sciacca, S. (2013).Heavy metals concentrations in fish and shellfish from eastern mediterranean sea: Consumption advisories. *Food and Chemical Toxicology.Elsevier*,53, 33-37.
- Arvidsson, B.M., Åsman, B., Åstrand, C., Gjerstad, K., Haugsnes, J., Heldal,V., Holm, K., Jensen, A., Johansson, M., Jonsson, L., Liukkonen Lilja, H., Niemi, E., Thorn, C., Utterström, K., Venäläinen, E.R., Waaler, T.(2000).Determination of lead, cadmium, zinc, copper, and iron in foods by atomic absorption spectrometry after microwave digestion.*Journal Of AOAC International*, 83, 1189– 1203.
- Bader, N.R.(2011). Sample preparation for flame atomic absorption spectroscopy: An overview. *Rasayan Journal of Chemistry*, 4, 49–55.
- Balcerzak, M. (2002).Sample digestion methods for the determination of traces of precious metals by spectrometric techniques, *Analytical Science. The Japan Society for Analytical Chemistry*, 18, 737–750.
- Benade, A.S., Marais, D.W., Opperman, M. (2011). Analysis of omega-3 fatty acid content of South African fish oil supplements. *Cardiovascular Journal of Africa*, 22, 324–329.
- Black, K., Kalantzi, I., Karakassis, I., Papageorgiou, N., Pergantis, S., Shimmield, T. (2013). Heavy metals, trace elements and sediment geochemistry at four mediterranean fish farms, *Science of the Total Environment. Elervier*, 444, 128–137.
- Dobaradaran, S., Ghaedi, H., Naddafi, K., Nazmara, S. (2010). Heavy metals (cd, cu, ni and pb) content in two fish species of persian gulf in bushehr port, iran. *African Journal of Biotechnology*, 37, 6191– 6193.
- Enterprise, Z. H. *Theory of Sample Preparation Using Acid Digestion, Pressure Digestion and Microwave Digestion (Microwave Decomposition)*.
- Evans, S.J., Johnson, M.S., Leah, R.T.(2010). Determination of mercury in fish tissue, a rapid, automated technique for routine analysis. *Agilent Technologies*.
- Hseu, Z. (2004). Evaluating heavy metal contents in nine composts using four digestion methods. *Bioresource Technology, Elsevier*, 95, 53– 59, 2004.