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The *Journal for Disaster Management & Risk Reduction* is an international, multidisciplinary journal, which provides a swift publication outlet for research and technical reports on various facets of disasters situations, their scientific aspects and social impacts. It also attends to issues of conflict management, peace research and humanitarianism. Its objectives are to:

- Identify techniques, methods, policies, education & training suitable for disaster risk reductions globally
- Contribute to decision-making by providing information on progress and constraints in disaster management
- Contribute to solving emerging global hazards by stimulating demand-oriented applied science

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FOREWORD

Over its brief period of four years since establishment, The Centre for Disaster Management and Humanitarian Assistance (CDMHA) has enthusiastically pursued its activities with the support of other Faculties and the Management of Masinde-Muliro University of Science and Technology. Its activities span from capacity building in disaster management as well as research and outreach programmes. Of particular importance is the determination of the Centre to gather and disseminate disaster reduction information to a wide range of audience, including policy makers and peer scientists. The launching of this Second issue of the *International Journal of Disaster Management and Risk Reduction* is an important step in the accomplishment of these noble objectives.

Disasters are on increase year by year for a variety of reasons including urbanization, growing population, environmental degradation and climate change. In these times where Universities are playing an increasingly more important role in disaster risk reduction and response, this Journal could not have come at a better time, and provides a forum through which researchers can share and exchange their knowledge among themselves and with other workers in the field of disaster management.

I am happy and hopeful that this Journal will stimulate research and provide an avenue for publication of scholarly work in and outside MMUST.

Prof. B.C.C. Wangila
Vice-Chancellor, Masinde-Muliro University of Science & Technology

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AGRONOMIC AND ECONOMIC EVALUATION OF PYMARC ON MAIZE YIELD IN RIFT VALLEY PROVINCE OF KENYA

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Abstract

On many smallholder farms in Kenya, organic materials such as animal manures are commonly used to replenish soil fertility. These soil amendments are however, in short supply and are unlikely to meet the nutrient requirements of crops over large areas. There is need, therefore, to explore other non-traditional organic inputs as sources of crop nutrients. One such organic resource is pyrethrum marc (pymarc), a by-product of pyrethrum processing. The researchers investigated the effect of rate and method of pymarc application i.e. spot-applied (SP) or broadcast (BR) on maize yields and conducted economic analysis using partial budgeting to determine its potential for adoption for two consecutive seasons at three sites in the Rift Valley Province. The treatments consisted of two methods of pymarc application (SP and BR) in a factorial combination with two rates of pymarc i.e. 4 and 8 t ha⁻¹ laid down in a randomized complete block design. There was no significant interaction between the method and rate of pymarc application. There was also no significant effect of pymarc application method but maize yields increased with increasing rate of pymarc application which was attributed mainly to increased soil phosphorus availability. Net financial benefits were, however, negative for all treatments in all seasons, therefore, casting doubts on pymarc's potential for adoption as a soil fertility management intervention.

Key Words: Pymarc, Methods of application, Maize yield and Partial budgeting.

Introduction

Soil fertility depletion due to continuous cultivation with little or no nutrient inputs is a major constraint to crop production in many parts of Kenya. Nitrogen and phosphorus are usually the most limiting nutrients for crop production and their deficiencies often occur simultaneously on many farms (Jama et al., 1997). On smallholder farms, organic materials are commonly used as sources of nutrients. In most cases the organic materials are often treated as sources of N (Palm et al., 1997) with little attention given to their potential to provide P to crops. Furthermore, most research on organic inputs in Kenya has focused on the traditional organic amendments such as animal and green manures. It is now, however, clear that these amendments are in short supply and are unlikely to meet the nutrient requirements of crops over large areas. There is need, therefore, to explore other non-traditional organic inputs as sources of crop nutrients. One such organic resource is pymarc, a by-product of pyrethrum processing. One ton of dry pyrethrum flowers yields about 970 kg of pymarc of which less than 10% is used as animal feed (Muriuki et al., 2001). The surplus is often left to waste.

Pymarc has average N, P, and K contents of 2.2, 0.28 and 3.8% respectively, and is therefore a relatively rich source of these nutrients (Muriuki et al., 2001). However, while the nutrient concentration may be a good indicator of the potential of an organic resource to supply nutrients to crops, plant growth is usually the best way of determining the effectiveness of an organic material as a nutrient source. The rate and method of application are important factors that determine the effectiveness of a nutrient source. The two also impact on profitability, which usually determines whether or not a technology will be adopted.

The two common methods of application of nutrients are spot placement (SP) and broadcast application (BR). SP of pymarc may concentrate the nutrients close to the plant roots and therefore make it more effective than BR. However, given the powdery nature of pymarc, SP may also reduce the surface area of the pymarc in contact with the soil thus slowing down microbial degradation and hence nutrient release. While BR increases contact between the pymarc and the soil thus increasing microbial degradation of the organic material, the thin spreading may result in a dilution effect whereby the effective amounts of nutrients available to plants are greatly reduced. The agronomic effectiveness of the two application methods notwithstanding, SP is usually more labor intensive than BR and the choice of the application method should therefore be based on economic considerations (Opala et al., 2007). Unfortunately, economic analysis is rare in agronomic studies thus limiting the farmers' ability to make informed choices.

High rates of nutrient application usually lead to high yields. Most studies have however often used unrealistically high organic input rates, such as 10 t ha⁻¹, that are unlikely to be used by farmers. There is therefore merit in testing the effectiveness of organic inputs at rates that are likely to be used by farmers. The objectives of this study were to determine the (i) effects of rate and method of pymarc application i.e. spot-applied or broadcast on the yield of maize (ii) the economic returns of using pymarc on maize.

Materials and Methods

Experimental site and treatments

The experiment was conducted at three sites i.e. Egerton (00°22'S, 35°56'E), Molo (00°14'S, 35°43'E) and Kosirai (00°20'N, 35°11'E) in the Kenyan Rift valley. Egerton and Molo have a mean annual rainfall of 1200 mm while Kosirai receives 1400 mm in two rainy seasons. The soils were mollic Phaeozems at Egerton, humic Cambisols at Molo and rhodic Ferralsols at Kosirai (FAO/UNESCO, 1988). Some selected soil properties at the sites are presented in Table 1. All the three sites had severe P limitations.

Table 1: Some initial physical and chemical properties of the soils used in the study

Soil Property	Sampling site		
	Egerton	Molo	Kosirai
Soil pH H ₂ O	5.8	5.4	4.60
% Total Nitrogen	0.25	0.28	0.12
% Carbon	2.46	2.16	1.32
C:N ratio	9.84	7.71	11.0
Olsen P (mg kg ⁻¹)	1.20	1.70	1.00
K (Cmol (+) Kg ⁻¹ soil)	0.38	0.42	1.23
Ca (Cmol (+) Kg ⁻¹ soil)	11.21	6.11	3.42
Mg (Cmol (+) Kg ⁻¹ soil)	8.01	3.01	2.01
CEC (Cmol (+) Kg ⁻¹ soi)	28.8	24.2	14.3
Texture			
% Sand	35	38	56
% Silt	43	42	22
% Clay	22	20	22

Pymarc was used as a source of P in this study. It was analyzed for chemical quality parameters using standard procedures (ICRAF, 1995) and some of its chemical characteristics are shown in Table 2.

Table 2: Pymarc characteristics

parameter	% N	% C	C: N	% P	% C: C:	% M _g	% K	% Lign	% Polyphenol
Value	2.2	2.6	11.7	0.2	0.4	0.3	3.8	10.5	1.8

The experiment was conducted for two consecutive seasons in the long rains of 2003 and 2004. The imposed experimental treatments were

- (1) Control with no pymarc input
- (2) Pymarc (4 t ha⁻¹) SP
- (3) Pymarc (4 t ha⁻¹) BR
- (4) Pymarc (8 t ha⁻¹) SP
- (5) Pymarc (8 t ha⁻¹) BR

Pymarc at 4 t ha⁻¹ and 8 t ha⁻¹ provided 13 and 26 kg of P ha⁻¹ respectively.

Crop establishment and management

A randomized complete block design with four replications was used. In the BR method, pymarc was evenly spread within the appropriate experimental plots and incorporated to a depth of 0-15 cm at the time of planting while in the SP method pymarc was applied in the planting hole. No N inputs were applied because the pymarc applied supplied more than the recommended N rate for the area i.e. 102 and 204 kg N ha⁻¹ for 4 and 8 t ha⁻¹ pymarc respectively. Hybrid maize (H 614 variety) was grown in both seasons. The maize was planted at a spacing of 0.75 m between rows and 0.25 m within the rows to give a plant population of 53000 plants ha⁻¹. Other recommended agronomic practices for the area were used to manage the crop.

Data collection and analyses

Composite soil samples were collected from the inter-rows of all BR treatments and the control at 9 weeks after planting in both seasons. Sampling was not done for the SP treatments because the pymarc was within the planting holes and attempts to sample the holes would damage the maize roots. All the soil samples were analyzed for soil pH and available Olsen P. Soil pH was determined using 1: 2.5 soil: water ratio. Determination of Olsen P consisted of extracting soil P with 0.5 M NaHCO₃ (pH 8.5) using a soil extractant ratio of 1:20. The samples were shaken on a reciprocal shaker for 30 minutes, filtered and the P in the filtrate determined colorimetrically (ICRAF, 1995).

Each maize crop was harvested at maturity by opening the maize cobs, removing the husks, and hand shelling. Maize grain yields were expressed at 13% moisture content. Costs and benefits of each treatment were compared using partial budgeting, which included only costs and benefits that varied from the control. The values used are presented in Table 3. Amounts of labor for application pymarc were determined through observation at planting time. Discount rate of capital was estimated at 10% per season and applied only to cash costs. This discount rate reflects a farmer's preference to receive benefits as early as possible and postpone costs (Jama et al., 1997).

Table 3: Values used for cost benefit analysis

Parameter	Value (KSh)		
	Egerton	Molo	Kosirai
Labour cost for pymarc application (ha ⁻¹)			
BR	380	380	380
SP	1140	1140	1140
Price of pymarc (Kg ⁻¹)	6	6	7
Price of maize (Kg ⁻¹)	18	18	15

BR and SP are the broadcast and spot methods of pymarc application respectively

The grain and soil data from each season were subjected to analysis of variance (ANOVA) using GENSTAT statistical package. The standard error of the differences (Sed) was used to compare the treatment means at $P < 0.05$.

Results

Soil pH

In the two seasons, soil pH generally increased with increasing rate of pymarc application at all the sites (Table 4). The soil pH of pymarc applied at 8 t ha⁻¹ was significantly ($P < 0.05$) higher than that of 4 t ha⁻¹. The increase in soil pH over the respective controls at 4 t ha⁻¹ of pymarc application was however not significant at all the sites. The highest increase in pH over the control (0.64 units) was obtained with application of pymarc at 8 t ha⁻¹ at Kosirai in 2003 while the least increase (0.03 units) was recorded with application of pymarc at 4 t ha⁻¹ at Molo in 2004. The increase in soil pH above the respective controls in the first season was generally higher than in the second season.

Table 4: Effect of pymarc application on soil pH

Treatment	Egerton 2003	Egerton 2004	Molo 2003	Molo 2004	Kosirai 2003	Kosirai 2004
Control	5.26	5.18	5.41	5.39	4.51	4.56
Pymarc (4 t ha ⁻¹) BR	5.32	5.36	5.46	5.42	4.64	4.70
Pymarc (8 t ha ⁻¹) BR	5.71	5.62	5.89	5.76	5.15	4.98
Sed	0.07	0.11	0.07	0.10	0.09	0.13

BR is the broadcast method of pymarc application.

Olsen extractable phosphorus

The Olsen extractable soil P results are presented in Table 5. At 4 t ha⁻¹, pymarc increased the Olsen P above the control at Molo and Egerton only the second but not first season. At Kosirai the effect was opposite, whereby pymarc at the lower rate significantly increased the Olsen P in the first but not second season. The Olsen extractable soil P generally increased with increasing rate of pymarc application with the 8 t ha⁻¹ application having significantly higher values than the 4 t ha⁻¹ application at all sampling times other than at Kosirai in the 2003 season. Averaged across all the treatments, the Olsen P levels followed the trend Egerton > Molo > Kosirai in both seasons.

Table 5: Effect of pymarc on available Olsen phosphorus (mg Kg⁻¹)

Treatment	Egerton 2003	Egerton 2004	Molo 2003	Molo 2004	Kosirai 2003	Kosirai 2004
Control	5.70	5.67	5.42	5.20	4.52	4.33
Pymarc (4 t ha ⁻¹) BR	6.51	7.2	6.11	6.14	4.91	5.06
Pymarc (8 t ha ⁻¹) BR	8.58	9.7	7.49	7.56	6.21	6.40
Sed	0.58	0.45	0.15	0.19	0.70	0.47

BR is the broadcast method of pymarc application.

Maize grain yield

There was no significant interaction ($P > 0.05$) between the method and rate of pymarc application and the main effects are therefore presented in Table 6. In 2003, Pymarc (4 t ha⁻¹) BR did not significantly increase the maize grain yield above the respective controls at any of the three sites while Pymarc (4 t ha⁻¹) SP significantly increased grain yield at both Egerton and Kosirai but not Molo. In 2004, all the pymarc treatments applied at 4 t ha⁻¹, other than Pymarc (4 t ha⁻¹) SP at Kosirai, significantly increased grain yield compared to the control. Pymarc applied at 8 t ha⁻¹ significantly increased yields above the control regardless of the method of application at all sites in both seasons. The grain yields were not affected by the method of pymarc application. The highest cumulative grain yield for the two seasons (10.4 t ha⁻¹) were obtained with Pymarc (8 t ha⁻¹) BR at Egerton while the least (5.4 t ha⁻¹) was by the control treatment at Molo.

Table 6: Effect of pymarc application methods and rate on grain yields (t ha⁻¹)

Treatment	Egerton 2003	Egerton 2004	Molo 2003	Molo 2004	Kosirai 2003	Kosirai 2004
Control	3.2	2.8	2.9	2.5	2.9	2.6
Pymarc (4 t ha ⁻¹) BR	4.0	3.8	3.4	3.6	3.1	3.4
Pymarc (4 t ha ⁻¹) SP	4.3	4.1	3.0	3.4	3.5	3.1
Pymarc (8 t ha ⁻¹) BR	5.4	5.0	4.6	4.3	4.7	4.6
Pymarc (8 t ha ⁻¹) SP	5.1	5.2	4.8	4.0	4.6	4.3
Sed	0.50	0.41	0.27	0.42	0.25	0.33

BR and SP are the broadcast and spot methods of pymarc application respectively

Economic analyses

Net negative financial benefits obtained with application of pymarc at both rates irrespective of the method of application (Table 7). The largest financial loss was Ksh 25,854 obtained with Pymarc (4 t ha⁻¹) SP in 2003 at Molo while the least was Ksh 1218 obtained with Pymarc (8 t ha⁻¹) BR in 2004 at Kosirai. The added costs for the SP treatments were higher than those of BR due to the higher labour cost of SP of pymarc.

Table 7: Effect of pymarc rate and method of application on net financial benefits (KSh)

Treatment	Egerton 20C	Egerton 200	Molo 2003	Molo 2004	Kosirai 20	Kosirai 2004
Control	---	---	---	---	---	---
Pymarc (4 t ha ⁻¹) BR	-12418	-8818	-17818	-7018	-23218	-19218
Pymarc (4 t ha ⁻¹) SP	-7854	-4254	-25854	-11454	-23054	-24554
Pymarc (8 t ha ⁻¹) BR	-13618	-13618	-22618	-20818	-4218	-1218
Pymarc (8 t ha ⁻¹) SP	-19854	-10854	-19854	-27054	-6554	-6554

Discussion

The observed increase in soil pH when the soil was amended with pymarc is consistent with findings by other workers (e.g. Haynes and Mokolobate, 2001; Tang et al., 2008; Whalen et al., 2000) who reported similar results when organic materials such as animal manures and green manures were incorporated into soils. Paul et al. (2001) attributed the increase in pH to initial mineralization of the organic materials which releases basic cations. The pymarc had high levels of Ca, Mg and K (Table 2) and these are likely to have been responsible for the increased soil pH, especially at the higher application rate of 8 t ha⁻¹, when pymarc was mineralized.

The initial soil Olsen P levels at all the sites were lower than 10 mg kg⁻¹ which is generally considered to be adequate for maize growth (Okalebo et al., 1987). Although application of pymarc significantly increased available soil P, especially at 8 t ha⁻¹, the critical level of Olsen P was not exceeded in any of the seasons, indicating that the crop would have benefited from a higher application rate. The increase in soil P is attributed to rapid mineralization of the pymarc. The pymarc was of high quality, with low lignin and polyphenol contents, and a P concentration of 0.28% (Table 2) which is above the critical level of 0.25% suggested by Palm et al. (2001) as the threshold below which net immobilization of P would occur.

The increase in maize yield with increasing rate of pymarc application is likely due to the higher available soil P at the higher rate. The higher pH at the highest pymarc rate could also have reduced toxic metals such as aluminum, therefore providing a more conducive environment for crop growth (Lungu, 1993). The lack of significant differences in grain yields between BR and SP methods of pymarc application is consistent with similar findings by Okalebo et al. (1990) who used mineral P fertilizers. However, studies with organic materials by Nhamo et al. (2004) suggest that SP of organic materials is likely to result in better crop yields than BR.

While the agronomic and soil data indicated that pymarc was a good source of P for maize, the net financial benefits were negative in all seasons indicating that it is not economically attractive to use pymarc on maize. Although the cost of pymarc, (about KSh 6 kg⁻¹) is low compared to inorganic fertilizers such as Diammonium (DAP) which costs 80 KSh kg⁻¹, its low content of P makes it more expensive than DAP because much larger amounts have to be applied to provide the same amount as P as DAP. For example the 13 kg of P provided by pymarc applied at 4 t ha⁻¹ would, on a P basis, cost 215 Ksh at Kosirai kg⁻¹ while the P from DAP would cost only 28 KSh kg⁻¹. Furthermore, the very large amount of pymarc that has to be applied increases the labour costs thus further decreasing its profitability.

Conclusion

The study revealed that pymarc can increase both the soil pH and available P but the high rates required preclude its economical use as an alternative to lime and inorganic P fertilizers. Both the BR and SP are

equally suitable as methods of pymar application. While pymar was agronomically effective as a source of P for maize, the negative financial benefits associated with its use casts doubts on its economic viability. For pymar to give positive financial benefits, the increase in yields above the control (farmers practice) as a result of pymar application must be very large. This was not the case in this study where the control treatments gave yields of $> 2.5 \text{ t ha}^{-1}$, which are much higher than the often reported yields of $< 1 \text{ t ha}^{-1}$ on most smallholder farms. We conclude that pymar as a soil fertility management intervention for maize is unlikely to be adopted by farmers in the study areas because it is economically unattractive. There may be merit, however, in further testing pymar at sites where maize yields are known to be extremely low or on high value crops such as vegetables.

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DEFECTS IN STRUCTURES IN NAIROBI CITY: CAUSES AND MITIGATIVE STRATEGIES.**Caroline Onyancha^{1*}, Eliud Mathu², Sixtas Mwea³ and Wilson Ngecu²**¹ Civil and Structural Engineering Department, Masinde Muliro University² Department of Geology, University of Nairobi, P.O. Box 30197, Nairobi Kenya³ Department of Civil Engineering and Construction, University of Nairobi**ABSTRACT**

This research was carried out to determine the causes of defects in structures in Nairobi City and to propose mitigative strategies. The study made use of results of: geotechnical tests, failure investigations, excavation for foundation placement, excavation observation as well as the collective experience of consulting engineers and contactors in the city. The results indicate that the subsoil includes highly plastic soils, collapsible soils and soft clays of variable thicknesses, red soils containing cavities, weathered and fracture zones of variable profile, expansive weathered tuffs and deep organic fills. The research concluded that each of these soil types has caused distress of varying degree, and as such, an understanding of the critical ground performance is fundamental in a successful construction program.

Key Words: Ground profile, structural failure, Construction methods, Remedial/ precautionary measures.

INTRODUCTION

Nairobi city is underlain by subsoils of variable characteristics (Figure 1). There have been reports of defects in structures such as wall rotation; separation around garage door, windows and/or walls; cracked bricks; broken and/or cracked foundation; displaced moldings; misaligned doors and windows; cracked sheetrock and cracks in floor.

METHODS OF STUDY AND ANALYSIS

To determine the causes of defects in structures in Nairobi city, geotechnical test results and reports for more than two hundred sites supporting lowrise, mediumrise and highrise structures were collected. These results had been obtained from trial pits by observation, field tests through standard penetration and cone penetration tests, laboratory tests on cores and bag samples. The tests included: particle size analysis, free swell, Atterberg limits, shrinkage limit, bulk density, oedometer, point load and unconfined compressive strength. Reports for foundation failure investigation and proposed remedial measures were collected. These results were for those structures that owners had sought advice from either the Ministry of Roads and Public Works or consulting engineers when they observed signs of distress. The signs of distress include wall rotation, separation around garage door, windows and/or walls, cracked bricks, broken and/or cracked foundation, displaced moldings, misaligned doors and windows, cracked sheetrock and cracks in floor. To determine the methods of construction that have worked in the areas prone to structural defects, consulting engineers and contractors were interviewed. The information obtained from each interview included: variable subsoil, soft spots, sensitive soils, groundwater flow problems and, remedial or precautionary measures taken to mitigate distress in structures. Since it is not possible to present such a large amount of data in this paper, a method of analysis was devised. This method involved study of information of every single site and comparison with results from other sites within the city. This enabled conclusions to be drawn on the causes of distress in structures and classic examples are discussed hereunder.

RESEARCH FINDINGS

The results of this research are discussed below in form of case histories. On each case, the following issues are pointed out: main scenario, geotechnical conditions, main design criteria, main construction issues and main advantages.

Variable stresses and inhomogeneous subsoil

Investigation for Westlands Motors by Ministry of Roads and Public Works (MR&PW) in 1975 for a site along Uhuru Highway encountered variable subsoil and concluded that a subsurface gully, possibly an old river course may be running through the site discharging its water to Nairobi river. Dark grey to brown silty clays of high plasticity were recovered from the test holes and groundwater table was encountered at the lower elevation. The recommendations for this site were: construction of French drains along the perimeter of the site to a depth of 2.5 m to keep down the groundwater table, all organic silt be removed from site and provision of joints in pavement slab to prevent damage caused by uneven heave. These recommendations were in accordance with the research findings by Burland et al (1972).

Collapsible and expansive soils

On carrying out geotechnical investigation for Kyuna Estate in 1973, MR&PW concluded that the red soil at the site can be classified as sandy silty clay of high plasticity. This indicates that the soil is liable to settlement when loaded. Settlement tests also indicated that the soil could collapse when flooded, further aggravating the settlement problem. To prevent cracking of houses due to uneven settlement several recommendations were made thus; use of T-beam foundation on red soil or cantilever foundation on the underlying weathered tuff, allowable bearing pressures of 150 kN/m² and good surface drainage. Similar soil conditions were encountered at the Kangemi United Club and National Soils Laboratories in Kangemi. In addition, settlement monitoring after construction was recommended for these two sites. Brown highly plastic soils were encountered at Karen Police Station and continuous ring beam foundation and use of polythene sheeting to prevent soil moisture were recommended.

Owner of house on Plot 3734/R/113 at Bernhard Estate in 1973 had requested for investigation into the cause of cracking of the house. On investigation, it was observed that the outer walls of the house were in good condition and did not show any cracks, while the inner walls had cracks. Based on findings by Burland and Wroth (1972), it was concluded that the defects were of local nature and had no connection with the soil conditions. Decomposed yellow tuff was found to be expansive at National Housing Corporation site in Nairobi City Centre. The ground strata includes 1-2 m layer of top soil and black cotton soil followed by a decomposed yellow tuff up to a depth of approximately 4 m below which is a pumiceous grey tuff. It was recommended that: the foundation be placed on the grey tuff, the yellow weathered tuff be avoided, a drainage system be used instead of a watertight basement structure and underpinning of the neighbouring building because of the new deeper foundation. Without these measures cracks could occur on the structure and neighbouring building. In 1974, the Greek Ambassador requested MR&PW to carry out an investigation into the cause serious cracking of the main house and guest house at the residence at Muthaiga estate. The subsoil consists of red sandy clayey silt of a very low density. The oedometer test results indicated that the soil is very sensitive to settlements and particularly shows high additional settlement when soaked with water while subjected to load. It was concluded that the cracking was caused by: Uneven settlement of different parts of the buildings, The outer walls were subject to additional settlements due to flooding of the foundation ground caused by very shallow foundations for the guest house and no apron around the buildings thus the water sprayed on the flower beds and rain water easily entered under the foundations; absence of reinforced beam or strip to give the necessary stiffness to take up uneven settlements. One trial hole revealed that there was no concrete footing and reinforcement could be absent. The following were recommended: put apron around the houses, avoid flower beds, use pots, check and repair any leakages and lead all water away.

In June 1975, Nairobi Mbagathi Central Training School requested for an investigation into the cause of cracks on one of the buildings. Cracks were found at either end of the building. Four trial holes were excavated to expose the foundations. Tests on the samples showed that the soil is silty clay with high plasticity overlying a murram layer. It was noted that aprons had been constructed on either side along the building but on either end of wall rainwater could easily enter under the building thus influencing the soil under the foundations. With a roof overhang and a properly constructed apron at the ends of the building, future damage was expected to be minimized. Future foundations on this soil were recommended to be stiff ring beam. On 12th May 1970, Mr Limsdaine requested failure investigation for his house along Langata Road. The house was inspected and samples were obtained from trial holes. Results of the laboratory tests

show the samples obtained at 1m and 2 m depth are basically the same type of clayey soil although they differ slightly in colour and are of high shrinkage characteristics on an otherwise well-drained site. The nature of the cracks was such that they may have resulted from differential settlement of the building. The pattern was, however, somewhat more complex than that usually associated with red soil (Terzaghi, 1936), indicating that the problem could be attributable, in part, to shrinkage occurring during dry periods. On further inquiry the client informed the engineers that the house had previously been underpinned during which the foundation had been deepened, so the cracking could also be attributed to settlement of the new foundations due to underpinning. The shrinkage limit tests carried out on two samples showed that the shrinkage limit for this soil is around 26%. This was the same moisture content at the time of inspection. It was concluded that no further shrinkage could occur and that the cracks were at their worst as pointed out by Burland and Wroth (1968). It was recommended that the cracks be repaired as no further settlement was likely to occur.

In July 1970, there was collapse of a wall at Manchester Outfitters in Industrial Area injuring two watchmen. Investigation revealed the following: the wall was founded on concrete strip footing at 0.25 m depth, the foundation was resting on fill, and a 0.5 m trench had been excavated adjacent to the wall for construction of a building. It was concluded that with the weight of the wall placed close to the excavated face and eccentric on the foundation strip, foundation stresses became too large and the soil underneath started yielding. This caused the wall tilt which further increased the foundation stresses and foundation failure took place. Foundation failure was promoted by the faulty foundation. The foundation should not have been placed on fill. Geotechnical investigation for construction of Ngei Estate in Langata was carried out in 1972. Trial holes were dug at the site and plate loading tests were carried out at the base of the excavation. The subsoil that consists of murrum failed under instant static load of 60-80 kN/m². A sample of the murrum was collected and tested in a wet condition. After 24 hours of soaking, the material crumbled at very low unconfined compressive stress (8-12 kN/m²). It was recommended that: foundation be placed below the murrum, a stiff concrete ring beam be used, hardcore and polythene sheeting be provided under floor slab and apron be provided around the structure. By 1979, several house owners such as Hse No. 53 and 135 (figure 2) were complaining of cracks on floors, walls and block work while a number of the houses were in good condition. It was observed that the above recommendations had been disregarded in the distressed houses. Lambe and Whitman (1979) carried out research on Massachusetts Institute of Technology (MIT) and concluded that settlements in excess of approximately 125 mm will cause brick and masonry walls in buildings on MIT campus to crack. So, the distressed houses in Ngei Estate may have undergone differential settlements greater than 125 mm.

Construction on site with thin competent substrata by Reconsult Engineers

Trial pits were done to investigate the site for construction of a three storey residential cum commercial house at Lavington. The soil profile includes 1.5 m thick layer of black cotton soil underlain by gravel and groundwater table 1 m, so the structure was designed for 1.5 m depth. Experience from sites within the vicinity indicated that an underground river exists but this was not encountered at this particular site. To eliminate the water from the excavation, trenching was done and the water was pumped out. The other problem that was encountered at the site was existence of old pits. Before foundation placement, the consultant found that the excavation bottom was too weak and requested the contractor to excavate beyond the foundation base in order determine the reason behind the weakening of soil. The exercise revealed that the gravel layer that had been designed for foundation support was very thin (600 mm) and underlain by weak decomposed rock that extended to deeper levels. This necessitated use of in situ concrete piles taken to 6.0 m below ground surface. No distress has been observed since the structure was completed. These conditions were not noted in the adjoining plots because the foundations are shallower. The structures could be liable to settlement. There is need for carrying out site investigation before construction as this reduces the risk of failure and the consequent losses (Goldsworthy et al 2004).

Construction on site with deep soft plastic soils at Adams Arcade by Otieno Odongo & Partners.

The project involved construction of three storey block of flats. Trial pits dug at the site indicated that weak plastic subsoil extends up to 7 m. With such weak subsoils, if the structure was supported on shallow foundations it could undergo settlement beyond tolerable limits. Pile foundations could also not be used

because they could have made such a kind of structure very expensive. The site was excavated up to 2.5 m depth and the excavated material was wasted. The excavation was filled with suitable material compacted in thin layers of 300 mm. the foundations were set at 1.2 m below natural ground surface. The ground floor was suspended well above the ground surface; all the loads were supported on ground beam. 2 m allowance was left from the perimeter wall incase a problem occurred and necessitated remedial measures. That was 1990s and no problem has been reported to date and that means the method worked.

Problem of underground erosion

Howard Humphreys East Africa was requested to carry out investigation into the causes of severe cracks in one of the buildings at the British High Commission Residence in Lavington and propose remedial measures. The investigation revealed that the distress in the structure was due to groundwater flow and proposed that the affected structure be demolished because the prevailing conditions at the site would not allow for remediation. Goro Consultants also encountered similar conditions during construction of Nginyo Towers along Koinange Street in the City Centre. The project consisted of 10 storey commercial building within a built up area in the city centre. Construction of many buildings within the vicinity had encountered underground rivers flowing towards Nairobi River. Construction of a structure with a basement meant that the foundation would go beyond the adjacent shallow foundations and expose the footings so a system of shoring the structure had to be incorporated in the design. Geotechnical site investigation carried out at the site established that the subsoil profile across the site is variable and includes a layer of highly fractured pervious rock with a lot of groundwater flow. The bearing capacity tests indicated that it was not possible to adopt any customary foundation. To build on highly fractured and pervious materials of variable profile, high level foundation network was used. Pads were tied together (strapped), forming some semblance of a raft. To control the groundwater flow into the excavation, a system of containerising water was developed. This was to allow the basement slab to be cast of pervious rock and the water was allowed to pass below the slab as it flowed in its natural course. The slab was heavily water proofed. Since the existing foundations were almost at the same level with new foundation, they were shored by 45° props and the props were removed as the work progressed. No damage to the existing structure was reported.

Underpinning of residential houses at Garden and Karen Estates by J.M. Kariuki Consultants

The Garden Estate structure was a double storey residential house that had undergone distress. There were a lot of cracks on the floor and partition walls. Trial pits excavated next to the foundation indicated that the subsoil at the site consist of 2.4 m layer of black cotton soil that is underlain by a firm layer. The structure was on strip footings supported on 0.9 m layer of expansive clay at on 1.5 m depth. During construction, the 1.5 m of black cotton soil was excavated in bulk and replaced with hardcore and concrete. The contactors probably thought that the expansive soil beyond 1.5 m would not be detrimental to the structure. Cracking started slowly and the size of the cracks increased with time, the floor was extensively damaged. To rectify the problem, all the original footings were demolished and the new footings were founded at 2.4 m just on top of the firm layer of soil. The foundation wall, ground floor slab and partition walls were all replaced. The upper floor was retrofitted and repainted. The underpinning was done in phases because the structure had to be shored as the underpinning progressed. In all, the cost of underpinning and retrofitting was just slightly lower than the cost of a new house. The house in question at Karen was extensively cracked on one side. Foundation failure investigation showed that the columns were supported on pad foundation taken to firm soil while the rest of the structure was supported on ground beams. It also showed that three columns that had settled were founded on murrum of lower bearing capacity and had therefore undergone differential settlement. Underpinning of the structure was done by making strip footings below the structure. The load on the beams was distributed to the strip footings to relieve the columns. The method worked well and the retrofitting that was done on the structure was sufficient to restore the aesthetic value of the house.

Remediation of a residential house in Lavington Estate by Otieno Odongo & Partners

The house had undergone severe cracking that were very wide (rat could almost pass). The pattern of cracking was such that cracks were opening downwards. The client requested the consulting firm to carry out failure investigation. Trial pits were dug adjacent to the exterior walls and the foundation failure

investigation was as per the guidelines provided by Kany (1977). The investigation determined that the structure was supported on fill that may have been a dumpsite and the fill was settling under the weight of the structure. The vertical cracks indicated that the the foundation soil was settling in a sagging mode (Kerisel, 1987). To rectify the problem, underpinning was done in phases. Mass concrete pads were prepared below the 1.2m deep foundation. The size of the pads was 1 m³. This was meant to distribute the loads to deeper levels. The interior walls were also underpinned and this involved drilling through the ground floor slab. After foundation repair, minor patching and repainting was done on the walls. The cost was minimal compared with rebuilding costs.

Pile underpinning of Asili Cooperative House on Moi Avenue by Vex Engineers

Prior to this project, Asili Cooperative had a two storey building fronting the road with parking space behind. The foundation of the existing structure rested at 1.5 m depth, and was supported on pad footings. The new plan was to have two additional floors to the existing structure and to convert the parking space to office space. Because of the conversion of parking space to office space there was need to have a basement for parking. A geotechnical site investigation was carried to establish the type of strata at the site and for bearing capacity calculation. Rotary drilling with core recovery was done to a depth of 25 m. The core recovered indicated that the strata at the site were 1 m layer of black cotton soil, followed by weathered rock with a lot of groundwater flow. Investigation pits were excavated to expose the existing footings to determine whether they were capable of carrying the additional load. The original plan indicated that they were designed to carry two additional floors. During the construction period the groundwater was pumped to a tank for other uses. This was done throughout the construction period because the flow at the site was very high. Because the new building was to be 10 storeys, if supported on pad footings the pads could almost touch so the structure had to be designed for strip footings. The new structure was to have two basements so the depth was to be 7.0 m below street level. This meant that excavation had to be done beyond existing foundations so a system of underpinning had to be included in the design. An adequate underpinning system had to be approved before the structural designs were accepted. During construction of additional floors the structure was to be occupied so noise and vibration were intolerable. There was also a lot of groundwater flow into the excavation and this could undermine the existing buildings so a system of controlling groundwater flow into the excavation had to be designed. Since the column footings could have been undermined if exposed during excavation, a support system consisting of piles cantilevered to the base of the footings was presented as an alternative to direct underpinning. The piles had to be driven 1 m away from the footings at every column position. The steel piles were machine driven to 10 m below the existing foundations. Pile caps were provided on the piles. To transfer the loads from the existing columns to the piles, horizontal cantilever beams were anchored on the piles and extended to the base of the existing footings. This method of underpinning was found to be sufficient and no distress has been observed more several years after completion of the structure.

Goal Kenya – South C project - House constructed on deep organic fill? By Xenocon Consulting Engineers

The structure was an institutional house for destitute children. The house was built on uncompacted fill on a sloping area. To make the ground level, a thick layer of hardcore was placed and then the foundation slab and ground floor were done. After some time, cracks appeared on the floor walls and beams. The house was sinking! The engineers were asked to investigate the cause of the problem and provide a solution. The investigation revealed that 1 m layer of hardcore had been placed on sloping uncompacted fill, the hardcore was uncompacted and it was also not retained on the lower elevation side. This caused movement of the material outwards from under the structure. Due to loss of support, the house was bulging out and, inevitably, distress occurred. To rectify the problem, pad footings were introduced at intervals of 3 m and at the same level with hardcore to retain it; beams were also provided to tie the columns together. The hard core was forced inside and a nice finish was created and it stabilized the system. . The foundation was considered to act as a raft. The structure may be liable to settlement due to secondary consolidation. If this occurs, the structure will act as a rigid body and no distress will occur. In agreement, Fenton et al (2003) concluded that settlement is not usually detrimental provided the structure settles uniformly or is robust enough to accommodate differential settlement.

Construction on bad soil conditions along Brookside Drive (Eng. J.P Muraguri)

The project consisted construction of a house in a valley covered by 2 m deep black cotton soil, the site looked like it may have been a spring in the past. To prevent future expansion of the black cotton soil the soil was inundated for several days to attain the maximum moisture content. The pad foundations for supporting columns were taken below the black cotton soil to rest on weathered rock. The contractor protected the sides of excavation with timber shoring to avoid failure. 4 inch layer of red soil was placed on the soaked soil to provide a working platform because the clay was too soft. The red soil was covered with polythene to maintain the moisture in the underlying soil. Spacer blocks were placed on the polythene and the ground floor slab was cast. Ground beams were provided on the sides to prevent moisture migration to the sides.

Remedial measures on a residential House at Lavington (Engineer Kering)

The site is covered by very deep soft soils so the foundation had to be taken to more than 6 m below ground level. After some time, the owner decided to make an extension that was sharing a wall with the main house. The foundation of the extension was no deep like the foundation of the main house. The extension settled and pulled the main house with it. This induced cracks mainly on the walls. The foundation of the extension needed to be extended to the level adopted for the main house. The structures could be repaired.

Distress due to non- uniform loading- Residential house at Marurui (Behind Safari Park Hotel). (Courtesy of Mwaka Consultants)

The structure developed cracks, windows and doors could not open. The owner of the structure requested the engineers to investigate the cause of distress. Trial pits were excavated to expose the substructure up to foundation level. The investigation revealed that the structure was supported on very poor soils. The contractor had used pad foundations supported on rock at 6 m below ground level. On one side of the structure, the columns were separated by 6 m span whereas on the other sides of the building the span was between 3-4 m. A ground beam was provided to carry the structural loads. Top marking across the cracks was done to investigate whether the cracks were opening. It was observed that the cracks were not increasing in size. Due to the self weight of the ground beam and the loads from first floor slab, the 6 m long beam started sagging, cracks developed and the ground heaved. The structural design details indicated that all the columns were designed for 200 kN load. The beam was therefore loaded with 40 kN-m moment that made it to sag causing cracks. To control the sagging, another column was introduced in between the columns to reduce the actual moment. The ground beam was shored to allow for excavation for the column up to firm ground. The sides of the excavation were strutted as the base was prepared. The column reinforcement was attached to the beam, bent and welded. The ground floor was removed and set again. The structure was observed for six months and no problem was noted. Recent studies by Richardson (2005) have confirmed that when remedial measures are carried out at the end of the settling period, the problem will not recur, unless the status quo alters.

Construction of Loita House (Koinange Street), on deep variable subsoil by Gath Consulting Engineers

Before construction of the 24 storey structure, geotechnical investigation by means of boreholes was done to establish the depth to firm ground. The deepest borehole at the site was taken to 75 m and is the deepest geotechnical borehole in the city. The soil profile revealed the site is underlain by soft subsoil; truly hard rock was encountered at 75 m. It also indicated that the groundwater table was high and the weak subsoil at the site was liable to movement. Therefore the design of the structure had to include a method of underpinning the adjacent structures to mitigate distress. Foundations for the Loita house were designed as a raft taken 12 m below street level to accommodate four basements. To underpin the adjacent structures, horizontal holes were drilled beneath the base of the foundations at an interval of 1 m and reinforcing steel was inserted and the holes were jet grouted using low mobility grout to avoid swelling of the ground upward especially at the base of the foundation. The process was repeated as the as the excavation progressed so as to control ground movement. The grouted material was considered to have formed a reinforcement mesh. This process enhanced the performance of a 12 deep excavation ultimately supported

by a concrete diaphragm wall. The road was shored and the loose materials were grouted to allow ease of transportation and haulage from the site. Enormous amounts of groundwater were encountered during excavation. Waterproofing was done after a skin wall of 100 mm was constructed. It was feared that the big river that flows near the site as reported from nearby sites but it was not encountered. No distress was reported in the adjacent structures during construction or afterwards. Thus the structures were effectively underpinned.

CONCLUSIONS AND RECOMMENDATIONS

Bulging floors, cracked walls, and doors and windows that won't close are all signs of foundation distress. The problem occurs when only part of the foundation heaves or settles, causing cracks and other damage. This differential movement is largely caused by differences in soil moisture. Loss or gain of soil moisture can cause serious shrinkage or swelling. If the frame of a house does not begin to distort until after three or more years of satisfactory performance, it is doubtful that the distortion is caused by full-depth foundation settlement, which is always evidenced by matching cracks. Cracks occur at each side of a portion of the foundation wall that is undergoing downward movement caused by soil bearing failure. Settlement cracks are nearly always vertical, and they should not be confused with cracks that occur when a wall is subjected to lateral movement from soil pressure. Foundation settlement and movement requiring foundation repair can be caused by building on expansive clay, compressible or improperly compacted fill soils, or improper maintenance around foundations. Whatever the cause, settlement can destroy the value of structures and even render them unsafe. On a very important job, it is usually worthwhile to make a very detailed study of the subsoil to, locate stronger and weaker zones and to investigate comprehensively the relation between total settlement and differential settlement and to state the design criterion in terms of allowable total settlements.

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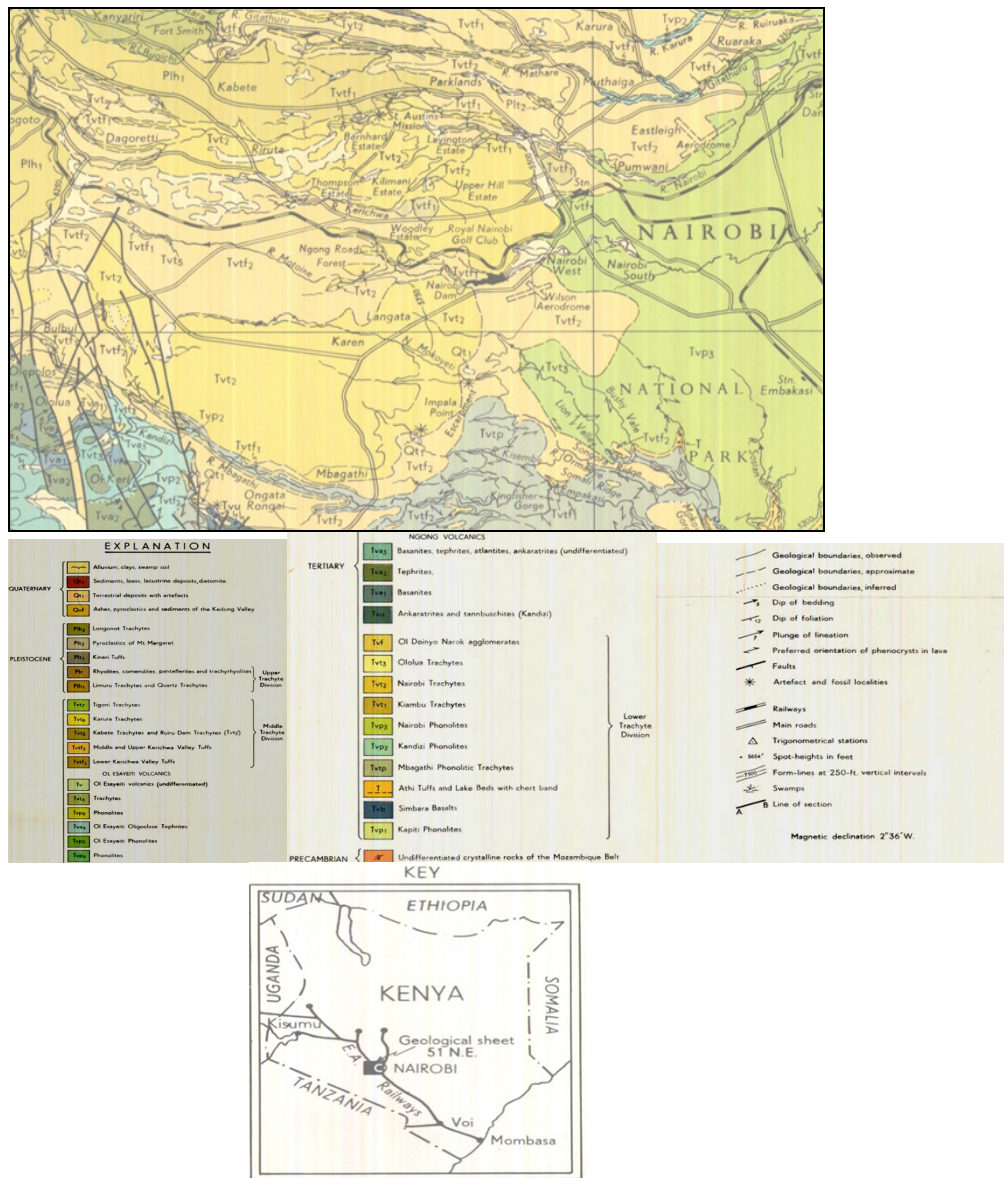


Figure 1: GEOLOGICAL MAP OF CITY OF NAIROBI AND SUBURBS (after Saggerson 1964, not drawn to scale)



Figure 2: Distress in Ngei Houses (House No. 135 and House No. 53)

ASSESSMENT OF CLIMATE CHANGE THREATS TO FRESHWATER RESOURCES IN KENYA AND MANAGEMENT OPTIONS

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ABSTRACT

Fresh water resources in Kenya have been susceptible to threats posed by climate change initiated by human activities and natural causes at various levels and forms. Human activities that have contributed significantly to climate change include industrialization leading to increased emission of greenhouse gases hence global warming, deforestation due to population explosion, and unscrupulous use of water resources leading to recession and depletion of catchments areas. The paper reviews the major impacts of climate change on freshwater resources. Environmental threats resulting from human activities are discussed. The impact of floods and drought on fresh water resources in Kenya due to extreme fluctuation in precipitation on surface water resources is examined. Finally, the paper discusses possible sustainable water resources management options.

Key Words: Climate Change, Fresh water resources, Threats

INTRODUCTION

Despite its location across the Equator, Kenya experiences wide variations in its climate due to great differences in topography. The climate is controlled by the seasonal northward and southward movement of the Inter-Tropical Convergence Zone (ITCZ). The influence of ITCZ produces two rainy seasons, April/May, "long rains" and October/November, "short rains". The coastal belt along the Indian Ocean is relatively wet with heavier rainfall in the south. In the Nyika Plateau there are large areas of arid and semi-arid lands (ASALs). The Highlands are temperate, receiving moderate to heavy rainfall. All the mountainous areas in the Rift Valley have adequate rainfall while other areas, mainly to the north and south of Nakuru are dry. Another wet area covers western Kenya just east of Lake Victoria (JICA/GOK 1992). Due to effects of climate change, variations in trends and predictability of climatic conditions have been witnessed across Kenya's climatic sub-regions in the last two decades. Anomalies such as El nino and La nina have been experienced for periods and at times when they have been least expected and or predicted by the meteorological instrumentation with explanations being attributed to climate change.

Kenya has a wide spectrum of the water resources base, which consist of both surface and groundwater resources. The surface water resources mainly comprise of the natural storage systems such as reservoirs. The terrestrial-surface-water resources systems are strongly influenced by climatic factors such as rainfall and evaporation. To a smaller extent, the rechargeable groundwater resources are also influenced (but with a considerable time lag) by rainfall and evaporation. Climate information is therefore vital in planning and management of water resources and institution of management policies for water resources related disasters, such as floods, landslides, soil erosion, water pollution, dam breaks and water-borne diseases (UNDP/WMO/GOK, 2002). Maintenance and development of monitoring systems based on climatic data is lacking.

The main sources of surface water in Kenya are lakes, rivers and swamps. Kenya is well endowed with rivers, but only eight are permanent and flow regularly. These are Tana and Athi, the Nzoia, Yala, Nyando, Sondu, Sio and Mara. The majority of Kenyan lakes are found in the Rift Valley. Most of these lakes are highly alkaline (Ph > 9.5). The freshwater lakes are moderately alkaline (pH < 9) and soft (total hardness less than 100 mg/l as CaCO₃).

Kenya has five major surface water drainage basins. Drainage area 1 has river systems draining into Lake Victoria. Drainage area 2 with rivers within the Rift Valley (Lakes with no outflows characterize this area). Drainage area 3 defines the Athi/Galana/Sabaki River systems. Drainage area 4 defines the Tana River system and drainage area 5 defines the North Ewaso Ngiro basin. Of all the river basins, area 1 receives the highest amount of mean annual rainfall of about 1245 mm. Due to the predominantly poorly drained soils, this drainage basin has the highest runoff, which amounts to about 12% of the mean annual rainfall (UNDP/WMO/GOK, 2002). This high runoff impacts on the quality of water in the lake; increases chances of silting due to erosion, accumulation of dissolved substances from leachates from farms and other effluent points and increases vulnerability to floods by households living in the flood plains in the drainage basin.

Ewaso Ngiro River system basin has the lowest mean annual rainfall of about 255 mm. Area 2 (Rift Valley River systems basin) has the lowest relative annual runoff of about 1% of the annual rainfall (UNDP/WMO/GOK, 2002).

Table 1 below shows the main hydrological characteristics of these basins.

Table 1: Hydrological Characteristics of the drainage basins in Kenya

Drainage Basin	Area (km ²)	Mean annual rainfall – mm (m ³)	Mean annual runoff – mm (m ³)	National River flow potential	Climate and soils
Lake Victoria (Area 1)	49,210	1,245 (61.3x10 ⁹)	149 (7.3x10 ⁹)	49	Humid to sub-humid Poorly drained
Rift Valley (Area 2)	126,910	535 (69.9x10 ⁹)	6 (0.8x10 ⁹)	4	Arid to semi-arid. drained soils
Athi River (Area 3)	69,930	585 (37.4x10 ⁹)	19 (1.3x10 ⁹)	7	Semi-arid. Well drained soils
Tana River (Area 4)	132,090	535 (70.7x10 ⁹)	36 (4.8x10 ⁹)	33	Upper: Semi-humid Lower: Semi-arid to arid Impeded drainage soils
Ewaso Ngiro (Area 5)	204,610	255 (52.2x10 ⁹)	4 (0.8x10 ⁹)	7	Arid to semi-arid. drained soils

Source: UNDP/WMO/GOK, 2002

Generally area 1 has the highest national river flow potential. Unfortunately this potential has not been harnessed satisfactorily. The Tana River system, area 4, has the second highest national river flow potential amounting to about 33%. Particularly due to the cheaper and lower economic characteristics of Hydropower and Irrigation developments options in this basin, this utilization options have been used to harness some of the water resources potential in this basin. The other river basins (area 2, 3 and 5) have a low national river flow potential, each with no more than 7% of the total national river flow potential. The rivers that flow in the basins whose climates are predominantly semi-arid are being exploited mainly for domestic and private entrepreneurship. The settlement, land use and river flow utilization practices in these drainage basins, particularly area 5, are mostly based on selfish objectives with little consideration to the impacts to the environment (UNDP/WMO/GOK, 2002).

In Eastern Africa, due to climate change, general moisture circulation models predict an increase in rainfall of up to 20%, a change in seasonal distribution of rainfall and an increase in air temperature of up to 5 °C for this century and there are also indications of increasing frequency and intensity of droughts (Odada, 2008). Only 51% of the rural areas in Africa were covered by water-supply in 2002 whereas the coverage for urban areas was 86%. Analysis of water-supply data of the region reveals that despite the progress in the coverage for drinking water between 1990 and 2002 improvement still falls short of the progress needed to achieve the Millennium Development Goals (MDGs) target of 75% coverage by 2015. Regarding the MDG

sanitation target the situation is critical and progress should be accelerated. Northern Africa is almost on track in meeting both targets although it is the most water stressed sub-region (Odada, 2008).

Obstacles to accelerating the rate of progress towards the MDG targets in all sub-regions with the exception of northern Africa include political instability, high rates of population growth, poor governance, dwindling or diminishing budgetary allocations and subsequent increased demand from the agricultural and domestic sectors and low priority given to water and sanitation in terms of investment in infrastructure and maintenance (Odada, 2008).

ASSESSMENT OF THE IMPACT OF CLIMATE CHANGE ON WATER RESOURCES

Environmental Degradation

For countries relying on hydropower generation for their electricity supply, environmental degradation is a serious concern. Hydropower generation requires the reliable water for most of the time (wet and dry seasons). Degradation of the catchments areas' environment results in the decline of springs, streams and rivers with catastrophic consequences for human welfare and environmental integrity. Pollution of water resources is also a great concern as it is a threat to both the environment as well as availability of freshwater. Poor land use practices have resulted in sedimentation of river channels, lakes and reservoirs and changes in hydrological processes. Deterioration of the quality of water resources resulting from further increases in nutrient loads from irrigation (irrigated agriculture) and the domestic, industrial and mining sectors has also significantly depleted available fresh water resources and increased water scarcity.

The largest freshwater lake in Africa and the second largest in the world, Lake Victoria occupying a total catchment of about 250,000 km² of which 68,870 km² is the actual lake surface supports one of the densest and poorest rural populations in the world with densities of up to 1,200 persons per square kilometer in parts of Kenya (URT, 2001, Hoekstra & Corbett, 1995). An average population growth rate of 3% is exerted pressures on the lakes' natural resources. In all the riparian countries, the people living around the lake have increasingly become vulnerable to environmental change over the past two decades, due to natural processes and inappropriate human actions (Birch-Thomsen et. al., 2001). The eutrophication of the lake is clearly linked to land-use changes and rapid population growth. The proliferation of the water hyacinth and siltation in parts of the lake due to fishing and farming activities are major threats to the quality of water in the lake.

The Mau range is one of the five water towers in Kenya. The other four are Mt. Kenya, Aberdares, Cherangani and Mt. Elgon. All of them have one thing in common – large tracts of ancient indigenous forests. It is notable that one third of the world's major river/lake basins have lost 75% of their original forest cover. Tropical mountain forests are disappearing faster than any other kind of forest (SAEFL, Bureau of the Convention on Wetlands & WWF, 2002). This reduces water quality and quantity for human uses. By virtue of these ancient forests, Kenya has had enough fresh water to keep the people and its economy alive. The Mau's 400,000 hectares of forested land has experienced several threats in the recent past resulting from scarce water and agricultural resources caused by mainly by increasing drought conditions in neighboring sections.

In 2001, the government excised 35,301 hectares out of 65, 921 hectares in the eastern Mau and 22,797 hectares out of the 84,012 hectares in the southwestern Mau with 21,000 hectares illegally settled on, in an improperly executed project initially aimed at resettling the poor or the original area hunter-gatherers, the Ogiek but ended up benefiting the politically correct groups (Mangat, 2008). What followed was destruction of the Maasai Mau parts of the forest.

Notably, Mau water tower besides the others supply freshwater to 12 rivers such as the Nzoia, Yala, Nyando, Naishi, Mara, Nderit, Sondu and others. It is unfortunate that no proper valuation of the forest resources has been done in Kenya. Indigenous forests in particular play a very important role. For years, the total percentage of Kenya's indigenous forest cover has been cited as 1.7% of the country's total area. Its planted forest cover is about 2%. Experts recommended minimum forest cover of 10% for a country, ideally composed of indigenous forests. Planted forests, like many farm crops are monocultural in nature and are harvested periodically and their harvesting easily leads to changes in area microclimate.

The potential for freshwater resources in urban areas is diminished with growth of cities. Urban structures change the local climate such that the weather in the city differs from that of the surrounding countryside.

The city produces changes in wind, temperature, humidity, precipitation and radiation balance together with the various atmospheric pollutants, in the form of aerosols from motorized traffic and effluents from industrial stacks. It has been estimated that every million people in a city generate 25,000 tons of greenhouse gases, carbon dioxide and 300,000 tons of wastewater everyday (Boodhoo, 1997). Since our cities have been passing through different stages of development, changes in the weather, particularly rainfall has been discernable.

A study by Rotich (2003) on the comparative magnitudes in the differences in the frequency and the rainfall amounts for Nairobi and Kisumu established that for Nairobi, the relative range are in the magnitude of 30% for the cumulative five years. For Kisumu the number of rain days differs by as many as 20 in five years. This variability has a negative impact on the stability of freshwater resources in the country, especially those in the neighbourhood of these cities such as Lake Victoria.

Many other human activities lead to the exposure of the water environment to a range of chemical, microbial and biological pollutants, as well as micro-pollutants. The mining and industrial sectors in particular produce high concentrations of waste and effluents that act as non-point sources of water quality degradation, including acid mine drainage which pollutes groundwater resources. Africa’s water resources are thus already facing serious risks from climate change.

Impacts of El-Nino and Drought on drainage basins in Kenya

Kenya was hit by a series of droughts in 1991/1992, 1996/1997 and devastating floods in 1997/98. The semi-arid and arid areas were worst hit due to severe lack of available water which in turn led to massive loss of vegetation cover and subsequent death of large populations of animals. The volume of water in rivers and other reservoirs has continuously decreased over the years due to changes in land use. Lakes continue to be degraded by a combination of siltation, reduced inflow and encroachment by invasive plant species. Collection, pans, wetlands and streams are targets of encroachment by agricultural activities. These practices could have contributed significantly to the drying up of these water sources in arid and semi arid lands leading to severe shortage and low recharge of underground reserves. In general, the national water deficit was estimated at 704,522 m³, with some rivers completely drying up (UNEP/GOK, 2006).

Factors that aggravate the severity of drought such as prior consecutive dry spells, change in land use activities, sub-divisions of communal lands used as dry season dispersal areas and environmental degradation among others contributed negatively to availability of forage and water leading to dehydration and starvation related mortalities (UNEP/GOK, 2006).

Figure 1 below shows that river flows in Tana river basin was lower during droughts as depicted by troughs in 1980, 1984, 1992-1994 and 1999 to 2000. These were areas of drought in the Tana river basin. The water levels for Masinga Dam dropped significantly during the 1999-2000 drought from average of ten years 1055m to 1035m leading to a reduced power generation by as much as 98%.

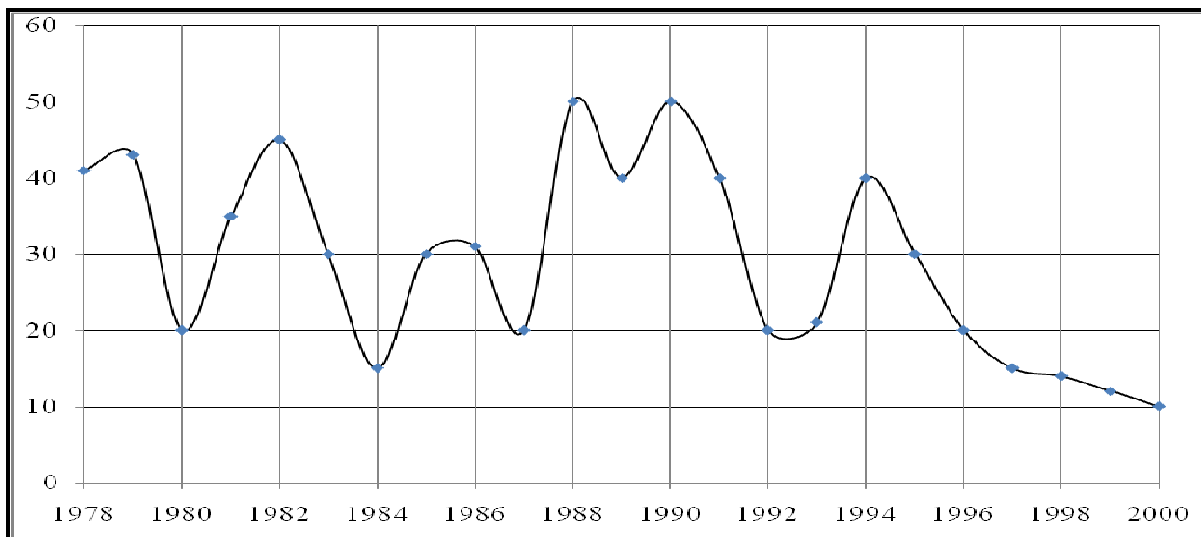


Figure 1: Water discharge from mid Tana River basin (1978 to 2000 in m³)

Source: UNEP/GOK, 2006

A reduced water volume of the Lorian in the Ewaso Ngiro River Basin directly affected the water levels in boreholes in Biyamadhhal area of North Eastern Province. The local population in the region is constrained accessing fresh water for domestic and other uses.

MANAGEMENT OPTIONS

Sustainable options ensure provision of water and maintenance of the ecosystem for posterity. A sustainable approach is when the use of ecosystems and their resources may yield the greatest continuous benefit to present generations while maintaining their potential to meet the needs and aspirations of future generations. This can only be achieved through the maintenance of the natural properties of ecosystems.

IUCN defines an ecosystem-based approach as a strategy for integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable fashion (IUCN (2001). The specific aims are to: (1) maintain ecosystem functions and services; (2) support livelihoods; (3) ensure equitable sharing of benefits amongst shareholders; (4) promote adaptive management, to enable people to make informed choices; (5) decentralize management, to empower people to manage their own resources; and (6) foster intersectoral cooperation, to achieve greater effectiveness through partnerships.

Mangat (2008) notes that it may be appropriate for policy makers to examine innovative and alternative ways of marketing the forests on the international market without destroying them. This will enhance conservation of major watersheds and protect them against illegal encroachment. One way is selling carbon credits to mop up carbon in the atmosphere caused by over reliance on fossil fuels. These carbon sinks can be marketed in countries that cause high emissions in the atmosphere.

The existing and proposed planning, design and management practices in urban and rural water supply systems, flood control and environmental conservation measures should be promoted and implemented (Ogola et. al, 1997). Policies aimed at reducing vulnerability to effects of climate change should be formulated and adopted as integral aspects of national development plans. Optimization of water yield, hydropower production and flood control, among others which require the involvement of all key actors in the sector is important.

In 2002, water was internationally recognized as a human right through the United Nations Economic and Social Committee. Clean and safe drinking water for domestic use ranks as the most crucial and urgent water need. Among the approaches shown to be effective in accelerating progress towards achieving the water Millennium Development Goals (MDGs) are decentralizing responsibility and providing a choice of service levels to communities based on their ability and willingness to pay (Odada, 2008).

The water Act 2002 in Kenya focuses on decentralization and implementation of community water projects by total participation by the target beneficiaries. The Act involves adoption of a schedule called Community Project Cycle (CPC) that involves training of the target communities in water resources use and management. Full implementation of this model will contribute to the achievement of MDGs. High level of awareness and knowledge on importance of sustainable resource utilization by communities ensures the quality of the resource remains high. Integrated river basin management programmes need to be promoted especially among riparian communities.

CONCLUSION

There is increasing threat on Freshwater resources in Kenya as a result of various human activities and subsequent climate change. The reduced potential of the Lakes, Rivers and swamps requires sustainable and integrated resource management approaches. Legal and policy interventions that involve communities are necessary.

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APPLICATION OF LINEAR-BASED MODELS IN NZOIA RIVER BASIN - KENYAKiluva V. M¹, Oteng'i S.B.B¹ Miima J.B¹.

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ABSTRACT

Kenyans have recorded many incidences of flood disasters in Nzoia River Basin (NRB) in the past. For mitigation against the flood risk, this study has utilized the Linear Perturbation Model (LPM) in conjunction with the Simple Linear Model (SLM) and the Linearly Varying Gain Factor Model (LVGFM). Rainfall and discharge data of the catchment North of Webuye town at Webuye flow gauging station (IDA02) of Nzoia River Basin were used with the three candidate models for calibration, verification and final application. During the calibration and verification of the SLM on the simulation mode, the model efficiency index (R^2 %) was 48.35% and 48.99% respectively while in the LPM; it was 55.60% and 74.13% respectively. For the LVGFM, during the calibration and verification on the simulation mode, the model efficiency index (R^2 %) was 54.07% and 41.28% respectively. Based on the efficiency indices (R^2 %), the LPM demonstrated the highest efficiency during both calibration and verification periods. The LPM proved to be a useful tool for flood mitigation in the NRB.

Key Words

Nzoia River Basin, Flood risk, Simple Linear Model, Linear Perturbation Model, Linearly Varying Gain Factor Model, Model efficiency index (R^2)

INTRODUCTION

The flood-prone zone in Nzoia River Basin is protected by dykes that have been surpassed by the design flood. Hence inhabitants of this basin are still at a risk of flooding despite the existence of this structural measure. The government of Kenya has not consistently maintained these dykes. Optimum benefits from these dykes can be achieved only when structural and non-structural measures are combined in coordination to mitigate flood losses in river basins (Seki, 1989). The process of reducing vulnerability and increasing resilience to flooding is a complex task for the community living in the lower reaches of Nzoia River Basin. Preparedness and response measures require a multidisciplinary and a well coordinated approach. Preparedness and response actions by the various disaster management authorities to prevent or mitigate against flood-related disasters highly depend on the overall flood management strategy adopted for the inhabitants of the flood prone area.

Disaster mitigation measures include activities that prevent an emergency happening or lessen the damage of the effects of the unavoidable emergency (Makhanu, 2005). This can be realized through the development of an environmental early warning system in the basin which is necessary to reduce flood risk (ISDR, 2002). The absence of a clear strategy and policy for flood management has contributed to increased adverse impacts of flood disasters both socio-economically and environmentally.

During the period 1960 to 2000, Budalangi Division of Nzoia River Basin has experienced serious incidences of flood disasters that led to loss of lives and property. The flood forecasts being done by hydrological services in terms of water levels are not of much use unless these levels are described with reference to certain threshold levels like 'warning level', 'danger level' and 'highest flood level observed so far'. Studies by Ogallo et al. (2004) on the problems encountered during the Budalangi perennial floods in Kenya show that, it is extremely important to ensure that the inhabitants of the flood prone areas have the capacity and skills to manage the floods. In the search for a stable runoff impulse response function (a model) of Nzoia River Basin, Mutua (1979) analysed the two-hourly rainfall and discharge data of the upper sub-catchment which has an outlet near Webuye. This analysis gave both an unrealistic and an unstable rainfall-runoff model.

Global Positioning Systems (GPS) such as the GPS-LEO (Low Earth Orbiting) satellite have been used for flood forecasting. Awange and Fukunda (2003) brought into the field of flood forecasting the concept of GPS radio occultation and the satellite gravity measurement of rise in sea level. They concluded that

modern day positioning GPS satellites together with LEO satellites could be used to obtain meteorological data to enhance flood forecasting. A study was done by Rwigi (2004) on Nyando River Basin that found out that system-based models can give a high model efficiency index (R^2) just as other more complex models. Opere (1991) conducted a study on the use of rainfall-runoff models in the forecasting of discharge from rainfall in the upper Athi river catchment. He developed a hydrological model through plotting of the isochrones using the cross-correlation and coherence functions. The model gave reliable forecasts of discharge during most of the cases apart from few extreme cases. He concluded that good forecasts of the discharge could be given in the upper Athi river catchment using simple models based entirely on discharge response to catchment rainfall values. This idea is noble in the search for non-structural flood mitigation measure.

In this paper, we present an application of linear-based models in Nzoia River basin in Kenya. The study involves calibrated and verified candidate models namely Simple Linear Model, Linear Perturbation Model and the Linearly Varying Gain Factor Model.

Conceptual Framework

When a rainstorm of a given magnitude falls on a river catchment, some of the precipitation seeps underground while the excess rainfall forms the surface runoff depending on the initial soil moisture content. Some of the infiltrated water then reappears at the outlet of the catchment at a longer time in future. The surface runoff via the river channel flows downstream leading to flooding on the lower reaches of the river. The magnitude of flow at strategic river gauging stations along the river is useful in the derivation of flood risk information using a hydrologic or hydraulic model which is important in flood mitigation. This is clearly demonstrated in

the flow diagram in Figure 1 below.

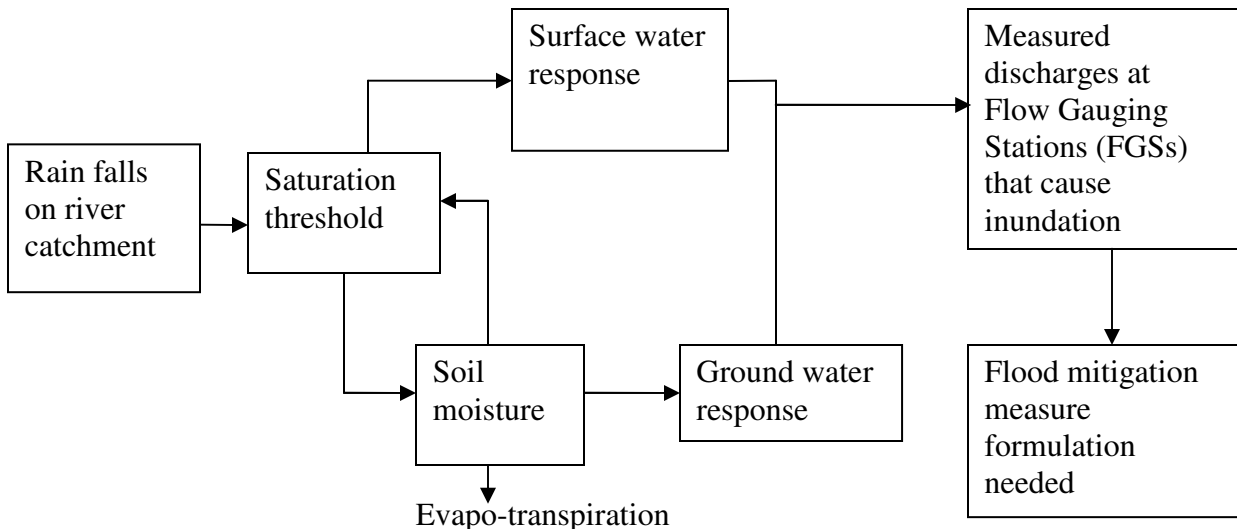


Figure 1: Schematic view of the rainfall-flow process.

MATERIALS AND METHODS

The Nzoia River Basin is located in the Western Province of Kenya within the Lake Victoria Basin. It covers a total area of about 12,696km² as defined geographically in Figures 2 and 3. In this study, emphasis was given to the region that receives the highest annual rainfall, contributing to over 90% of the excess runoff that leads to the flooding problem downstream at Budalangi Division. This is the entire region situated North of Webuye town at Webuye flow gauging station (1DA02) covering an area of 8,417km² as shown in Figure 2 below.

The study area is located between Webuye town, Cherangani Hills, Mt. Elgon and Nandi Hills. Land use in this area is characterized by small-scale/subsistence farming (agriculture which is mainly mixed farming). Large-scale/cash crop plantations of tea, sugarcane (mostly under companies) can be identified in this area. Forests (both indigenous and exotic) provide part of the land cover. There is wide spread encroachment into river banks which exposes the inhabitants to flood risk during rain seasons.

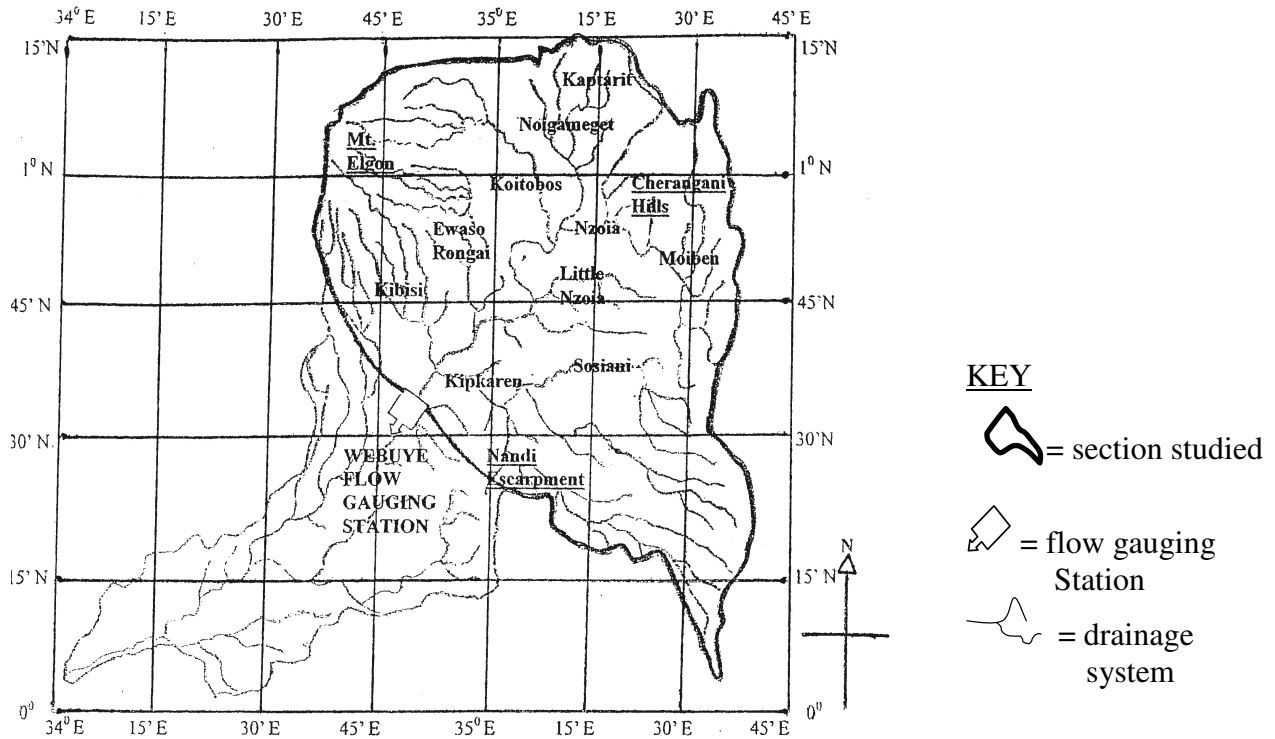


Figure 2: A map of Nzoia River Basin showing the section studied and river tributaries.

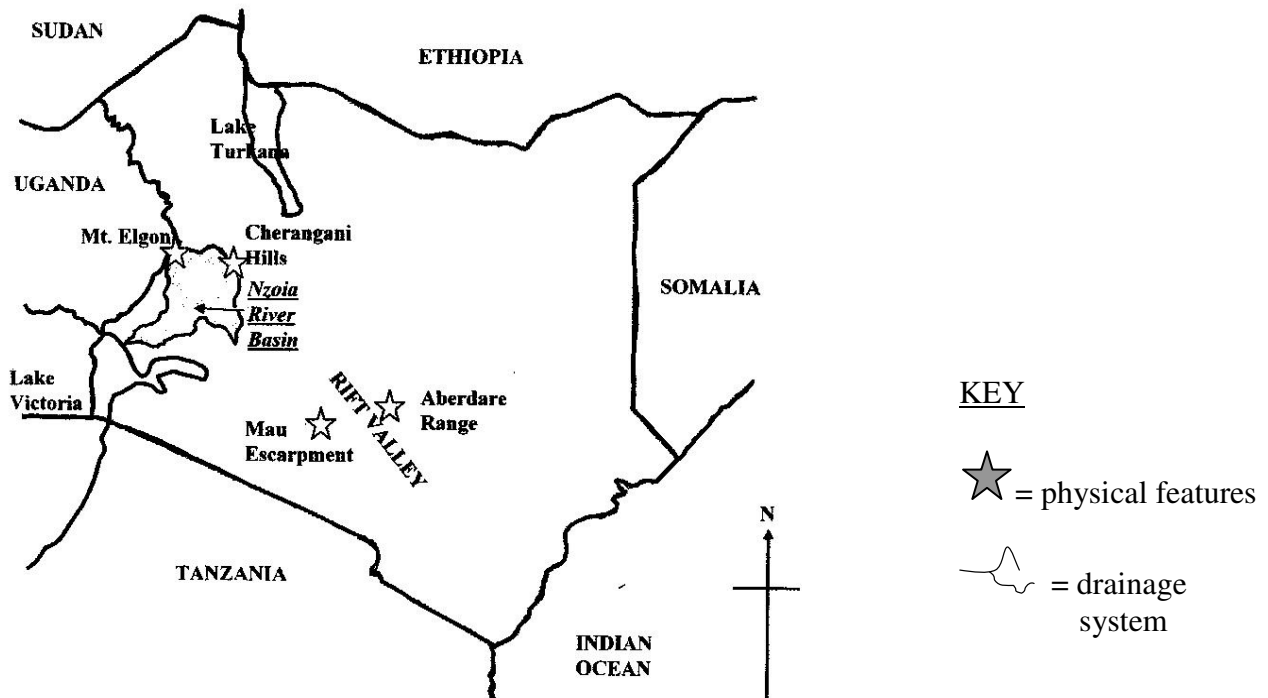


Figure 3: A map of Kenya showing Nzoia River Basin and major physical features.

Rainfall data of the period 1960 to 1990 was obtained from the Kenya Meteorological Department (KMD) while discharge data of the period 1960 to 1990 was obtained from the Ministry of Water Resources Management (MWRM).

Models used in the Study

Hydro-meteorological data (rainfall and discharge) of Nzoia River Basin were used to calibrate and verify three candidate system-based models (Kiluva, 2007 and Kiluva et al., 2007). These models are the Simple Linear Model, the Linear Perturbation Model and the Linearly Varying Gain Factor Model, all available in the Galway Flow Forecasting Software Package. Based on the model efficiency index (R^2), the coefficient of determination (r^2), the Index of Volumetric Fit (IVF) and the Mean Square Error (MSE) computed, ranks were assigned to the candidate models and the most efficient model was identified.

A brief description of these models is provided in the sections below.

Simple Linear Model (SLM)

The intrinsic hypothesis of the SLM is the assumption of a linear time-invariant relationship between the rainfall (x_i) and the total discharge (y_i). In its discrete non-parametric form, the SLM, including the forecast error term (e_i) is expressed by the convolution summation relation in equation 1 below.

$$y_i = \sum_{j=1}^m x_{i-j+1} h_j + e_i \dots (1)$$

Where,

y_i = output discharge at the i^{th} time-step ($i = 1, 2, 3, 4 \dots n^{\text{th}}$ time-step),

x_i = input rainfall at the i^{th} time-step,

h_j = j^{th} discrete pulse response ordinate or weight ($j = 1, 2, 3, 4 \dots m^{\text{th}}$ time-step),

m = the memory length of the system (60 days),

e_i = model error at i^{th} time interval (model residual).

The SLM was used as a baseline tool for comparison.

Linear Perturbation Model (LPM)

In the LPM, it is assumed that, during a year in which the rainfall is identical to its seasonal expectation, the corresponding discharge hydrograph is also identical to its seasonal expectation. However, in all other years, when the rainfall and the discharge values depart from their respective seasonal expectations, these departure-series are assumed to be related by a linear time invariant system. Hence, the LPM structure reduces reliance on the linearity assumption of the SLM and gives substantial weight to the observed seasonal behaviour of the catchment.

The relation between the departures/perturbation series of the LPM, incorporating an output error term (e_i) is represented algebraically by the convolution summation as shown in equation 2 below.

$$Q_i = \sum_{j=1}^m R_{i-j+1} h_j + e_i \dots (2)$$

Where,

$$Q_i = y_i - \bar{y}_d$$

= departure series of the outflow (y_i) {output discharge at the i^{th} time-step} from its own

seasonal mean (\bar{y}_d)

$$R_i = x_i - \bar{x}_d$$

Where, $d = 1, 2, 3, 4 \dots 365$ days and $i = 1, 2, 3, 4 \dots n^{\text{th}}$ time-step,

= departure series of the inflow rainfall (x_i) {input rainfall at the i^{th} time-step} from

its own seasonal mean (\bar{x}_d)

h_j = j^{th} discrete pulse response ordinate or weight ($j = 1, 2, 3, 4 \dots m^{\text{th}}$ time-step),

m = the memory length of the system (60 days),
 e_i = model error at i^{th} time interval (model residual).

A schematic diagram of the LPM is presented in Figure 4 below.

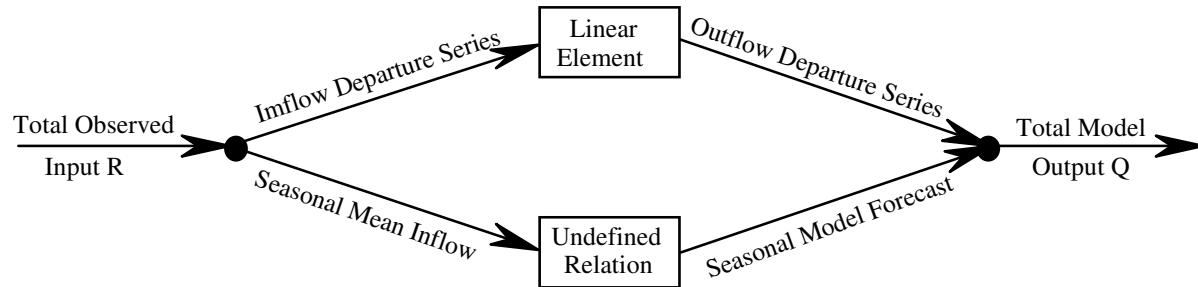


Figure 4: Schematic representation of the structure of LPM (Kachroo et al., 1988).

Linearly Varying Gain Factor Model (LVGFM)

The LVGFM output has the familiar convolution summation structure (based on the concept of a time-varying gain factor G_i as shown in equation 3 below.

$$y_i = G_i \sum_{j=1}^m x_{i-j+1} w_j + e_i \dots (3)$$

Where,

- y_i = output discharge at the i^{th} time-step ($i = 1, 2, 3, 4 \dots n^{\text{th}}$ time-step),
- G_i = Gain factor at the i^{th} time-step,
- x_i = input rainfall at the i^{th} time-step,
- w_j = j^{th} discrete pulse response ordinate or weight ($j = 1, 2, 3, 4 \dots m^{\text{th}}$ time-step),
- m = the memory length of the system (60 days),
- e_i = model error at i^{th} time interval (model residual).

A schematic diagram of the LVGFM is presented in Figure 5 below.

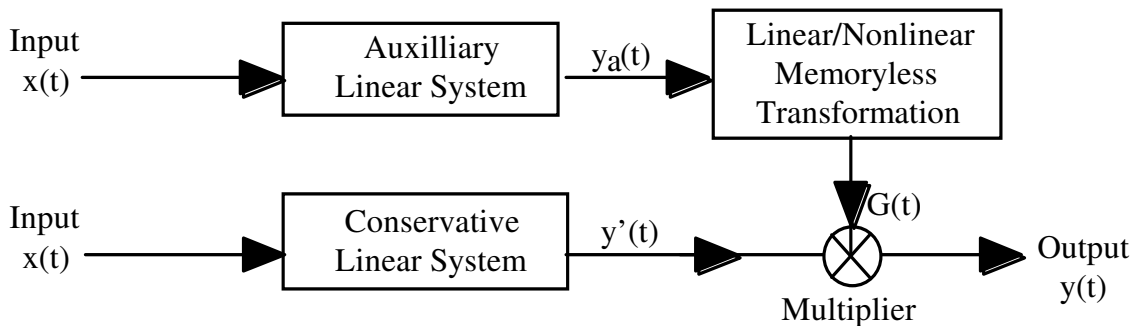


Figure 5: Schematic representation of the structure of LVGFM (Kachroo et al., 1988).

Evaluation of Models used in the Study

The basis of evaluation is the model efficiency index (R^2), the coefficient of determination (r^2), the Index of Volumetric Fit (IVF) and the Mean Square Error (MSE) in terms of calibration and verification. The models were ranked to select the most efficient model for the subsequent study based on the efficiency criterion developed by Nash and Sutcliffe (1970) as expressed in the equations below.

To select the most appropriate model that met the above requirements for the subsequent study, an efficiency criterion which expresses model accuracy that was developed in 1970 by Nash and Sutcliffe was used. Nash and Sutcliffe used an objective function of the sum of squares of differences F between the observed and the estimated discharges with the summation taken over the whole of the calibration period expressed by equation 4 below.

$$F = \sum (y - \hat{y})^2 \dots (4)$$

Where,

F = sum of squares of differences or index of disagreement,

y = measured output (m^3/sec),

\hat{y} = model output estimates (m^3/sec),

Based on equation 4 above, Nash and Sutcliffe defined the R^2 analogously to the coefficient of determination in linear regression as the proportion of the initial variance accounted for by F , hence defining the initial variance (F_o) as in equation 5 below.

$$F_o = \sum (y - \bar{y})^2 \dots (5)$$

Where,

F_o = initial variance (%)

$\bar{y} = \frac{1}{N} \sum_{t=1}^N y_t$ = the mean of y in the calibration period (m^3/sec),

N = number of data points.

From equations 4 and 5, the model efficiency index (%) (R^2) was determined as follows;

$$R^2 = \frac{F_o - F}{F_o} \times 100 \dots (6)$$

Where,

R^2 = model efficiency index (%),

F_o = initial variance (%),

F = final variance (%).

In addition to the R^2 , the r^2 , IVF and MSE were also determined. The Coefficient of determination (r^2) was computed using equation 7;

$$r^2 = \frac{F_1 - F_2}{F_1} \times 100 \dots (7)$$

Where,

r^2 = Coefficient of determination

F_1 and F_2 are the index of disagreement / sum of squares for models 1 and 2 respectively.

The Index of Volumetric Fit (IVF) was computed using equation 8;

$$IVF = \frac{\sum_{i=1}^T \hat{y}_i}{\sum_{i=1}^T y_i} \dots (8)$$

Where,

IVF = Index of Volumetric Fit (a ratio),

T = period under consideration (years),

\hat{y}_i = estimated discharge series (m³/sec),

y_i = observed discharge series (m³/sec),

The Mean Square Error (MSE) was also computed using equation 9;

$$MSE = \frac{1}{D} \sum_{i \in D} (y_i - \hat{y}_i)^2 \times 100 \dots (9)$$

Where,

D = period under consideration (years),

\hat{y}_i = estimated discharge series (m³/sec),

y_i = observed discharge series (m³/sec),

RESULTS AND DISCUSSIONS

This section gives a summary of the results that were obtained using each model and the corresponding discussions.

Simple Linear Model (SLM)

Tables 1 and 2 give the results from the SLM based on 60 days memory length (m) that was arrived at during model calibration. The R² values were 48.35% and 48.99% which portrays an inadequacy of the SLM to forecast flow from rainfall in the Nzoia River Basin. The indices of volumetric fit (IVF) were 1.03 and 1.00 during calibration and verification periods respectively; indicating that the model optimally estimated the flow volume during verification but slightly overestimated it during calibration. The coefficient of determination (r²) value was 0% during calibration and 0% during verification period because the SLM is a model used for comparison purpose. Any model that does not give efficiencies greater than those given by the SLM is not regarded as an appropriate simulation model for the particular catchment.

Table 1: Results of SLM calibration and verification exercise on simulation mode

SLM		
Computations	Calibration	Verification
Mean of outflow (m ³ /sec)	56.9305	56.9305
Mean of observed series (m ³ /sec)	58.2133	59.3335
Mean of estimated series (m ³ /sec)	60.0238	57.3315
Ratio of estimated to observed mean of outflow	1.0311	0.9663
Initial variance (%)	3074.5900	1960.440

Residual variance (%)	1588.0700	999.9360
Model efficiency index (R^2) (%)	48.3500	48.9900
Mean Square Error (MSE) (%)	6805.5400	2803.8200

Table 2: Results of SLM performance on simulation mode

SLM								
m = 60 day	Calibration				Verification			
	R^2 (%)	r^2 (%)	IVF (ratio)	MSE (%)	R^2 (%)	r^2 (%)	IVF (ratio)	MSE (%)
	48.35	0	1.03	6805.54	48.99	0	1.00	2803.82

Linear Perturbation Model (LPM)

Tables 3 and 4 give the results from the LPM based on 60 days memory length (m) that was arrived at during model calibration. The R^2 values were 55.60% and 74.13% showing the importance of seasonal information in the Nzoia River Basin. This also portrays the great ability of the LPM to forecast flow from rainfall in the basin, better than the SLM. The coefficient of determination or indices of improvement in performance (r^2) of the LPM over the efficiency indices of the SLM were 13.04% and 33.91% during calibration and verification periods respectively. The LPM was thus able to account for a greater proportion of variance that was unaccounted for by the SLM. This was a clear indication that Nzoia River Basin is highly influenced by seasonal variation due to the remarkable performance of the seasonally based model (LPM). The indices of volumetric fit (IVF) were approximately 1.01 and 1.00 during calibration and verification periods respectively; indicating that the model optimally estimated the flow volume during calibration and verification.

Table 3: Results of LPM calibration and verification exercise on simulation mode

LPM		
Computations	Calibration	Verification
Mean of outflow (m^3/sec)	56.9305	56.9305
Mean of observed series (m^3/sec)	58.2075	59.3335
Mean of estimated series (m^3/sec)	58.8365	58.1535
Ratio of estimated to observed mean of outflow	1.0108	0.9801
Initial variance (%)	3074.5900	1960.440
Residual variance (%)	1365.2100	507.1800
Model efficiency index (R^2) (%)	55.6000	74.1300
Mean Square Error (MSE) (%)	6075.3400	1597.0300

Table 4: Results of LPM performance on simulation mode

LPM								
m = 60 day	Calibration				Verification			
	R^2 (%)	r^2 (%)	IVF (ratio)	MSE (%)	R^2 (%)	r^2 (%)	IVF (ratio)	MSE (%)
	55.60	13.04	1.01	6075.34	74.13	33.91	1.00	1597.03

Linearly Varying Gain Factor Model (LVGFM)

Tables 5 and 6 give the results from the LVGFM based on 60 days memory length (m) that was arrived at during model calibration. The indices of volumetric fit (IVF) were 0.99 and 0.94 during calibration and verification periods respectively; indicating that the model slightly underestimated the flow volume during calibration and verification. The (r^2) value of the LVGFM during verification was -18.68% indicating that it underperformed as compared to the SLM.

Table 5: Results of LVGFM calibration and verification exercise on simulation mode

LVGFM		
Computations	Calibration	Verification
Mean of outflow (m ³ /sec)	56.9305	56.9305
Mean of observed series (m ³ /sec)	58.2075	59.3335
Mean of estimated series (m ³ /sec)	57.9043	55.9441
Ratio of estimated to observed mean of outflow	0.9948	0.9429
Initial variance (%)	3074.5900	1960.4400
Residual variance (%)	1412.0800	1151.1000
Model efficiency index (R ²) (%)	54.0700	41.2800
Mean Square Error (MSE) (%)	4355.1400	2894.7300

Table 6: Results of LVGFM performance on simulation mode

LVGFM								
m = 60 day	Calibration				Verification			
	R ² (%)	r ² (%)	IVF (ratio)	MSE (%)	R ² (%)	r ² (%)	IVF (ratio)	MSE (%)
	54.07	10.58	0.99	4355.14	41.28	-18.68	0.94	2894.73

Table 7: Results for the model performance indices on individual model runs

MODEL PERFORMANCE INDEX (R ² %) - individual model runs		
Model type	Calibration	Verification
SLM	48.35%	48.99%
LPM	55.60%	74.13%
LVGFM	54.07%	41.28%

CONCLUSIONS AND RECOMMENDATIONS

With reference to the findings of this study, it has been noted that the hydro-meteorological data-base in Kenya could actually be put into technical use by modelers in order to solve hydro meteorological-related problems like floods. The hydrology of a catchment can be mapped or simulated by the use of hydrological and hydraulic models. The use of the system-based hydrological models has proved to simulate flow in the NRB and can provide a non-structural mitigation measure against the losses incurred during flooding. The candidate models applied on the study area have given an indication that high performance efficiencies can be obtained by using simple linear based models in the Nzoia basin.

Among the models used in this study, the LPM has accurately simulated the flow in the study area. Use of this model can offer ample information about the hydrology of the Nzoia basin. The existing dykes on Nzoia basin have proved to be ineffective for flood protection as was evident during the 2007 flooding incident when the river broke its banks leading to the dyke's structural failure. It is thus the role of the Kenyan government to formulate policies geared towards strengthening non-structural flood mitigation measures that can supplement the structural measures.

There is a glaring need for more research to understand the hydrologic and hydrological processes of the Nzoia basin. Computation of the flood wave travel time (time to peak) at strategic points downstream of Webuye town (from Webuye FGS to Mumias FGS to Ruambwa FGS to Lake Victoria). In addition to the hydrological and hydraulic studies, there is a critical need for a cost-benefit analysis study of the structural

versus the non-structural approaches in flood management. This type of study can also be replicated in other river basins in Kenya that experience flood problems.

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QUANTIFYING LAND COVER AND LAND USE CHANGE BY REMOTE SENSING AND GIS TECHNIQUES IN RIVER NJORO CATCHMENT, KENYA

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Abstract

River Njoro catchment is a high potential area that is undergoing rapid land cover and land use change. Up to the mid 1980s, the area was covered by rich vegetation of highland evergreen forests which extended from the Mau hills and turned into woodland dominated by acacia trees in the Rongai-Njoro plains. Rapid increase in population between the 1970s and the 1980s led to massive land degradation. To meet the increased demand for food, fuel wood, charcoal and housing, land fragmentation, deforestation and cultivation of wetlands was carried out. To quantify the changes, remotely sensed data, Geographical Information System, ground survey and ancillary data were used. Land cover and land use classification was done by using area frame sampling for data collection and estimation. Multi-date imagery showed significant changes mainly from forest and large scale farms to subsistence agriculture and built up land. The study showed that the land converted from forest to agriculture and built-up between 1975 and 2005 was 144.6 km² which translated to 322% change. The impacts of change were manifested in increased soil erosion, reduced stream discharges and drying boreholes. It was concluded that the integration of remotely sensed data and Geographical Information System provided information which could be used for effective routine tasks related to environmental inventorying and monitoring of the land cover and land use changes in catchments.

Keywords: Deforestation, imagery, land cover change, land degradation, soil erosion.

Introduction

River Njoro catchment is a high potential area that is undergoing rapid land cover and land use change, leading to environmental degradation. Up to the mid 1980s, the area was covered by rich vegetation of highland evergreen forests which extended from the Mau hills and turned into woodland dominated by acacia trees in the Rongai-Njoro plains. In the late 1980s, the government allowed cultivation of wheat and barley on degazetted forest lands. With increase in population, people started planting other crops such as pyrethrum, maize, beans, potatoes, vegetables and in addition kept dairy animals, goats and sheep (Matiru, 2000). This led to expansion of land under crops and built up by converting forest land to agricultural land. As a, soil erosion increased, infiltration declined and stream discharges reduced. These were indicators of environmental degradation hence the need to quantify the changes and determine the associated impacts in the area. In view of this, a study was carried out for the period between 1969 and 2005, which was considered long enough to cover both the pre-change and the post-change eras.

The potential for using remote sensing and GIS to quantify change was showed by earlier work done in Eastern Mau to estimate spatial distribution of soil erosion. Kundu et al., (2006) used GIS and remote sensing to estimate soil erosion in Gichobo catchment and revealed deforestation and illegal cultivation in forestlands, which resulted in increased erosion rates. Chemelil, (1995) used the Normalised Difference Vegetation Index (NDVI) and land use estimates from earlier work by Karanja et al., (1986) and the Department of Remote Sensing and Resources Survey (DRSRS), to evaluated the human influence on the quality of water resources

~~in River Njoro. The results showed that land use change adversely affected the quality of water in the river.~~ Baldyga et al., (2004) used digital image processing and pattern recognition to estimate land cover change in River Njoro catchment and found that the change was significant. The results however had an accuracy of 76% which was low and made them unreliable. When digital image processing and pattern recognition is used, the accuracy should be above 85% for the results to be reliable (Burrough, 1986). Soil erosion increased as a consequent of the poor land use practices such as continuous cultivation without fallowing and lack of conservation measures (Owino et al., 2005; China, 1993).

Remotely sensed data and ground survey methods were used to evaluate the land cover and land use change which occurred in the area. A combination of multi-date fine, medium and coarse resolution images were used to detect and quantify changes. The studies showed changes from predominantly forest, woodlands and large scale farms to small and medium scale farms, subsistence agriculture and built-up land. The replacement of forest by depletive subsistence agriculture caused degradation which resulted in massive inflow of sediment into Lake Nakuru (Ramesh, 1998). This affected the growth of blue-green algae (*spirulina platensis*) which is the main food for flamingo birds as it grows on clear water. As a result, there was massive migration of the birds to other lakes within the rift valley such as Solai, Elementaita and Bogoria in search of food.

The Study Area

River Njoro catchment shown in Figure 1 lies between the Rongai-Njoro plains and the upper slopes of the Mau escarpment, at elevations ranging from 1759 m to 3420 m, mostly above 2000 m. It is located between Latitudes 0° 15' S and 0° 25' S and Longitudes 35° 50' E and 36° 05' E and measures 282 km² in area. The topography is predominantly rolling land with slopes ranging from 2% in the plains to 54% in the hills. It is mainly covered by the Quaternary and the Tertiary volcanic deposits (Kinyanjui, 1979). The Quaternary deposits include the black ashes of the Rongai-Njoro plains, pyroclastics and sediments of the Rongai plains and Mau slopes, and cover the Northern part of the area. Tertiary deposits cover the Southern part of the area and include black ashes and welded tuffs. The topsoil in the plains are of clay loam or loam texture with friable consistence and a weak to moderate, subangular blocky structure. The subsoil texture ranges from silty clay loam to clay loam and clay with pH ranging from 5.6 to 6.4, making them slightly to moderately acid (Kinyanjui, 1979).

The minimum and maximum average monthly temperatures vary from 5°C to 28°C. The average annual rainfall ranges from 840 mm to over 1200 mm. The mean monthly rainfall ranges from 30 mm to over 120 mm with a trimodal pattern having peaks in April, August and November.

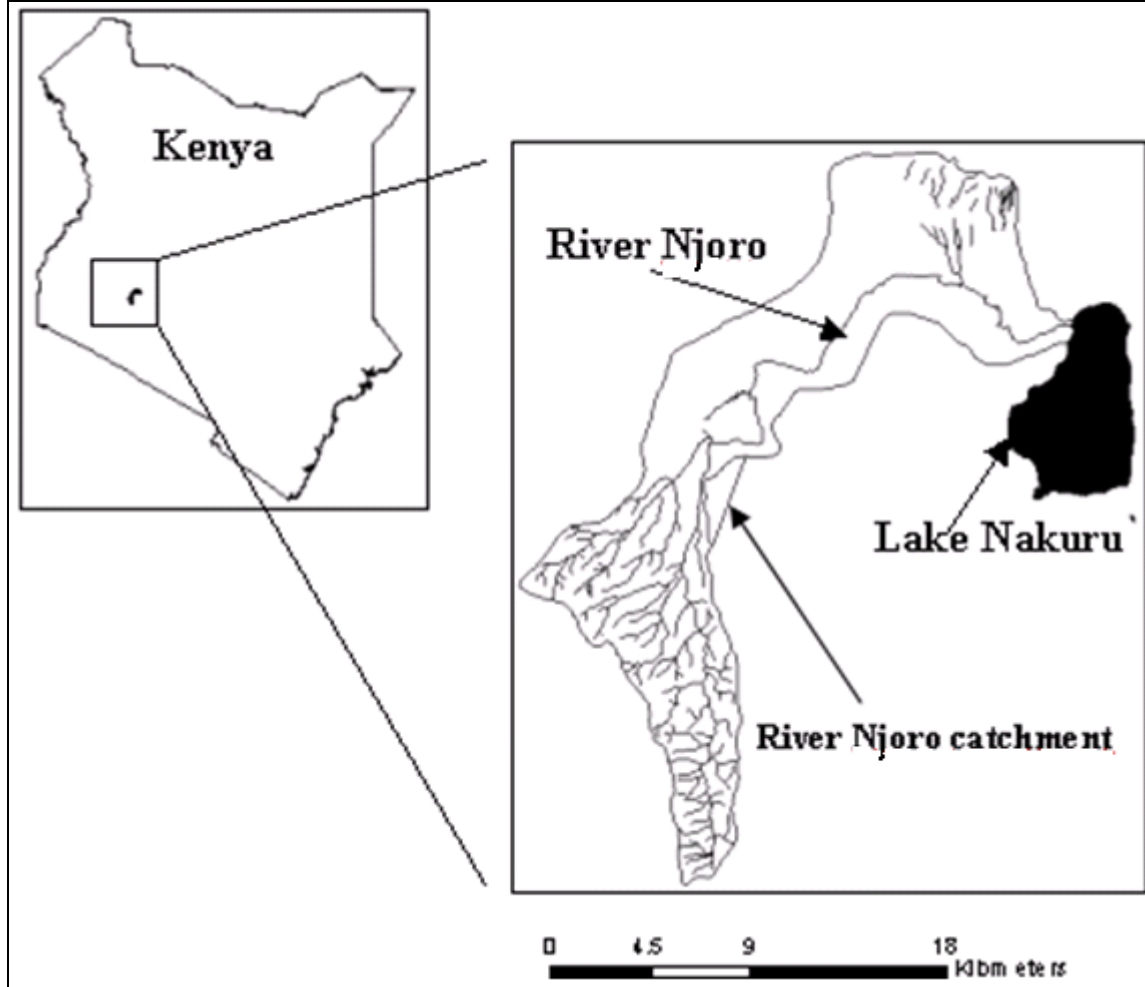


Figure 1: The study area

Materials and Methods

Land cover and land use change was determined by comparing multi-temporal images, air photographs and ground survey data. A systematic sequence of airphoto interpretation based on the methods described by Avery et al., (1992) was done on photographs of 1969 to ensure that definite, reliable and significant information was extracted. The photographs were enlarged to show the land cover clearly. Multi-date Landsat images were used by clipping the area covering the catchment and enlarging. The large area covered in one image was important for the various kinds of studies with details of size 30-80 m being observed using linear stretching. Thematic bands 4, 5, 3 were selected as they show vegetation and land use features more clearly (Sabins, 1986). Topographic maps for 1975 were used to provide the base line data for evaluating the expansion in arable land between 1975 and 2005.

Ground survey was carried out in 2005 based on area frame sampling. In order to achieve unbiased samples, surveys were based on an unaligned systematic random sample of 79 fixed-size segments of 1 km x 1 km. A high densification of 28% for sample sites was preferred in order to validate the consistency of the land cover and land use database. Individual land parcels and ground cover classes were identified in each sample segment. By the method of direct expansion (Taylor and Eva, 1992; Sushil, 2001) shown by the equations in section 3.1 below, the area for each cover class was determined for the entire study area. Ground survey provided the locations of known land cover and land use types such as natural and plantation forests, wheat farms, maize farms, dairy farms and wooded grasslands. It provided the locations of unknown features such as rural built-up lands, heterogeneous crops and subsistence farms which could not be identified on the image by using visual interpretation techniques. Data verification processes involved rechecking photographs and images to determine if the interpretation was correct, and where questions existed, the site was field verified. At least 2% of the segments were field checked, results tabulated and compared to the original interpretation.

The regression of ground survey data over satellite image classification provided an estimate of the land cover and land use area sizes in the study region.

3.1 Area of coverage by direct expansion

3.1.1 Mean proportion:

$$\bar{y}_c = 1/n \sum_{i=1}^n y_i \tag{Eq. 1}$$

Where,

\bar{y}_c = Mean proportion of each coverage area

y_i = Coverage proportion for each segment

n = number of segments in the sample

3.1.2 Total area under coverages

$$Z_c = D y_c \tag{Eq. 2}$$

Where,

Z_c = Estimate of the coverages area

D = Total study area

3.1.3 Variances of area estimator

$$Var(\bar{y}_c) = (1 - n/N) 1/(n(n-1)) \sum_{i=1}^n (y_i - \bar{y}_c)^2 \tag{Eq. 3}$$

$$Var(Z_c) = D^2 Var(\bar{y}_c) \tag{Eq. 4}$$

Where,

N= Total number of segments in the study area

3.1.4 The regression estimator

To provide an estimate of the cultivated and forest/woodland area in the study region using ground survey data with image classification, the area counts from the ground survey and the classified image were regressed. The coefficient of variance (CV) was used as a measure of the accuracy of unbiased area estimates by using the equation:

$$CV(\%) = \frac{\sqrt{Var(Z_c)}}{Z_c} \times 100 \tag{Eq. 5}$$

Results

The study showed that the natural and planted forest which existed in the area had been cut and cleared by 2005. Figure 2 shows the changes in forest/woodland between 1969 and 2005 for selected segments in the catchment. Forest/woodland was greater in all segments in 1969, reduced in 1989 and by 2005, many segments were completely devoid of any forest/wood at all. Figure 3 shows the sharp increase in arable land by 2005 in areas which were under forest/woodland in 1969. Many areas such as Nessueit which were under dense forest in 1969 had completely been converted to arable in 2005, and were under subsistence agriculture producing maize, potatoes and vegetables. Many former large scale farms had been subdivided and sold to

subsistence farmers in small holdings of between 0.5 and 5 hectares. Table 1 shows expansion of agricultural land use in the catchment between 1969 and 2005. The change in large scale farms was by subdivision into smaller holdings whereas there was expansion in land under small and medium scale farms from 35 km² in 1969 to 51 km² in 2005. In 1969, the wooded grassland and pasture category was free from any agriculture but by 2005, 33.6 km² had been converted to subsistence agriculture. Similarly, Mau forest which was free from agriculture in 1969 had 95 km² converted to subsistence agriculture by 2005.

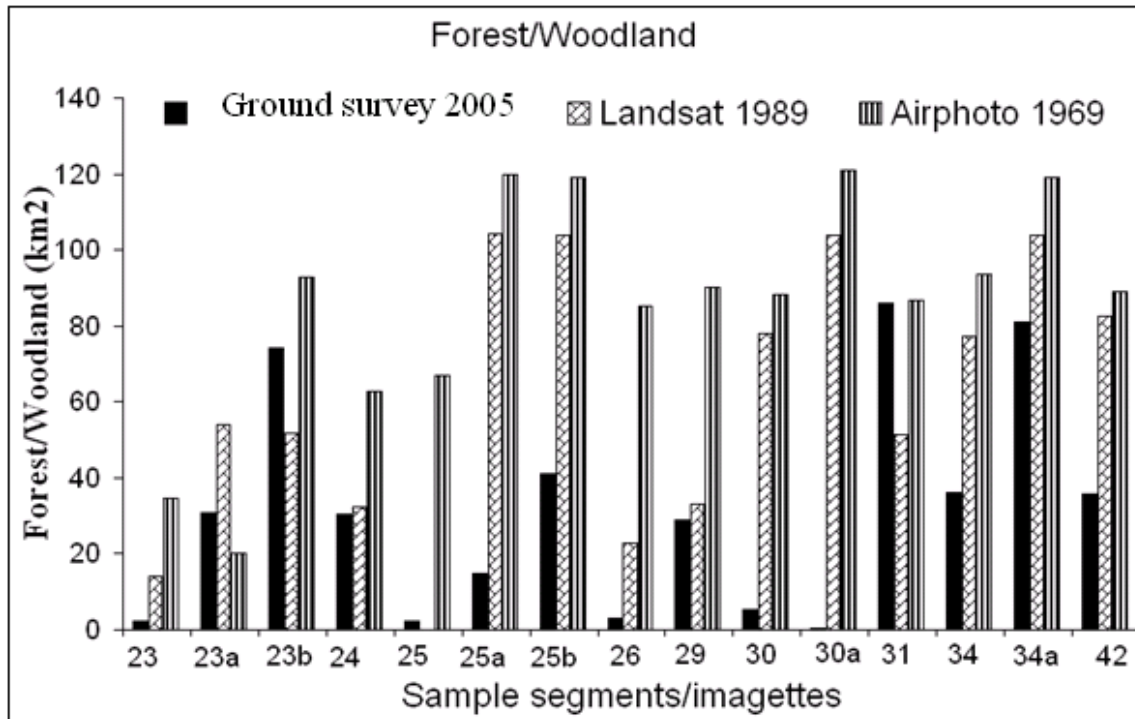


Figure 2: Change in Forest/woodland between 1969 and 2005

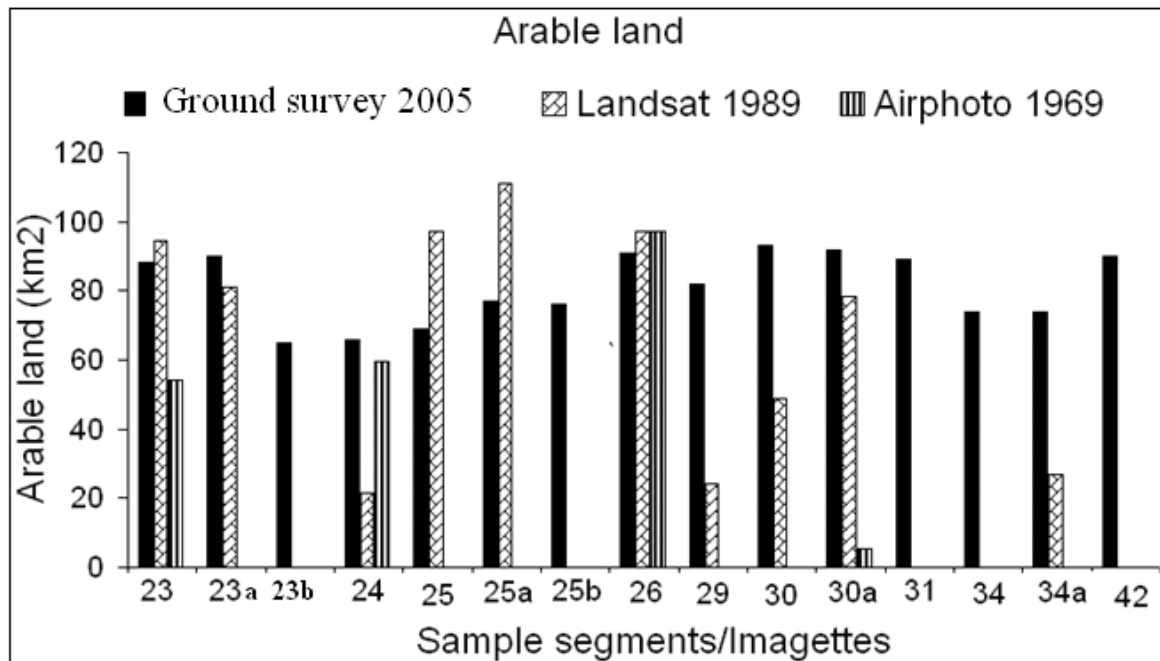


Figure 3: Change in arable land between 1969 and 2005

Table 1: Expansion of agricultural land use in the catchment between 1969 and 2005

	Land use/land cover	Area (km ²)	Area agriculture (km ²)	Area agriculture (km ²)	New agricultural land (km ²)	% Change
A	Large scale farms					
1	Kimakia/Ngongonger farm	3	2.3	2.3	0	0
2	Mukunguku farm	5	0.35	0.35	0	0
3	Njoro farm	5	0.3	0.3	0	0
4	Sugden farm	7	2	2	0	0
5	Mwikito farm	2	0.45	0.45	0	0
6	Mwariki farm	5	0.55	0.55	0	0
7	Piave farm	5	0.31	0.31	0	0
8	Nakuru south farm	4	0.81	0.81	0	0
9	Rahemdula Estate	5	0.97	0.97	0	0
10	Kalenjini Estate	7	1.8	1.8	0	0
B	Small to Medium farms	60	35	51	16	45.71
C	Wooded grassland Pasture	65.5		33.6	33.6	100
D	Forest					
1	Mau forest	110.4		95	95	100
2	Lake Nakuru f (Closed acacia trees)	1.4				
		Σ285.3	Σ44.84	Σ189.44	Σ145	322

It was evident that loss of forest cover in the reserves was by both clear cut and progressive thinning due to poaching by local residents (Ottichilo, 2000; Matiru et al., 2000). Subsistence agriculture in forest and deforested areas was dominant on higher grounds while remnants of wooded grassland occupied the depressions and lowlands. The land converted to agriculture 144.6 km² which translated to 322% change in land use.

Figure 4 showed the location of urban and rural built-up areas which increased with developments of new commercial blocks, residential estates and slums. New villages including Ngundu, Soilo Baraka and Kiamunyi, were established after 1969. Ngundu formerly known as Wright farm used to produce wheat and dairy products while Njokerio formerly Sebiens farm was for horses and flower production. Beeston area was Forest land which has now been converted to arable and built-up land.

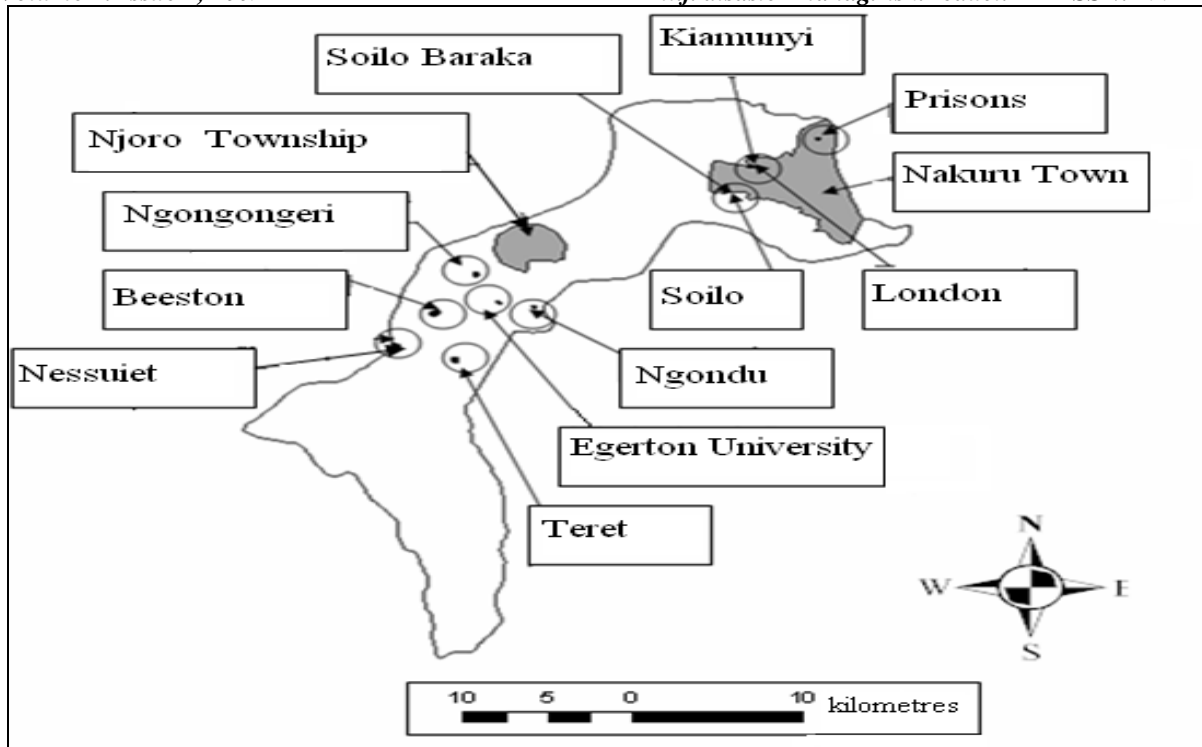


Figure 4: Location of major urban and rural built-up areas

Table 2 shows the area under Urban and Rural built-up within the catchment between 1969 and 2005. Nakuru Town grew from 9 km² in 1969 to 28.62 km² in 2005 while Njoro Town grew from 5.8 km² in 1969 to 10 km² in 2005. Under rural built up, the establishment of new villages was the most significant, having grown from nil in 1969 to 3.82 km² in 2005.

A combined change of such magnitude affects the hydrology of the area by reducing infiltration, raising temperatures and causing high peak runoff (Calder, 1998). Infiltration rates were found to be declining on Tatton farm at Egerton University, as compared to what they were in the 1970s (Owido et al., 2003). Soil erosion was wide spread and many gullies at various stages of development were observed on former forest lands at Beeston and Nessuiet (Owino et al., 2005). Peak runoff increased while stream discharges had reduced (Kundu et al., 2004).

Table 2: Urban and Rural built-up area within the Catchment between 1969 and 2005

A	Towns	Area 1975 (km ²)	Area 2005 (km ²)	New built-up land (km ²)
1	Nakuru Town	9	28.62	19.62
2	Njoro Township	5.8	10	4.2
B Rural Built-up				
1	Soilo	0.07	2	1.93
2	Ngongongeri	0.58	0.58	0
3	Tatton	0.77	1	0.23
4	Ngondu	0	0.15	0.15
5	Beeston	1.28	1.28	0
6	Nessueit	1.32	1.58	0.26
7	Teret	0.915	0.955	0.04
8	New Villages	0	3.82	3.82
	Total	19.735	49.985	30.25

The relationship of the coefficient of variation (CV) to agricultural area shown in Figure 5 decreased with increasing size of agricultural land, indicating that the standard error ($SE = \sqrt{Var \frac{Z_c}{Z_c} \times 100}$) decreased. These results were consistent with the study since it focused on broad classification of forest, woodland and agriculture on large area sizes. The method would however be unsuitable for small farms with crops under subsistence agriculture given the larger coefficient of variation that would result.

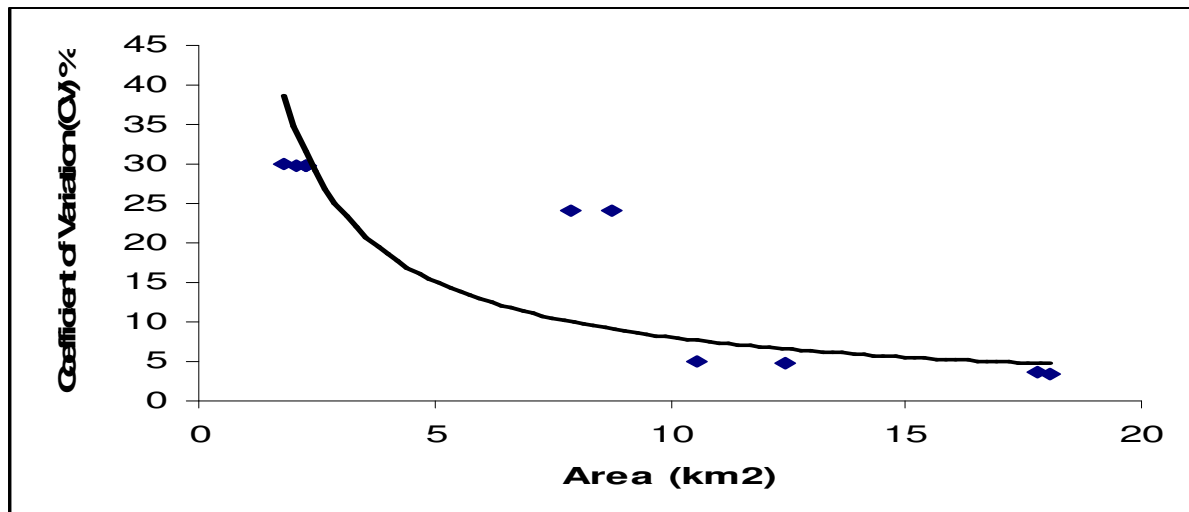


Figure 5: Relationship of Coefficient of Variation (CV) to agricultural area

Discussion

The study showed that natural forests and woods which existed in the catchment before 1969 had been cut and cleared by 2005. Through time series analysis of remotely sensed data and ground survey, it was ascertained that significant change in land cover and land use, particularly the conversion of forest and woodlands to arable and built-up land had occurred. The land converted to agriculture alone between 1975 and 2005 was 144.6 km² which translated to 322% change. This change caused land degradation, which was impacting negatively on the catchment. Infiltration rates were declining as compared to what they were in the 1970s. Soil erosion was wide spread, peak runoff increased while stream discharges had reduced. It was therefore concluded that integration of remotely sensed data and GIS provided information for effective

routine tasks related to environmental monitoring and inventorying, especially land cover and land use change. New strategies for sustainable development in the catchment should adopt the technique and take full advantage of the capabilities of GIS as a tool for planning and decision making.

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Environmental and Health risks of post-harvest pesticides use in Lugari District, Kenya

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Abstract

Due to changing environmental conditions occasioned by climate change coupled by increasing pest resistance, pest outbreaks are becoming more common and destructive in the agricultural sector, especially at the post harvest stages. New pesticides have continually been developed for use at pre- and post-harvest stages to prevent losses due to insect pests. Some of these toxic compounds are poorly packaged and do not carry instructive material handling sheets. These chemicals are often handled carelessly and endangers the health and safety of farmers. This study was undertaken in Likuyani Division of Lugari District, Western Kenya to investigate the usage of post harvests maize storage pesticides by farmers and their possible health, environmental and safety implications. The study examined the adequacy and clarity of pesticide labels and instructions regarding handling and application; farmers ability to read and follow the instructions, and role of agro-veterinary dispensers in promoting safe product usage. Data was collected through observations and interviews. Interviews were administered to 90 farmers using simple random sampling. Collected data was evaluated against the 1977 ILO recommendations, and the guidelines stipulated in the Pest Control Products Act (Cap 346, Laws of Kenya).

The study revealed that 97% of farmers in the area use chemical pesticides for maize storage against weevils, while 3% did not. None of the five pesticide brands investigated fully adhered to the ILO recommendations and requirements of the Pest Control Products Act. Labels and accompanying instructions were inadequate leading to poor translation and interpretation. In addition, no agro-vet shops sampled stocked the recommended first aid kits, antidotes or application gears. Leaflets, brochures and pesticide measuring cans were not properly wrapped in pesticide packages and often failed to reach farmers, contributing to the farmers' poor adherence to pesticide handling instructions. This was evident in the poor disposal or reuse of empty pesticide cans, likely to compromise the quality of the environment and their health. In view of these findings, the government should be more stringent in enforcing the Pest Control Products Board Act (Cap 346), to ensure that the pesticide manufacturing companies adhere to all guidelines on labelling as required by the Act and in conformity to ILO regulations. Regular monitoring of these shops should be done. It is also recommended that all brochures, leaflets and measuring cans accompanying the pesticides must be properly enclosed in the pesticide packages. The government should further encourage farmers through mass media, to comprehensively read and strictly adhere to instructions on pesticide labels before application of the pesticides. In addition, the government should provide incentives to the pesticides agro-vet dealers to stock the recommended pesticide application gears

Keywords: Post-harvest pesticides, maize, safety, Likuyani

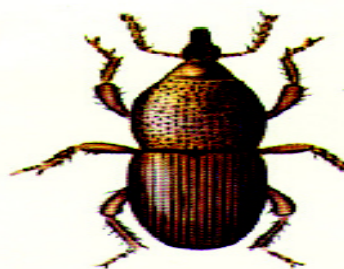
INTRODUCTION

In the last few decades, there have emergence destructive weevil forms, which have caused heavy losses to farmers and threatening food security. Such weevils include the large grain weevil, *Prostephanus truncatus* (also called the scania weevil). Most of the destructive pests have become resistant to popular brands of storage pesticides. The use of agricultural pesticides against pests and diseases is of vital importance, but such substances can create health problems for the user, in addition to environmental pollution if not properly handled (Reed, 1988). Storage pesticides have generally become popular among small-scale farmers due to the increasing destructive nature of new and emerging species of weevil, some which were brought in the country through imported maize. In less than two decades, *P. truncatus* has spread relatively unchecked from Tanzania, where it was first discovered, to 13 countries in East and West Africa. The pest is very widely distributed and causes huge losses of stored maize and dried cassava.

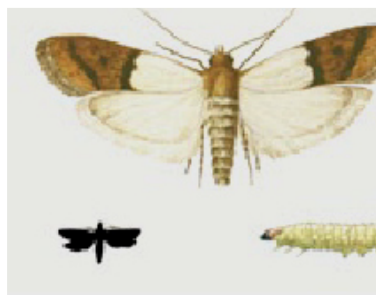
Unscrupulous businesspersons have used the opportunity to market substandard chemical pesticides to unsuspecting farmers, which do not meet the required standards as stipulated in the Pest Control Products Act

(Cap 346, Laws of Kenya). Due to the generally low level of education and lack of forehand information on pesticide handling and application, health problems due to misuse are likely.

In Likuyani Division of Lugari District, Maize is the common and popular crop, which serves as a food crop and cash-crop simultaneously. Thus any loss during storage is usually devastating, due to financial inputs incurred from planting to harvesting. Post harvest pesticides are thus commonly used.



Maize weevil



A moth and its larvae

Figure 1: Examples of pests managed through chemical control

Diversity and effects of post-harvest pesticides used in maize

Pesticides retail shops (agro-vets) have been increasing alarmingly in the last decade. Many types and formulations of pesticides for control of insects, other agricultural pests and weeds are found in these shops. Most of those who sell the pesticides are purely businesspersons in for profit, and employ persons not trained or qualified in handling and providing expert information and assistance to farmers.

Most of the storage pesticides contain organophosphates, carbamates or thiocarbamate compounds. Common pesticide formulations include: Permethrin 0.5% dust - 55 g; malathion 2% dust (50g) Deltamethrin 0.2% dust - 50 g; Fenvalerate 1.0% dust - 50g (g/100 kg maize). Others are a combination of several compounds such as Pirimiphos-methyl and Permethrin. Most of these compounds are toxic and can provoke allergies in sensitive persons. Severe exposure may cause difficulty in breathing. Other symptoms include nausea, headache, loss of joint coordination, blurred vision, stomach cramps and chest tightness. They are also toxic to aquatic organisms.

Safety in handling and disposal

There is no absolute safety for pesticide products. This mainly depends on the product's chemical and physical properties, its toxicity, dose received, and the length of time for exposure (Green, 1977).

Poor handling can lead to exposure through several routes such as oral (accidental, eating at workplace without cleaning hands, reusing pesticide containers for domestic purposes, etc); or dermal through skin contact. Hazards related to pesticide application can be aggravated by lack of personal protective gear, poor personal hygiene, illiteracy of users, misinformation due to ambiguous labels, lack of antidotes and first-aid kits, and poor application methods/equipment.

Justification

Pesticide residues on foodstuffs and in water demonstrate potential non-occupational exposure (He, 1993; Brewster et al, 1992; Krieger et al 1992). Pesticide residues on foods create an important though under-reported exposure route for the general population in most developing countries. Episodes of mass pesticide poisonings often point to ingredients such as seeds, flour, sugar, oils and wheat contaminated with pesticides in storage or transport (WHO, 1990). Food standards in developing countries are typically neither as stringent nor as well enforced as those in the industrialized world, and pesticide residues are often found on agricultural products.

The use of pesticides in the agricultural sector will continue to increase in the foreseeable future. This is due to several reasons. Firstly, more and more pests are becoming resistant to some pesticides in use, hence necessitating the application of higher doses and introduction of new pesticides. Secondly, the need to produce more and more food for the expanding world population is becoming increasingly urgent

(Akhabuhaya, 1988). Thus more and more pesticides will therefore have to be used in order to reduce the currently estimated 45% loss of potential production. 30% of this loss is as a result of pests, weeds and diseases before harvest while 15% is due to post harvest losses (Akhabuhaya, 1988). It is imperative that the potential dangers and their causative factors be established and assessed to provide information for designing possible intervention strategies.

Scope of the Study

The study covered the administrative region of Likuyani division in Lugari district, Kenya. It scrutinized the acquisition, handling, storage and application of the post harvest maize pesticides by individual farmers in the region. Thus educational institutions, research organizations, agricultural corporate bodies or farming institutions were not investigated.

The study also investigated the possible environmental health and safety implications of the pesticide misuse and mishandling by making reference to other relevant studies and researches undertaken by other scholars. The said studies and the respective scholars have been cited in this paper. Thus the actual analysis to investigate the precise level and extent of poisoning as a result of misusal of post harvest maize pesticides in the division was not undertaken. In addition the health implications of consuming unwashed treated maize were not subjected to any scientific tests. However, possible health impacts were derived from literature reviews. Finally, The chemical analysis of the pesticide ingredients was also not undertaken to authenticate the presence of the chemical ingredients as indicated on the pesticide packages.

LITERATURE REVIEW

Most of the poisonings and environmental problems caused by pesticides in the third world countries stem from the misuse (or indiscriminate use) and mishandling or careless/improper handling) of the pesticides as briefly explained here below.

The first is the farmers' ignorance. The ignorance of farmers concerning the hazards of pesticides may cause them to mishandle these chemicals. The second issue is poverty. Inadequate funds both for the farmers and governments in the developing world, has forced many farmers to use poor and leaking equipment, improper or no protective clothing, wrong or no antidotes and inadequate and poor handling utensils and equipment. Another aspect is the issue of misleading advertisements and marketing practices. Due to the present marketing competition, many pesticide firms are inclined to label and advertise their products misleadingly (Akhabuhaya, 1988).

Direct observations of pesticide handling, spray operations and disposal confirm significant occupational exposure. Observations of household practices in pesticide storage and disposal, proximity to pesticide applications and washing and food preparation establish that rural household members can be exposed through various routes.

These observations are confirmed by biological measurements of pesticide residues in body and acetylcholinesterase depletion. The presence of persistent bio-accumulative pesticide residues in foods, body tissues and breast milk indicate that consumers far removed from agricultural operations can also be significantly exposed. A large body of experimental evidence based on *in vitro* and *in vivo* models suggest that many of the pesticides to which such populations are exposed, damage the immune system. (Repetto and Baliga 1996).

Most lapses in safety precautions occur in the developing world, where inadequate safety and hygiene practices are the norm while applying, formulating, storing, transporting and manufacturing pesticides. There, most farm workers are not trained in safe pesticide use and the few regulations that address farm-worker safety are unrealistic or un-enforced (Dinham,1993). Pesticide warning labels do not ensure safe use. Often, they are printed incorrectly or in the wrong language and many users are illiterate. A survey by the Thai Division of toxic substances found that 44 per cent of randomly selected pesticides formulations had the active ingredients incorrectly labeled (Tayaputch, 1988).

The major health problem arising from the use of pesticides is the acute and sub-acute poisoning which results from repeated exposures during pesticide application. Studies from Sri Lanka have shown that approximately one thousand fatalities occur each year due to the unsafe handling of pesticides. Extrapolating these figures to developing countries as a whole, suggests that about 220,000 fatalities are likely to occur annually. Recent estimates indicate that over 350,000 cases of pesticide poisoning occur in Kenya each year.

However, pesticides and other agricultural chemicals can result in serious cases of poisoning through contaminated food and water (Choudhry and Levy, 1988).

METHODOLOGY

Primary data collection

The population of the study comprised 90 individual farmers in Likuyani division. The sampling procedure was through simple random sampling. It also included 6 agro vet dealers in the division. Both primary and secondary methods of data collection were used. Primary data was collected through interviews and observation schedules.

Interviews were administered through purposive sampling. Information on whether they stocked any antidotes and first aid kits in case of pesticide poisoning was sought. Inquiries were also made on whether they stocked the recommended pesticide application gears such as masks (that cover both mouth and nose) gloves, overall/overcoats goggles, boots, face-shield, hat etc.

Participant observations were done without prior knowledge of the observed participants, to find out how the agro vet dealers dealt with their clients with reference to the provision of all the pesticide product brochures and leaflets, measuring gadgets and the sale of application kit.

The brand names of the 5 pesticides investigated were not used to avoid any possible court litigation. However, they were given identification codes for ease of identification and explanation. The identification codes were as follows. The first pesticide was regarded as pesticide "A", the second pesticide "B" the third Pesticide "C", the fourth pesticide "D" and the last pesticide "E". The labels on the packages of pesticides sold by agro vet shops to the farmers in the division used by the farmers were investigated in regard to the 1977 ILO guidelines on the safe use of pesticides.

Secondary data collection

This was obtained from relevant books, relevant laws, journals and researches undertaken on pesticide usage in developing countries especially in Kenya. In these data particular emphasis is laid on the possible environmental, health and safety implication of pesticide misuse.

Data analysis and Presentation

Both qualitative and quantitative methods of data were used. Qualitative methods mainly involved description and explanation and charts. Quantitative methods involved mainly use of numerical data, and use of percentages

STUDY FINDINGS AND DISCUSSION

Labeling Requirements

None of the five pesticide investigated adhered to all the guidelines recommended by ILO and those set out by the PCPA cap 346 Laws of Kenya. The results of the instructions labels of the 5 pesticide brands investigated are summarized in the following two charts. Table 1 gives a summary of the instruction labels of the five-pesticide brands vis- a vis the ILO recommendations, while Table 2 summarizes the findings of the pesticide labels in comparison to the guidelines set out by PCPA cap 346 Laws of Kenya. As earlier explained, the brand names of the five pesticides investigated were not used but were given identification codes.

The first was Pesticide "A", the second pesticide "B", the third pesticide "C", while fourth and fifth were pesticides "D" and "E" respectively. A legend is provided after each of the two Tables to enable the reader analyze Table 1 and 2below.

Chart 1 Results of the labels on the five pesticides vis –a- vis the ILO recommendations.

SAFETY OF PRECAUTIONS TO BE TAKEN IN HANDLING AND USE	PCP 'A'	PCP 'B'	PCP 'C'	PCP 'D'	PCP 'E'
Caution to be taken by those advised by doctor not to use any chemical compound in the pesticide	A	A	P/TS	A	A
Don't consume	P/NTS	A	A	A	A
Don't smoke when using pesticide	A	P/TS	P/TS	P/TS	P/TS
Don't drink when using pesticide	A	A	P/TS	P/TS	P/TS
Don't eat when using pesticide	A	P/TS	P/TS	P/TS	P/TS
Avoid inhalation of pesticide dust	P/NTS	P/TS	P/NTS	P/TS	P/TS
Avoid contact with skin	A	A	P/NTS	P/PTS	A
Avoid contact with eyes	A	A	P/PTS	P/TS	P/TS
Wear protective clothing	A	A	P/TS	P/NTS	P/TS
Wear/put on a hat	A	A	A	P/NTS	A
Use hand gloves	A	A	P/NTS	P/TS	P/TS
Mask covering nose	A	A	P/NTS	A	A
Mask covering mouth	A	A	P/NTS	A	A
Mask (no directions to cover both nose and mouth)	A	A	N/A	P	IP/TS
Eye protection	A	A	A	P/TS	P
Footwear e.g. boots	A	A	A	P/TS	IP
Use of overall/overcoat	A	A	A	P	P
Use of face shield	A	A	A	P/TS	A
Wash with soap and water after mixing & handling	P/NTS	P/TS	P/TS	A	P/PTS
Change work clothes and wash them	A	A	P/TS	A	A
Gadget for measuring pesticide provided by manufacturer	NPR-S PR/W-C	NPR	PR/NW	PR	A
Don't re-use packs/containers	A	A	P/TS	P/TS	P/TS
Don't dump pesticide in water	P/TS	P	P/TS	P/TS	A
Application ratios	P/TS	P/TS	P/TS	P/TS	P/TS
Environmental hazards/caution	A	A	P/TS	P/TS	SNS/T
Wash grain before consumption	A	P/TS	A	A	A
Recommended mixing implement	A	A	P/TS	P/TS	A
Brush pesticide dust from skin	A	A	P/TS	P/NTS	A
Specified active ingredients	P	P	P	P/TS	P

Table 2 Summary of the findings of pesticide labels in comparison to the set guidelines(Cap 346)

STORAGE OF PESTICIDE	Pesticide	Pesticide	Pesticide	Pesticide	Pesticide
Life span of treated grain	A	A	P/TS	A	A
Store pesticides in originally tightly sealed sa /containers	A	A	P/TS	A	A
Store away from children	P/PTS	P/TS	P/TS	P/A	P/TS
Store away from Human food	P/TS	A	P/PTS	A	P/TS
Store away from Livestock	P/PTS	P/PTS	P/PTS	A	P/TS
Store away from Medicine	A	A	A	A	A
Store away from other chemical	A	A	A	A	A
Store away from water	P/TS	P/PTS	NA	P/TS	A
Storage environment					
Cool place	A	A	P/TS	P/NTE	P/TS
Well ventilated place	A	A	P/NTS	P/NTE	A
Dry place	A	A	P/TS	P/NTE	P/TS
Date of manufacture	P/NTS	P/NTS	P/NTS	P/NTS	P/NTS
Shelf life	P/NTS	P/NTS	P/NTS	P/NTS	P/NTS
Nature of early symptoms indicative of poisoning	A	P/NTS	P/TS	P/NTS	SNS/NTS
First Aid in case of the following forms of poisoni					
Inhalation	A	A	P/TS	A	A
Skin irritation/contact	P/NTS	A	P/TS	P/NTS	P/TS
Eye irritation	P/NTS	A	P/TS	P/TS	P/TS
Ingestion	P/NTS	P/NTS	P/TS	P/TS	P/TS
Antidote	A	P/NTS	P/TS	P/NTS	P/TS
Antidote administration instructions	A	P/NTS	P/TS	P/NTS	SNS/TS

Table 3: Instructions on disposal of pesticides

DISPOSAL OF EMPTY PACKS	Pesticide	Pesticide	Pesticide	Pesticide	Pesticide
Proper disposal of empty packs by burying or bu .	A	IP/NTE	P/TS	P/NTS	P/TS
Disposal away from water sources	A	A	P/TS	P/NTS	A
Disposal away from human habitation	A	A	A	P/NTS	A
Disposal of accidentally spilled pesticide dust	A	P/TS	P/TS	P/TS	A

Legend

PCP-Pest Control Product NTS - Not translated into Swahili PR -provided

P- instructions present PTS - Poorly translated into Swah NPR -S- Not provided for sachet

A- instructions absent NP - not provided PR/NW - provided and not wrapped

TS- Translated into Swahil NPR - Not provided PR/W -C- Provided and wrapped fo

The Pesticide label findings vis-vis the Pest control Products ACT cap 346.

Most of the clauses highlighted by the PCPA cap 346 were subjected to verification. However the clause that states that the instructions should be indelible was not subjected to any tests as trying to rub them to see whether they are indelible. The observations were broken down from the requirements that have been explicitly expounded by the PCPA cap 346. There were some weaknesses on the PCPA that have been made. These weaknesses are as follows. First, there is no mention of the manufacturing date and shelf life. These factors are important to the buyer so that they not buy any expired product. Although all the five pesticides investigated had a manufacturing date and a shelf life, none had any translation on this, According to the PCPA, every information in the label must be translated into Swahili and must be conspicuous, legible and indelible. The Act also states that dangers that may arise from pesticide handling should be indicated. However it does not state that all the dangers/hazards should be indicated. This means that the manufacturer can just indicate one of the hazards or just a few. In addition, it does not indicate that all-protective clothing to be worn when using the pesticides. It just states that protective wear should be worn.

This makes the manufacturers not to feel bound to indicate all the needed protective wear in their instructions to users. Further, a clause should be included to compel the manufacturers to direct the farmers and other end users of the pesticide products to wash the grain before consumption. The PCPA states that the packages or labels of PCP should not have any mark that shows that they have been approved by any government agency. This requirement appears counter-productive, as consumers/farmers need to know PCPs that are approved and those that are not. Just as how Kenya Bureau of Standards puts its seal of approval on various consumer products to assure consumers of their quality.

Farmer's responses.

A total of 90 farmers were interviewed. Of these, 87(97%) used chemical pesticides to protect their maize harvest from attack by weevils. All the 87 respondents said that they mainly bought their pesticide from agro vet shops within the Lugari district. For the 3(3%) who never used chemical pesticides, the reason they gave was that their harvest was small and intended to sell the maize immediately after harvest. The three farmers were thus not interviewed. The 87 farmers who used chemical pesticides were interviewed using an interview schedule as explained in chapter three. The farmers answered questions, which shed light on what precautions they undertook to ensure their safety during handling, storage and use of the respective pesticide(s) they used. In information on how they prepared to administer first aid in case of pesticide poisoning was sought. Finally they were to explain how they disposed the empty containers. Their responses in regard to these issues are as elaborated hereafter.

Out of the 87 (100%) farmers who applied post harvest maize pesticides 44% indicated that they used pesticide "A". 31% said that they used pesticide "B", 13% responded that they used pesticide "C" while pesticide "D" was used by 6% of farmers. Finally 3% responded by saying that they used pesticide "E". In addition, another 3% of farmers said that they mixed two types of pesticides. Out of the three farmers that mixed the pesticide, one mixed pesticide "A" with pesticide "C" and two mixed pesticide "B" with pesticide "C". The respondents who mixed the pesticides said that they did that to improve the protection of their harvest from weevil attacks.

The farmers were asked whether they actually read all the pesticide instructions or read them partially before applying the respective pesticides. It was noted that none of the respondents actually read all the instruction labels despite the fact that all the 87 (100%) farmers said that they were either able to read Swahili or had a reliable person within the household who could read the instructions for them. 64%) of the farmers said that they partially read the instructions while the remaining 36% did not read the instructions at all.

Out of the 87 farmers, 78% used pesticides which had no measuring can provided by the manufacturer to assist them measure the recommended quantity of pesticides to be administered/admixed with the given weight/amount of grain in the instructions while the remaining 22% farmers were provided with such a gadget. All the 19 farmers who had such a gadget indicated that they used it to measure the recommended amount of pesticide. The 78% farmers who did not have a measuring gadget provided for them decided on the pesticide quantity by learning from their friends or watching how others administered it. They administered it liberally on shelled grain, which was spread on mats or bare-ground(where grass and vegetation had been removed) and then mixed it using bare feet. All the 87(100%) farmers said that they used bare feet to mix the pesticide with the grain despite clear instructions in some of the pesticides to use a spade instead and to have footwear.

All the 87(100%) respondents said they would not distinguish pesticide poisoning from any other illness nor were they aware that symptoms of pesticide poisoning were supposed to be indicated on pesticide labels. Asked where they stored the pesticide after buying,5 (6%)respondents said that they stored it in the kitchen,13 (14%) stored it in granary, 24 (28%) in sitting room and 45 (52%) stored in bedroom. A Kenyan study reported that 62 per cent of farmers store pesticides in areas used for sleeping or cooking. Half used cooking pots or water containers to mix pesticides (Mwanthi and Kimani, 1993b).

The respondents were also asked what application gears they used in the application of the pesticides. It was realized that none used all the application wear as recommended in the pesticide instructions. In particular, 13 (14%) farmers used masks that covered mouth and nose, while 7 (8%) used overalls/overcoats. Only 1 respondent (about 1% of respondents) indicated that he washed the grain before consumption. The rest never washed grain before consumption although pesticide "B" had clear instructions which recommended the washing of grain before consumption. 20 (23%) respondents said that they investigated the manufacturing date and the shelf life of the pesticide before purchase.

CONCLUSION AND RECOMMENDATIONS

The manufacturers of the PCPA are not adhering to all the regulations and statutes as expounded by the ILO 1977 recommendations and the PCPA cap 346 laws of Kenya and. This means that the Pest Control Products Board, the Government agency mandated by the PCPA to ensure compliance with this Act Cap 346, is lax in its operations. In addition, the PCPA has some weaknesses as already noted in the text. This means that the health, and safety of farmers and consumers of the treated grains is currently being compromised. In addition the disposal of empty pesticides packages is likely to dispose the quality of our environment.

In view of these findings, the study recommends that the government, through the Pest Control Products Board, should improve the enforcement of relevant laws to ensure that pesticide manufacturing companies adhere to all guidelines on labeling as expounded by the provisions of the Pest Control Products Act (Cap 346) and the ILO regulations and guidelines. The study also recommends that any additional brochures or leaflets should be wrapped in the pesticide packaging in a way to ensure that the targeted clients (farmers) access them. The current state where some leaflets are tied with a rubber band around the pesticide packages is ineffective in ensuring that the said brochures or leaflets reach the intended farmers. Regular monitoring of agro-veterinary shops would ensure only safe and approved pesticides are used by the farmers. There is also need to compel manufacturers to provide gadgets to assist farmers in measuring the recommended amount of pesticide during the application of the pesticide(s). In addition instructions should indicate that treated grain should be washed before consumption. Further, the government should encourage farmers through mass media and agricultural extension services, on the need to comprehensively read and strictly adhere to instructions on pesticide labels before application of the pesticides. In addition, the government should provide incentives to the pesticides agro-vet dealers to stock the recommended pesticide application gears.

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Social-Cultural Uses of Wild Wood Ear Mushrooms of Western Kenya

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Abstract

Wild edible mushrooms are an important food resource in Western Kenya. Harvesting and marketing wild mushrooms is a serious income generating business in Kakamega, Western Kenya. The mushrooms are often collected mainly from the forests and terrestrially, during fruiting seasons. For decades, they have been utilized for social and cultural purposes. In Western Kenya, they are commonly used as a source of food for nutritional purposes, medicinal, fetish protection articles/objects and for life-span longevity. A study was conducted to determine various aspects of mushroom as a resource. The study was conducted through oral interviews. Mushroom pickers and elderly persons in the community around Kakamega forest were identified and interviewed. Information was gathered on the social cultural issues of mushroom typologies, occurrence, gender role in collection, consumption and preparation, host tree species in relation to mushroom quality and the comparative differences between the traditional and contemporary culinary methods of preparation. The study revealed that indigenous knowledge with regard to mushrooms passed from generation to generation helped conserve and preserve the forest resources sustainably. Mushrooms were not only a restricted food source to man but also to forest animals especially the monkeys. Mostly men are the forest mushroom pickers and children pick terrestrially. The quality of specific wild mushroom species correlated to the kind of tree host species. Only a few species of forest mushrooms were edible.

Key words:Indigenous-knowledge;Gender; Culture; Wood ear mushroom

INTRODUCTION

The utilization of mushrooms by man predates recorded history. Historical data indicates mushroom cultivation and utilization occurred in ancient civilizations of China, Rome, Greece, Egypt and Central America (Ivors, 2003). Asian civilizations particularly China, have cultivated edible mushrooms for almost 1400 years since the first mushroom *Auricularia auricula* (wood ear) was first cultivated in China around 600 A.D. Enokitake (*Flammulina velutipes*) was cultivated around 800-900 A.D., shiitake (*Lentinula edodes*) around 1000-1100, button (*Agaricus bisporus*) around 1600, Paddy straw (*Volvariella volvaceae*) around 1700 and white jelly (*Tremella fuciformis*) around 1800 and oyster (*Pleurotus ostreatus*) around 1900. Of the leading mushrooms that were cultivated before 1900, only button was not first grown in China. Commercial cultivation of mushrooms began in the 17th century in France (Chang and Miles, 1987).

Wild mushrooms including wood ears (*Auricularia* spp.) are important natural resources. The highly prized wild, particularly the symbiotic mushrooms that also include African indigenous species of *Termitomyces microcarpus* and *T. giganteus*, have drastically fallen in harvest numbers, due to poor management of the environment. Pollution especially fertilizer application and plant diseases have damaged their natural habitats. Therefore, efforts are needed to protect the environment in which these mushrooms grow. This includes researching to better understand the relationship between the mushrooms, ethnobotany and their growing environment and in particular, researching into the symbiotic mushroom relationships with their hosts.

The most common wood ear mushrooms comprise *Auricularia auricula* and *A. polytricha*. These are two of the most popular edible species. Species of *Auricularia* are found worldwide and *A. polytricha* occurs in both tropical and subtropical regions (Cheng and Tu 1978). *A. polytricha* is prevalent in the tropics and *A. auricula* in temperate regions of the world. Wood ear mushrooms are the fruiting bodies of a fungus that invades and lives in the wood of fallen logs of several tree types. They resemble ears in shape and are gelatinous (with unusual jelly-like texture), elastic, rubber to leathery in texture and brownish-purplish in colour. Most are more solid than jelly. They can be found very soon after a rainfall. Most of them have the uncanny ability to dry out then re-hydrate. The fungi are spread by airborne spores produced on the basidiocarps. Spores landing on suitable substrate germinate, penetrate the wood and produce mycelium that grows throughout the wood. When the fungus sporulates, basidiocarps or wood ears are produced on the log surface and they have been collected in the wild in Kenya for many years.

The wood ears are of great economic importance globally. *Auricularia polytricha* was one of the edible fungi in ancient China. The precise time when the mushrooms were cultivated remain uncertain. Cheng and Tu (1978) proposed at least as early as 300 BC while others proposed 600 AD. The mushroom is prized in Chinese cuisine and is commonly used to give texture to soups. They became an export product to the Chinese in China and San Francisco during the late 1800s (Anon. 1914). They were also exported from New Zealand during the same period (Stamets 1993). The earliest record of this species was recorded in about 200-300 BC. The commercial cultivation of this mushroom species is concentrated throughout the South Pacific and Asia. The cultivation and exportation of *Auricularia polytricha*, in Hawaii was substantial in the 19th century and probably was its first effort at cultivation of mushrooms. Regardless of where it is utilized, it has a common name which makes reference to the ear-shaped structure of the fruiting body, *Matere* (lobed) in Kenya (Isukha's dialect), *Mu-Erh* (wood ear) in China, and *Pepiao* (ear) in Hawaii, just to name a few. The fruiting bodies are usually brownish to reddish brown and have a consistency of jelly. In nature, the two species are saprobes that grow on tree logs. Thus, the cultivation of these species is the same as that of the *Shiitake* and the *Oyster Mushroom*.

The genus *Auricularia* spp. is classified in the order *Auriculariales* in the basidiomycete group of fungi and contains a number of species (Alexopoulos et al. 1996). *Auriculariales* is the largest order of jelly fungi and the fruiting bodies are basidiocarps. Many of the species are produced on wood. The brown, rubbery, earlike structures may reach 4 to 6 inches in diameter and are produced on dead stumps, logs and branches of hardwood trees. *Auricularia* spp. has a high content of indigestible polysaccharides and dietary fiber. The protein, vitamin and carbohydrate content are reported to be higher than that of many vegetables and fruits and the caloric content is relatively low (Cheng and Tu, 1978). As a result, they make a nutritious ingredient of soups or other dishes. Dried mushrooms need no further processing or refrigeration and could be sold to local markets, hotels or restaurants.

Besides its culinary value, wood ear mushroom has been used in China as medicine. Chinese herbalists have used them medicinally for more than four thousand years. It is particularly useful for stopping pain and bleeding, and is regularly prescribed in traditional Chinese medicine to treat hemorrhoids and excessive uterine bleeding (Ying et al., 1987). Pharmacologically, the polysaccharides have been used as immune toxins, anticoagulants and to lower cholesterol. It is reported that extracts of *Auricularia* spp. prevent egg implantation in animals terminating early and mid-pregnancy (He and Chen, 1991). Owing to this possible teratogenicity, it is recommended that *Auricularia* spp. extracts should not be taken by pregnant or lactating women and those planning to conceive.

There is paucity in information on East Africa and especially Kenya with regard to the traditional value of indigenous mushrooms amongst the communities that consume mushrooms. Despite the large scale utility of wood ear mushrooms for food and medicine by residents of the larger Kakamega region, hardly any literature is available on the ethnobotany. There has been no deliberate effort to record the cultural importance of the mushroom. The social and cultural uses of mushrooms in Kenya remain undocumented. However, indigenous edible mushrooms remain a priced relish amongst consumers. It is well known that the people of Western Kenya especially those that reside near the Kakamega forest, have a cultural attachment to their collection and consumption. However due to forest destruction and changing lifestyles, besides the old, less young people are cognizant of the cultural value of most of the traditional mushrooms. There is therefore need to document the indigenous knowledge associated with cultural and social importance of wood ear mushrooms in Western Kenya.

This study was therefore conceived to study the socio-cultural aspects related to the uses of wood ear mushrooms among the communities residing around the Kakamega forest. The basic question the study attempted to answer was; what are the cultural and social roles of wood ear mushrooms in Kakamega? Information was therefore gathered on the social- cultural aspects of mushroom typologies, occurrence, gender role in collection and preparation, host tree species in relation to mushroom quality.

Approach

The study was conducted around the Isecheno reserve of Kakamega forest. A stratified sample of informants drawn was used to collect social and cultural information associated with wood ear mushrooms. The informants were sampled on the basis of either old age (75 years and above), medicine men or custodians of the Isukha community culture. All the informants were elderly, spoke the Isukha language and were residents of around Isecheno forest reserve. Generally, data pertaining to wood ear mushroom utilization, methods of preparation and reasons for such practices were investigated by conducting participant observations, oral interviews and focus group discussions. Generally, data pertaining to wood ear mushroom utilization, methods of preparation and reasons for such practices were investigated by conducting participant observations, oral interviews and focus group discussions using the above described informants.

To identify ear wood mushroom host trees, mushroom forays were conducted to collect ear wood mushrooms in Kakamega forest. On these trips and with the aid of forest guides, information on ear wood mushroom types and host tree species was collected. Identification of tree species was conducted using botanical and taxonomic characteristics. Data collected included the texture and colour of the mushroom, local and scientific names of the host trees. A critical analysis of the cultural perceptions of the mushrooms was derived by correlating qualitatively the traditional uses of the mushroom host trees and uses of the ear wood mushrooms in communities residing around the forest.

To document the traditional uses of wood ear mushrooms, interview respondents were drawn from a diverse background of informants (as described above) and included perennial commercial mushroom pickers, forest guides and traditional medicine men. The questions asked were structured to collect information concerning uses of wood ear mushrooms. To determine the medicinal purposes as practiced in the past and at present, medicine men residing around the Kakamega forest were interviewed on the medicinal values of wood ear mushrooms. The information gathered included: illnesses cured or prevented; methods of preparing medicine for administration, that is, whether the medicine was administered as powder or after boiling and the correlation between mushroom host trees and their medicinal values.

The role of gender in wood ear mushroom collection, processing, preparation and consumption was investigated. Reasons for these practices were examined to provide in depth understanding of the perception of the activities in the community. The procedures for cooking wood ear mushrooms were investigated and documented.

Results & Discussion

Ear wood mushrooms collected from Kakamega forest were predominantly of one type, *Auricularia* spp. Variations were observed in the characteristics investigated. These characteristics included; colour, texture, and size. The mushrooms occurred in two distinct colours, dark brown, light brown and off white with the majority being dark (Figure 1). The light brown mushrooms (figure 2) were rare and limited in distribution. The relative abundance of the dark mushrooms was very higher than light brown mushrooms. In fact, the population of the dark wood ear mushrooms was very high and occurred in groups or clusters. The number of wood ear mushrooms on a given log or tree stump was high. Mushroom texture was variable and depending upon several factors including mushroom colour and host tree species. As a result, most of the light brown mushrooms were slimier than the dark mushrooms which tended to be more firm. In addition, it was observed that dark or brown mushrooms were found growing on specific trees although occasionally both species could be found growing on the same host tree (Table 1). The size of the dark mushrooms generally large and highly variable whereas the light mushrooms attained a relatively small size.

Culturally, the mushrooms are mainly used as sources of food and medicine. Dark coloured mushrooms are preferred over the brown type for eating purposes. Those interviewed sited firmness as a preferred attribute when selecting wood ear mushrooms for consumption. The lighter ones are more delicate while the darker ones have a more concentrated taste. For instance the, *Diosporos abyssinica* tree in comparison to other tree hosts is famous for the production of very large sized, dark coloured and tasty wood ear mushrooms.

The role of gender in mushroom collection, preparation and consumption in this community is diverse. Unlike other food types, the task of collecting wood ear mushrooms as was in the olden days, is reserved for the men. Women would often not be directly charged with this responsibility since the collection entailed access to the forest which is often infested with snakes and other scary wild animals. This explains why men foray for forest mushrooms. The forest was sacred to women who had reached childbearing age.

A forest was a shrine and therefore a sacred place where cultural rituals including cleansing, cursing and blessing occurred. Only the elderly members including women who were beyond child bearing age were allowed access to the forest. However, in the process of gathering wood for fuel, women have picked mushrooms.



Figure 1. Dark coloured wood ear mushrooms growing on fallen tree trunk



Figure 2. Light brown coloured wood ear mushrooms growing on a tree stump.

Today men in communities surrounding the Kakamega forest regard picking of wood ear mushrooms as a source of food and income. However, collection of non-forest mushrooms is solely done by women and children. Reasons attributed to this practice include; cultural beliefs on women and forest access, avoiding competition from other pickers, unsustainable harvesting and identification of edible species, collection times, risks from wild animals in forests; vulnerability of women and children to abuses, beliefs and practices associated with collection and transportation of the mushrooms from the forest. Often, picking is undertaken very early in the morning and extreme care is exercised in preventing over-harvesting and transportation of the otherwise very fragile mushrooms. Mushroom picking sites remain highly guarded secrets by pickers in order to minimise competition. Harbingers of luck have to be observed early in the morning before getting into the forest and they include placing a dried sample of a wood ear mushroom on your body.

Table 1: Wood ear host tree species and mushroom characteristics.

Host tree	Common name of host	Local name of tree *	characteristics (Colour of basidium and host tree characteristics)
Ficus thoringu	-	Mukumu	Dark, light, host tree treats chest infections
Olea capensia	Elgon teak	Mutukuyu	Dark, light
Markhamia lutea	-	Lusiola	Light
Funtumia africana	-	Mutondo	Light
Diosporos abyssinica	-	Lusui	Dark, big sized and tasty
Polycius fulva	-	Mwaanzu	Light, host tree protects against lightning
Croton megalocarpus	-	Musine	Dark, light
Albizia grandprateta	-	Mukhunzulu	Light, host tree treats stomach ailments
Ficus lutea	-	Mukavakava	Dark
Croton silvaticus	Forest croton	Musutsu munamuli	Light
Malinigara butangi	-	Lutolia	Dark, Very tough
Albizia spp.	-	Mukangu	Dark, host tree treats stomach infections, boosts immunity
Ficus exasparata	-	Museno	Dark, host tree Treats chest infections

* The local names used are of the Isukha community dialect

Indigenous knowledge pertaining to sites of collections and cleansing practices prior to conducting mushroom collection trips were passed over from fathers to young male children. This way, the male children were equipped with knowledge that enabled them to; collect the most delicious ear wood mushrooms, determine collection seasons, protect themselves against evil while in the forest, and even when to water drying logs to enhance sprouting and growth and thereby ensuring a steady supply of mushrooms all year round. Unfortunately, those still practicing log watering for continued supply of the mushrooms in the forest do not relate the practice to mushroom cultivation under forest storey.

Processing and preparation of wood ear mushrooms is done by women. The wood ear mushrooms in the olden days was an alternative to meat. Today, upon collection, freshly picked mushrooms are processed by sun-drying to a crispy state for storage (Figure 3). For cooking purposes, the dried mushrooms are re-hydrated to a thick fleshy state by soaking in water for several hours. The reconstituted mushrooms are then prepared in various ways. They can be cooked fresh or dried. The mushrooms can also be cooked by boiling or frying. They can be served singly or alongside other dishes such as “ugali” (baked maize flour porridge), banana, meat, beans, “thripes” (animal intestines). Traditionally, the mushrooms were cooked with a derivative of bicarbonate of soda but hardly fried. Presently, the mushrooms are both boiled in bicarbonate of soda and fried with fat.

Wood ear mushrooms are traditionally used as medicine to cure diseases and for protection. As such, they were used as fetish objects for protection against ailments and misfortunes. Dried pieces of the mushroom would be crushed into powder and administered to children to protect them from witchcraft and psychotic ailments. To date, mushroom pickers use dried wood ears (figure 3) to protect themselves against wild animals and snakes in the forest and also used as a harbingers of luck for locating mushroom sites. In men the wood ear is believed to enhance sexual potency. In addition, it is used as a treatment against, stomach ailments, heart related problems, epilepsy and general body pains like headache. The light brown types are believed to be memory boosters. The dark wood ear types are believed to be anti-hallucinogenic. Wood ears from the *Diosporos abyssinica* trees were solely used for medicinal purposes. The mushroom is also used as an immune booster to the body and particularly when consumed in small quantities. It is not surprising that, wood ears were recommended for eating twice of thrice a month to avoid overdose which was regarded to have adverse effects on the body such as aggravating illnesses. Consequently, consumption of wood ear mushrooms is believed to enhance immunity against many ailments when consumed in small quantities regularly. Conversely, over consumption compromises body immunity predisposing consumers to diarrhoea and general weaknesses of the body. Overall, edibility of wood ears was associated with life longevity by the old.

There is a correlation between the medicinal values between wood ear mushrooms and their host trees. Most host trees of wood ears have medicinal values. For instance, *Polycius fulva* protects against lightening which is considered a mysterious problem. *Albizia grandprateta* treats stomach ailments while *Albizia* spp. is used to treat stomach infections and to boost immunity. *Ficus exasparata* is used to treat chest infections.



Figure 3. Dried wood ear mushrooms for sale.

Africa appears to be generally mycophilic. There are some some regions, such as Nigeria, where mushrooms are a part of everyday life. Communities in Western Kenya are also mycophilic. In this region and particularly in communities residing around the Kakamega forest, mushrooms are a part of everyday life as food, charms and remedies in traditional medicine. The most preferred mushrooms are the symbiotic species,

Termitomyces microcarpus and *T. giganteus*, which are associated with termite nests. There are also myths concerning mushrooms that are unique. All edible mushrooms contain substantial amounts of protein and trace minerals, and many also have medicinal properties. These medicinal effects are probably the result of complex molecules present in the mushroom and mycelia called polysaccharides that the fungi produce to inhibit the growth of molds and bacteria in a mushroom.

Mushrooms generally contain many substances which support good health. Species contain alkaloids, nucleotides, proteins, triterpenes, polysaccharides and unsaturated fatty acids which have positive health effects. The surprisingly rich blend of polysaccharides contained in specific mushrooms has received a lot of scientific attention in the past few years (Ikekawa, 2002). The ability of polysaccharides to stimulate the human immune system has been established beyond question (Ikekawa, 1995; Xia, 1978). Different polysaccharides appear to support different elements of the immune response. Once in the body, a few medicinal mushrooms seem to be able to transmute metabolic waste and neutralize toxic accumulations without provoking eliminative catharsis as a consequence (Li et al., 2001). They are a safe and effective medicament that has been valued over thousands of years of human civilization. The result is that mushrooms, especially in combinations, can have broad and impressive effect on human health.

The culinary value of wood ear mushrooms in Western Kenya as is the case in South East Asia and Hawaii can not be overemphasized. Chinese mushrooms refer to them as "meat without bone" (as is tofu in Japanese). They are believed to be healthy and have considerable incomplete protein in form of amino acids in their composition. It has been postulated that 100g of dried tree ears contain 11g of protein, almost no fat, and 65g of carbohydrate, about 400 mg of calcium, 200 mg of phosphorus, 400 mg of iron, and various polysaccharides.

Auricularia spp. also has significant medicinal properties and has been used for many centuries in traditional herbal remedies all over the world. Owing to its resemblance to the folds of the throat, in Europe in the 1800's, *Auricularia* spp. was boiled in beer, milk, or vinegar and was used to treat throat ailments. Because its gelatinous consistency could bind eye medicine, it was also often used as a salve to treat eye ailments. *A. auricula-judae* and *A. polytricha* were used in China to cure hemorrhoids and strengthen the body, maybe by stimulating the immune system. It was also sometimes used to treat hemoptysis, angina, diarrhea, and warding against gastrointestinal upset. They are also widely used to treat debility caused by childbirth, relieve pains and muscle spasms, to stimulate bowel activity, and to even build intelligence quotient.

In modern medicine, *Auricularia* spp. has been reported to contain pharmacologically active agents. It has been shown to block blood clotting by obstructing the platelets. There is some evidence that regular ingestion of *Auricularia* spp. in small doses can be therapeutic in preventing strokes and heart attacks. However, cases of internal bleeding from sensitive people who accidentally ate too much sweet and sour soup combined with stir-fry containing this fungus may occur.

Other therapeutic uses of *Auricularia* spp. from modern medicine include; lowering blood cholesterol and triglycerides. There is even some evidence it can play a role in treating diabetes and cancer, and some studies claim it can reverse ageing by increasing SOD activity for DNA repair. However, due to the possibility of anti-fertility effects, this fungus is not recommended for pregnant or lactating women, as well as those intending to conceive. There is also a report of a man who consumed over 250 grams of this fungus who developed a severe "solar dermatitis," making his skin very sensitive to sunlight. Although there is anecdotal information such as this, general side effects are not well documented or expected.

Ancient and modern Chinese believe wood ear mushrooms are good for infections of the lungs since they clear irritations and smooth its surface. They also recommend them for hemorrhoids and as cleansing agents for both stomach and intestines. They are also used to quicken blood and to stop bleeding. Western science now agrees that tree ears play a role in blood coagulation due to their possession of anti-coagulants. Above all like in communities of Western Kenya, the Chinese believe wood ear to be a longevity tonic.

Conclusions

Wood ear mushrooms are an important natural resource amongst communities residing around the Kakamega forest. Besides being a source of food and medicine, they are a source of income for pickers. The mushrooms medicinal values are used traditionally in disease prevention, curing and protection. Amongst the Isukha community, gender determines the picking, preparation and consumption of wood ear mushrooms. However, there is need for more studies to document the social economic importance of the mushrooms in rural

households and for the identification and evaluation of the active medicinal compounds in wood ear mushrooms.

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VALIDATION OF SATELLITE RAINFALL ESTIMATES OVER THE NYANDO BASIN**C.O. Gaya¹, M.K. Gachari² and J.M.Gathenya²**

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Abstract

Floods are considered one of the most common natural hazards in the Lake Victoria basin.

However, significant delays in ground data availability have made it unfeasible to use traditional flood forecasting systems in this part of the world. Satellite rainfall estimates have therefore been identified as readily and economically available data that can be used as input to run hydrologic models and produce flood-warning systems. In this paper, historical daily rainfall data for the Nyando basin are used to validate the satellite-derived rainfall estimates (RFE). The results are not so good for comparisons at daily accumulations but they performed reasonably well in detecting the occurrence of rainfall. The products show good results for 10-day accumulations when forced against observed rain gauge data. The RFE estimation of precipitation has led to accurate rainfall prediction for up to 10-day periods and this input into a hydrologic model makes it possible to simulate the hydrologic process several days in advance in order to forecast flooding.

KEY WORDS: Rainfall Estimates (RFE), Flood Forecasting, Hydrologic Modelling, Geographic Information Systems (GIS)

Introduction

Floods are a perennial problem in western parts of Kenya during most of the rainy seasons. Spatially distributed rainfall is an important input for accurate flood forecasting. Conventional rain gauge estimation of rainfall requires a dense network of many gauges to accurately characterize precipitation over an area such as a watershed. The insufficient number of gauges on the ground can hinder this method. Some of these break down and take time to replace, thereby causing gaps in continuous data collection. Modern flood forecasting methods are increasingly being used as a strategy for mitigation of flood hazards (Aziz et al., 2002).

A technique for estimation of precipitation over Africa was developed to augment the rainfall data available from the relatively sparse observational network of rain gauge stations over this region. The method utilizes Meteosat satellite data, Global Telecommunication System (GTS) rain gauge reports, model analyses of wind and relative humidity, and orography for the computation of estimates of accumulated rainfall (Herman et al., 1997). The United States Agency for International Development (USAID) Famine Early Warning System (FEWS) has been supporting the production of 10-day Rainfall Estimate (RFE) data for Africa since 1995. The RFE 1.0 algorithm, implemented from 1995 to 2000, uses an interpolation method to combine Meteosat and GTS data, and warm cloud information for the 10-day estimations. The RFE 2.0 algorithm, implemented as of January 1, 2001 uses additional techniques to better estimate precipitation while continuing the use of cold cloud duration and station rainfall data. The RFE subsets are flat binary images of 8 km square pixels, with the cell value rainfall units in millimetres. With the RFE input into a hydrologic model, it is possible to simulate the hydrologic process 10 days in advance in order to forecast flood events.

In this study, RFE is compared with rain station data over the Nyando basin in western Kenya. Although not exhaustive, the results indicate that RFE can be a useful input for forecasting floods in the Kano plains.

Study Area

The area of interest is the Nyando river basin where perennial floods in the lower Kano plains have been causing a lot of human suffering. The Nyando River is located in western Kenya and drains into Lake Victoria. The basin covers an area of approximately 2,646 km². The Nyando River basin is bounded by latitude 0° 7' 8"N and 0° 24' 36"S and longitude 34° 51'E and 35° 43' 12"E. Lake Victoria is to the west, Tinderet Hills in the east, Nandi Escarpment to the north and Mau Escarpment to the south east. The basin mainly lies in Kisumu, Nyando, Nandi South and Kericho districts. The former two are in Nyanza province while the latter two are in Rift Valley province. The Basin has a total population of about 750,000, based on the 1999 Kenya population census. The mean annual rainfall varies from 1200 mm close to Lake Victoria to 1500 mm at the foot of the Nandi Escarpment. The annual rainfall pattern shows no distinct dry season; it is bi-modal with peaks during the long rainy season of the region (March–May) and during the short rainy season (October– December).

Data and Methods

A Visual Basic 6.0 program was developed in ArcGIS to extract the values of the satellite rainfall estimates (RFE) at the positions of the gauging stations. The stations are first displayed in the GIS user interface. The program imports each day’s RFE raster dataset in turn and loops through each station in the point feature class to obtain the cell value of the raster on that point. This routine was used to obtain the RFE data for the period 1995 to 2005 corresponding to the locations of 35 gauging stations in the basin. The values were compared with the observed gauge data for the same period.

Observed station data for 35 stations were obtained from the Kenya Meteorological Department. The stations used in the analysis are those with no missing days in observed data for any year full year between 1995 and 2005. Though RFE data were obtained for the years 1995 to 2005, some years were left out of the analysis due to lack of concurrent RFE and station data. There was no station without gaps in 1995 while the RFE data in 2004 and 2005 had gaps. The RFE data for 2000 had unrealistic values for day 305 (ranging from 0 to 14848, in multiples of 256). Consequently, the years used in this study are 1997, 1998, 1999, 2001, 2002 and 2003. The number of stations used in the particular years ranged from 2 to 12 gap-free stations. A total of 18 stations in all were studied.

Time-series graphs were plotted for each station for daily rainfall, with the Julian day sequencing from 1 to 365 (or 366 in leap years). Histograms were plotted of the annual rainfall for each year at each available station by summing the daily precipitation from both sets of data for a graphical comparison.

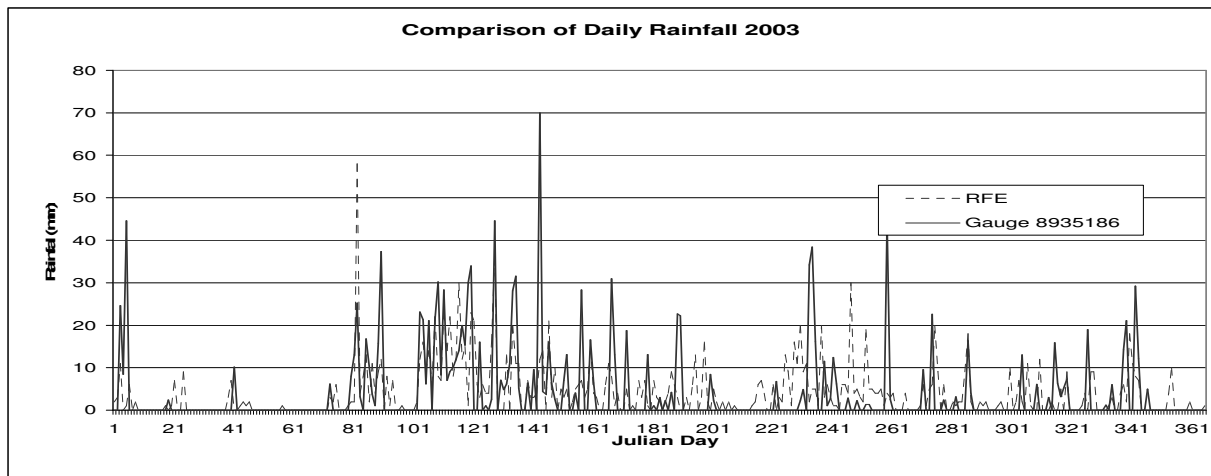


Figure 1: Time-series comparison of observed and satellite-derived estimates of daily rainfall in 2003 at Station 8935186, Kimwani A.D.C. Farm

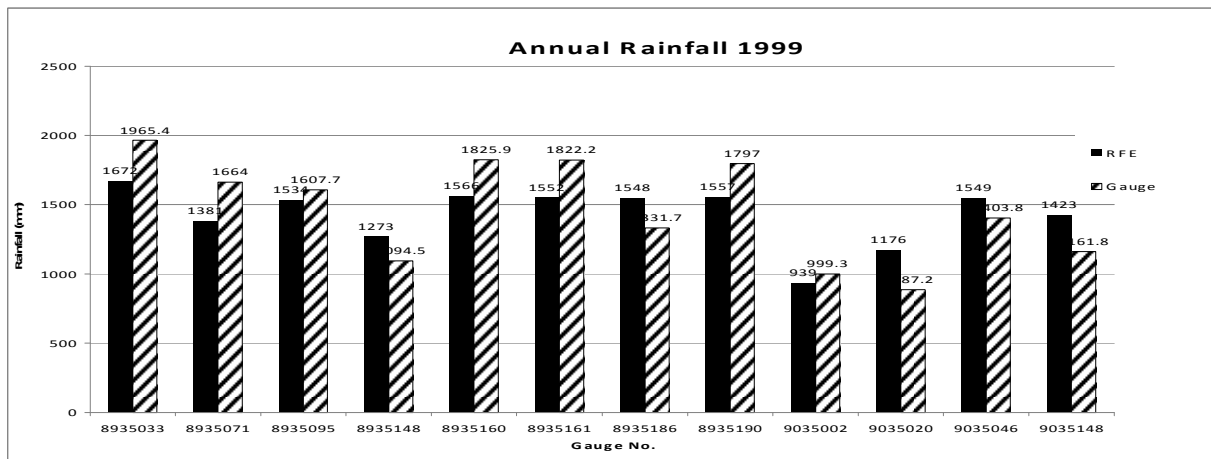


Figure 2: Comparison of annual rainfall between observed and satellite-derived estimates at the positions of 12 stations for the year 1999

Daily precipitation fields were summed up to into dekadal fields for both sets of data for each station. The arithmetic average of the included stations was then calculated for each dekad in both sets.

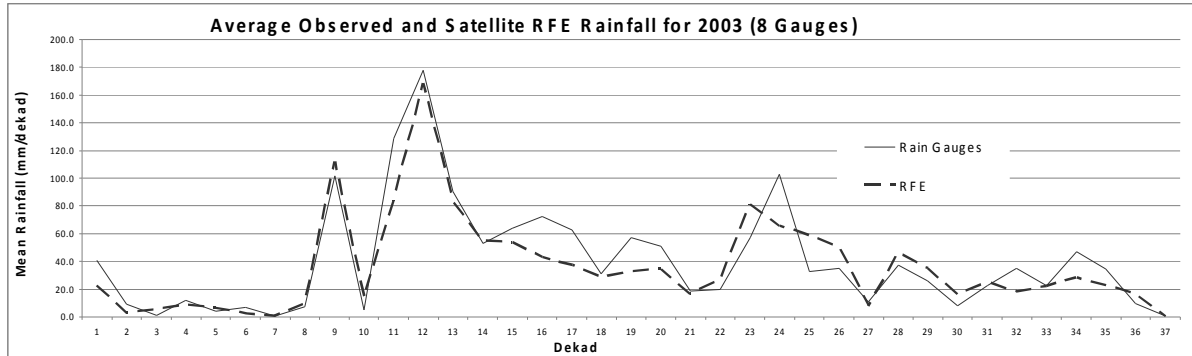


Figure 3: Time series plot of average study area rainfall (millimetres per dekad) for the 37 dekads of 2003 for the rain gauges (observed) and satellite RFE

Simple regression analysis was used to measure the degree of agreement between the observed rainfall and the satellite RFE. Time series traces (Figure 3) and scatter plots (Figure 4) of the data were prepared to illustrate the results.

The root mean square error (RMSE) was also calculated to quantify the amount by which the satellite-derived rainfall estimates differ from the rain gauge-observed values for the 10-day accumulations.

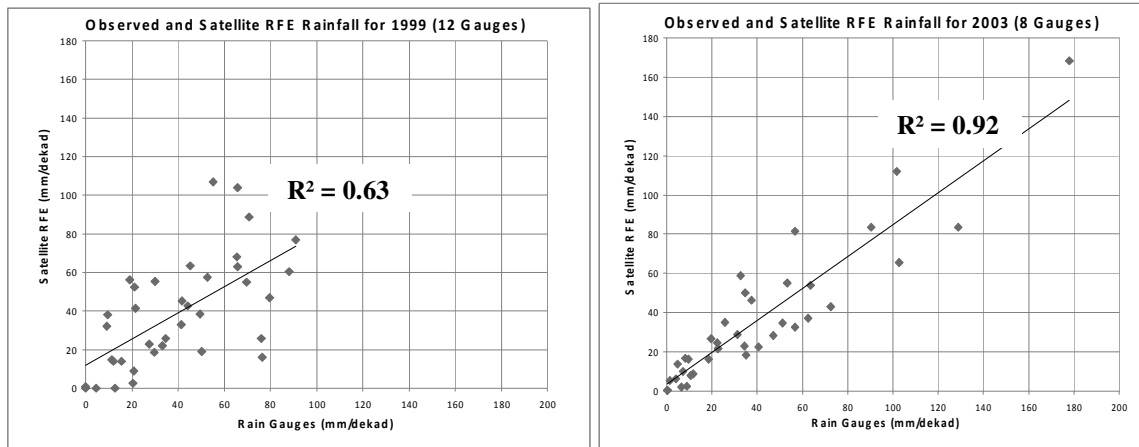


Figure 4: Scatter plots of dekadal average rain gauges (observed) rainfall versus satellite RFE for 1999 and 2003 with coefficients of correlation of 0.63 and 0.92, respectively.

Results

Though visual examination of the time-series graphical pictures of superimposed RFE and observed daily rainfall over each station does not show good agreement on the amount of rainfall, it shows some reasonable concurrence on the occurrence of rainfall. When summed into 10-day accumulations, better agreement can be seen on both the amount and occurrence of rainfall. However in some cases the RFEs underestimated or overestimated the observed rainfall. The erratic pattern was not only seasonal as one half of the year could be mostly overestimated while the other half is underestimated (as could be seen on the statistical plots of the monthly rainfall), but also spatial. On the annual scale, some stations were overestimated while others were underestimated as shown in Figure 2. Also, some years' totals showed a similar trend.

Figure 3 shows a good agreement between the arithmetic averages of the two sets of data from dekadal accumulations. Regression analysis yielded on average a correlation coefficient (R^2) of 0.78.

Table 1 summarizes the results of a comparison of the satellite rainfall estimates with the observed station data as the reference standard. Table 2 ranks the rainfall stations according to the correlation between the observed data and the satellite rainfall estimates at each station.

Year	Correlation coefficient	No. Gauges	RMSE (mm/Dekad)
1996	0.774	9	21.79
1997	0.903	11	16.79
1998	0.771	10	20.27
1999	0.629	12	23.37
2001	0.714	6	22.64
2002	0.775	4	25.11
2003	0.920	8	15.89

Table 1: Results of the correlation analysis between the satellite rainfall estimates and the observed station data for the selected period.

Station_ID	Station_Name	Mean Correlation Coefficient	No. of years used
9035127	P.B.K Londiani Pyrethrum Office Nursery	0.848	2
9035126	P B.K Olenguruone Field Office	0.801	4
9035080	Kamarero - Songhor	0.799	2
8935071	Siret Tea Co. Ltd. - Nandi	0.727	10
9035148	Koru Bible School	0.681	6
8935095	Nandi Tea Factory	0.64	6
9035046	Chemelil Plantation	0.637	12
9034124	Masaka Apundo's Farm	0.632	10
8935186	Kimwani A.D.C. Farm	0.632	10
8935161	Nandi Hills - Kibweri Tea	0.623	12
8935033	Nandi Hills - Savani Estate	0.609	6
8935190	Sitoti Estate	0.549	10
8935160	Kapsimotwa Tea Estate	0.525	12
9034086	Ahero Irrig. Research Station	0.524	4
9035020	Kipkelion Railway Station	0.483	6
9035002	Londiani Forest Station	0.467	6
9034121	Rae Girls' Secondary School	0.37	2
8935148	Kipkurere Forest Station	0.279	2

Table 2: Degree of association between the observed data and the satellite rainfall estimates at each station. Table 2 illustrates that the two years that showed the best match were in this sample were 2003 and 1997; incidentally these two years saw some of the most extreme flood events of recent times in this region. Even for the year 2000 where day 305 RFE data was suspicious, an arbitrary division of the cell values by 256 yielded a correlation factor of 0.74. The RMSE was on the order of 21 mm per dekad. Most stations showed a high degree of association between and RFE and gauge data. Apart from Stations 9034121 and 8935148 that had moderate positive correlations, all other stations illustrate very strong positive correlations (Table 2).

Discussion and Conclusion

The results from the graphical comparison of the satellite estimates with observed rainfall show that the RFE underestimates rainfall in some stations but overestimates in some. This may have been due to the topography of the region that may have resulted in orographic precipitation (Ouma et al, 2008).

On daily time scales, the two rainfall estimates were weakly correlated, whereas the match between dekadal accumulated rainfall values was good. This agreement between RFE and gauge data is actually distributed in space. The satellite rainfall estimates had a moderate under-estimation/over-estimation bias.

Some stations had only moderate correlation. Overall, as much as the estimates are constrained with gauge data, gauge errors cause uncertainty too (Vieux, 2004). Errors in gauge accumulations may be caused by wind effects and tipping of bucket gauges during heavy rainfall rates.

The results suggest that the satellite rainfall estimates can be a source of rainfall data for modelling processes for 10-day and longer periods (Funk and Verdin, 2008). The RFE data is therefore useful for hydrologic modelling when the hydrologic model is calibrated with such data (Artan et al, 2007).

In most of Africa, ground-based information is in short supply. Rain gauge networks are sparse with vast areas un-gauged, while radar is not a feasible proposition on the grounds of cost, technical infrastructure and topography (Grimes and Diop, 2003). Satellite rainfall estimation becomes an attractive option.

The results show that RFE data can be used as the rainfall input in the flood forecasting system. Satellite rainfall estimates (RFE) fill in gaps in station observations. The gridded rainfall time-series give historical context, and provide a basis for quantitative interpretation of seasonal precipitation forecasts. RFE are also used to characterize flood hazards, in both simple indices and stream flow models (Verdin et al., 2005). The Climate Prediction Center (CPC) produces precipitation estimates for Africa on the 1st, 11th, and 21st of each month (Herman, et al, 1997).

With the RFE input into a hydrologic model, it is possible to simulate the hydrologic process 10 days in advance in order to forecast flooding in the Lake Victoria basin.

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THE POTENTIAL OF RAINWATER HARVESTING FOR FOOD SECURITY IN THE RIVER NZOIA BASIN: ADAPTATION STRATEGY TO CLIMATE CHANGE

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Abstract

River Nzoia Basin (RNB) and its ecosystem are impacted severely by both climate change and anthropogenic activities. The basin experiences longer periods of dry seasons, and erratic rainfall. The basin is prone to both floods and drought disasters/hazards (extreme hydrological hazards). With the growing population in the basin, there is a rising demand for more food and water resources. Current farming systems in the region cannot yield enough food for domestic consumption and surplus for markets because they do not address the core challenges of water scarcity, soil erosion, low soil fertility and lack of high value crops that could be promoted through small scale irrigation enterprises.

This paper presents preliminary results of an on-going study that was initiated to promote the rainwater harvesting technologies for food security within the River Nzoia Basin. The objective of this paper is to show the potential of rainwater harvesting for food production within the River Nzoia Basin. It is hypothesized that rainwater harvesting and appropriate utilization of harvested rainwater will make the residents of the basin resilient to drought, conserve the environment, reduce floods, and boost food production. This paper presents the analysis of rainfall from two stations, representing the lower and upper catchment, of the basin. The paper also presents the current efforts on rainwater harvesting, as an adaptation tool to climate change, within the basin. Field visits, stakeholder participatory techniques and historical data were used in achieving the objective of this paper.

Results show that while some parts within the catchment are experiencing an average decrease in the amount of rainfall, others are receiving more rainfall than before. The potential for rainwater harvesting for food security in river Nzoia Basin is very high, shown through the uneven temporal distribution of rainfall within the basin and the need for irrigation farming. Most communities within the basin lack capacity to practice rainwater harvesting.

Key words: climate change, rainwater harvesting, drought, food security

LIST OF ABBREVIATIONS

ASL	Above Sea Level
CHE	Commission for Higher Education
GDP	Gross Domestic Product
GoK	Government of Kenya
ICRAF	World Agro forestry Centre
IFRC	International Federation of Red Cross
IPCC	Intergovernmental Panel on Climate Change
ITCZ	Inter-Tropical Convergence Zone
KES	Kenya Shilling
MMUST	Masinde Muliro University of Science and Technology
RCC	Red Crescent Societies
RNB	River Nzoia Basin
RWH	Rainwater Harvesting
UNEP	United Nations Environmental Programm

INTRODUCTION

Climate Change

Climate change refers to a change in the state of the climate that can be identified (using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer (IPCC 2007).

Even without climate change water managers face prodigious challenges in meeting sustainable development goals. Growing populations need affordable food, water and energy. Factoring in climate extremes

complicates the scenario and adds to the challenges. Indicators of climate change include changes in rainfall characteristics, such as changes in rainfall intensities, shifts in the onset and duration of rainfall seasons, and changes in rainfall amount. Other major indicators of climate change are temperature, and wind patterns (Treut et al (2007)).

The IPCC report of 2007 (Boko *et al*, 2007) projects the following scenario for Africa: -

- By 2020, between 75 and 250 million of people are projected to be exposed to increased water stress due to climate change.
- By 2020, in some countries, yields from rain-fed agriculture could be reduced by up to 50%. Agricultural production, including access to food, in many African countries is projected to be severely compromised. This would further adversely affect food security and exacerbate malnutrition.
- Towards the end of the 21st century, projected sea level rise will affect low-lying coastal areas with large populations. The cost of adaptation could amount to at least 5 to 10% of GDP.
- By 2080, an increase of 5 to 8% of arid and semi-arid land in Africa is projected under a range of climate scenarios.

Change in climate has impacted severely on environmental processes and livelihoods (IPCC, 2007). For development of effective adaptation measures, there is need for analysis and understanding the changes in climate change and the impacts at a local level.

Rainwater Harvesting and Food Security

Rainwater harvesting (RWH) is the process/system that involves capturing and storing of rainfall in soils, depressions, tanks for domestic, agricultural, industrial and environmental purposes. Techniques for rainwater harvesting include: use of plastic sheeting, trees, roof, run-off diversion/concentration, flood-water harvesting and subsurface techniques (Mati *et al*. 2007). One of the low-cost run-off harvesting techniques is by the use of water-pan. Food security is a situation where a person, or a household, or all members of a community, at all times have physical and/or economic access to buy, produce, obtain or consume sufficient, safe and nutritious food to meet their dietary needs and food preferences for a healthy and active life (IFRC, 2006)

STUDY AREA

Nzoia River Basin is found in Kenya and lies between latitudes 1° 30'N and 0° 05'S and longitudes 34° and 35° 45'E. The Nzoia River originates from Cherang'anyi Hills at a mean elevation of 2300 m above sea level (ASL) and drains into Lake Victoria at an altitude of 1000 m ASL. It runs approximately South-West and measures about 334 km with a catchment area of about 12,900 km², with a mean annual discharge of 1777 x 10⁶ m³/year. The population within the Basin is more than 3 million.

The Basin traverses Marakwet, Keiyo, West Pokot , Trans Nzoia, Uasin Gishu, and Nandi North in Rift Valley Province; Lugari, Mt. Elgon, Bungoma, Kakamega, Butere-Mumias, and Busia, districts in Western Province; and Siaya in Nyanza Province. The climate of the Basin is mainly tropical humid characterized by day temperatures varying between 16°C in the highland areas of Cherangani and Mt. Elgon to 28° C in the lower semi-arid areas on annual basis. The mean annual night temperatures vary between 4° C in the highland areas to 16° C in the semi-arid areas. Mean annual rainfall varies from a maximum of 1100 to 2700 mm and a minimum of 600 to 1100 mm.

The area experiences four seasons in a year as a result of the Inter-Tropical Convergence Zone (ITCZ). There are two rainy seasons and two dry seasons, namely, short rains (October to December) and the long rains (March to May). The dry seasons occur in the months of January to February and June to September. However the local relief and influences of the Lake Victoria modify the regular weather pattern (Karanja and Mutua 2000).

The economy of the region is still largely rural and more than 90% of the population earns its living from agriculture and livestock. The farms are privately owned and on average 1 – 3 hectares.

However, large commercial farms with an average of 50 – 100 hectares or more characterize such districts as Trans Nzoia and Uasin Gishu. The main food crops include maize, sorghum, millet, bananas, groundnuts, beans, potatoes, and cassava while the cash crops consist of coffee, sugar cane, tea, wheat, rice, sunflower and horticultural crops. Dairy farming is also practiced together with traditional livestock keeping.

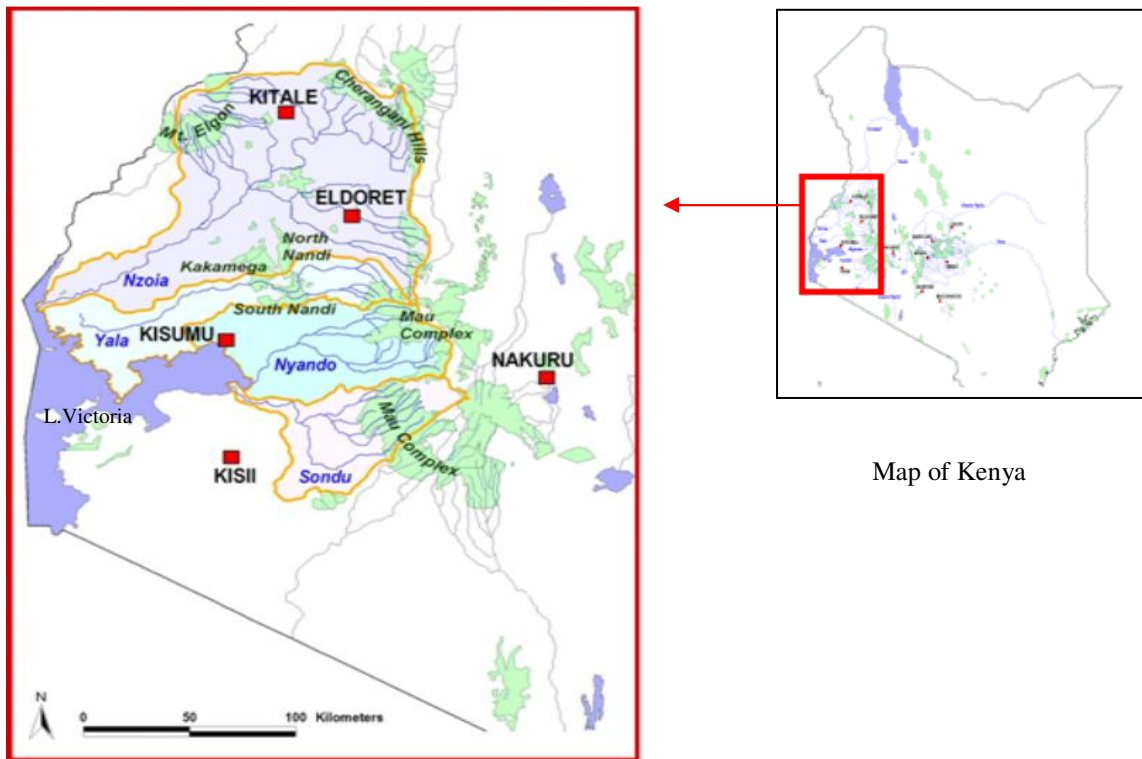


Figure 1 Study area on Kenya map

The River Basin is of great economic importance at local as well as national levels especially in such sectors as agriculture, tourism, fishing, forestry, mining and transport. It is also the main source of water for domestic, (rural and urban water supply), agriculture and commercial sectors, as well as for very important industrial establishments in Western Kenya, namely Pan Paper Mills, Nzoia Sugar Company, Mumias Sugar Company, and West Kenya Sugar. In addition there are numerous minor sugar factories, coffee roasters, wood processors and tea factories. Other factories are found in Eldoret, Kitale and Kapsabet. The local communities provide labor to these industries from which they obtain income to supplement those from their subsistence activities.

The main challenges in the basin include soil erosion and sedimentation, deforestation, flooding, wetland degradation, pollution and solid waste, river bank cultivation, sand harvesting, brick making, human-wildlife conflict and poorly developed infrastructure (Plate 1). A study by Waswa *et al* (2003) indicated that the incidences of flood disasters in the RNB have increased, a phenomenon attributed to changes in climate, deforestation in the upper catchment, and urbanization.



(a) Upper RNB



(b) Middle RNB



(c) Lower RNB

Plate 1 (a) Chereng'anyi hills, (b) Middle RNB Upper, (c) Lower RNB—prone to flooding (*UNEP & GOK, 2003*)

OBJECTIVE OF THE STUDY

This paper presents preliminary findings of a wider study that is being carried out in the River Nzoia Basin, whose overall objective is to promote rainwater harvesting practice among the residents of the River Nzoia Basin (RNB) for food security. The objective of this paper is to investigate the potential of rainwater harvesting, as an adaptation tool to climate change in River Nzoia Basin.

METHODOLOGY

The present study used field visits, interviews, seminars and workshops. Researchers started by visiting government offices. District headquarters offices of the ministry of agriculture and ministry of water and irrigation within the entire River Nzoia Basin were visited. Interviews were held with key government officers. Stakeholders' workshops were then held in which 75 participants including the farmers, government officers from the two key ministries, administrators and Non-Governmental Organizations operating within the basin. Reports on food production were analyzed. Historical rainfall data for key weather stations in the basin was obtained and used in analyzing trends.

For purposes of this paper results of two districts, Lugari district and Busia District are presented. Lugari district lies in the upper catchment while Busia District lies in the lower catchment, which also experiences floods. Information acquired from the field visits and workshops from the districts is presented. Daily rainfall data from two stations and for the period 1970 to 2000 is used. Existing rainwater harvesting technologies are

also presented.

RESULTS AND DISCUSSIONS

Food Security

Maize takes 90% of the cropped land. Factors that hinder full-scale food production in the area are Inadequate fertilizer; Pre- and post-harvest losses (poor storage); Poor farming practices; Poor tillage (use of oxen) due to poverty and small size of land; Lack of diversification of crops - drought resistant crops (that can be irrigated) and high value crops and direct rain-fed crops.

Monthly rainfall pattern

The rainfall pattern is bi-modal for both the Lugari and Bunyala. In Lugari long rains occur in February/March to June as shown in Figure 2 while the short rains occur in the months of July to October. The long and short dry seasons occur in November to February and June to July, respectively. However, the short dry season is not very distinct. The mean monthly rainfall ranges from the lowest of 50mm during the long-dry season, to the highest of 200mm, experienced during the in short rains. These results indicate that rainwater harvesting can be done during the short rains and be used during the long dry season. In the lower catchment, the two rainfall seasons are more distinct (Figure 3) compared to the upper catchment. The long rains start in February to June while the short rains span from August to November. Unlike the upper catchment, the wettest month, April, appears during the long rains. Generally the lower catchment receives less rainfall than the upper catchment. Rainwater harvesting will be very beneficial to the residents of the lower catchment especially during the dry seasons and also to supplement the short rains which is usually very little.

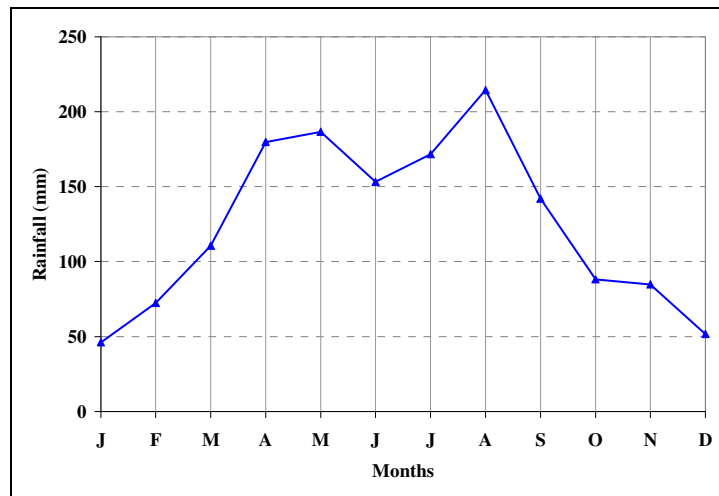


Figure 2: Mean monthly rainfall over Lugari (Upper RNB)

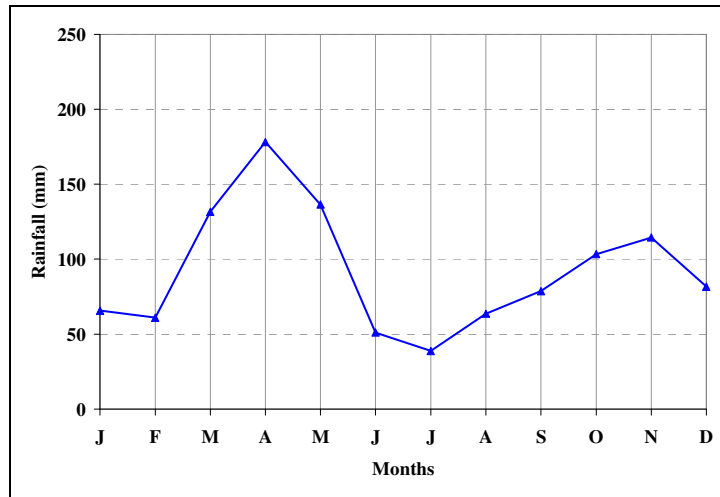


Figure 3: Mean monthly rainfall over Bunyala (Lower RNB)

Total annual rainfall

In general terms, the upper RNB receives more rainfall compared to the lower catchment. While the total annual rainfall over Lugari ranges from 750mm and 2000mm (Figure 4) over the period 1970 to 2000, that of Bunyala is between 750 and 1500mm (Figure 5). However, the same Figures 4 and 5, show that the general trend of total annual rainfall over Lugari is decreasing (negative trend) while that of Bunyala is increasing (positive trend). It shows that the severity of drought in Lugari is increasing. This quantitative information agrees with the information received from the stakeholders’ workshop, in which it was stated that Lugari is currently experiencing more severe drought than in the past, a phenomenon which is manifested through the high rate of crop failure due to scarcity of water.

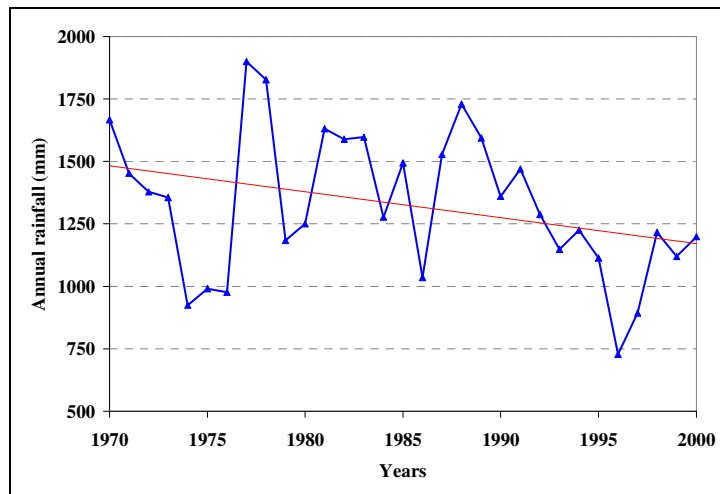


Figure 4: Total annual rainfall over Lugari (Upper RNB)

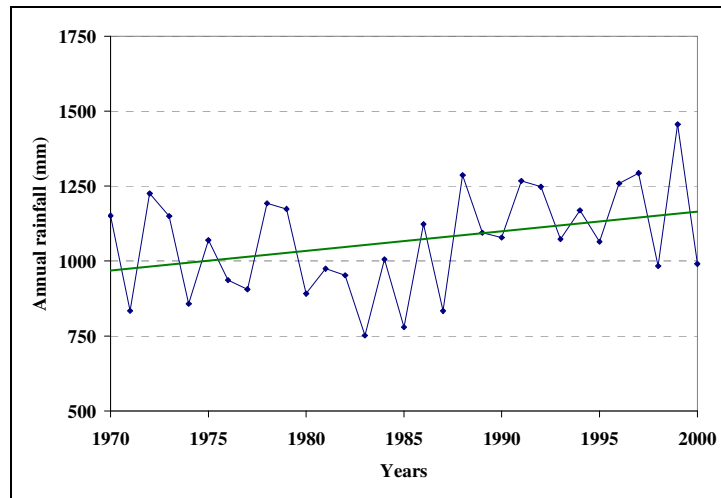


Figure 5: Total annual rainfall over Bunyala (Upper RNB)

Status of rainwater harvesting in RNB

There are 34 low-cost run-off rainwater harvesting structures, which can be classified as earth dams or water pans in Lugari district. These structures were constructed before independence (1963) by the white settlers. The total capacity of these structures dams is 9,000,000m³. However, most of the dams/water pans are not operational due to poor maintenance. The estimated cost for rehabilitating a water pan using a tractor is about Kenya Shilling (KES) 7,000.00 (US\$110) per hour, which is very costly. Manual rehabilitation costs about KES 200.00 (USD 4) per m³. If all the constructed capacity is operational, the stored water can irrigate about 850 ha of land for about 120 days (equivalent to the longest dry period) at a rate of 4 litres per second per hectare, 6 hours a day.

Small-scale water-pans of about 2,000m³ are constructed by community members in the Upper and Lower River Nzoia Basin. However, some of water pans, such as the one shown in Plate 2, experience the problem of siltation, which is due to the lack (poor construction) or poor maintenance of silt-traps. Some of the water-pans have been overgrown with vegetation. Plate 3 shows a water-pan under construction by a community in the lower river Nzoia basin. The main problem with water-pans is loss of water through seepage. Plastic sheets and burned bricks are used to make a lining in order to minimize seepage losses. However, the local communities do not have access to the appropriate plastic sheets and the technology of lining the water pan using masonry materials.



Plate 2 Water pan with failed silt-trap (in the lower RNB)



Plate 3 Water-pan under construction (Lower RNB)

CONCLUSIONS AND RECOMMENDATIONS

The potential for rainwater harvesting for food security in river Nzoia Basin is very high. This is shown through the unevenly distributed rainfall through the year. High amount of rainfall is concentrated in within some months of the year, while there is acute lack of rainfall in other months. Farming activities within the basin are dependent on direct rainfall. This implies that farming activities are at the peak only during the rain season and almost non-existent during dry seasons. Harvesting and storing rainwater during the rain season will enable farmers to continue with the farm activities even during the dry season. While some parts within the catchment, such as Lugari are experiencing a decrease in the amount of rainfall other parts, such as Bunyala, are experiencing an increase in rainfall.

Most communities lack capacity to practice rainwater harvesting. First, some communities lack knowledge on the importance of practicing rainwater harvesting. Second, some communities have knowledge but do not have skills and technology to overcome technical problems that are experienced in the rainwater harvesting implementation. Third, some communities lack finance to harness and store rainwater harvesting. This conclusion on lack of capacity agrees with those by Rockström (2000).

There is need to develop more effective policies, and reinforce activities, towards conservation of natural resources (soils, water and forest) within the River Nzoia Basin. This will assist in reducing deforestation activities within the catchment. It will also help reduce siltation of rivers. Natural resources conservation activities will also reduce the intensity of hazards such as drought and floods in RNB.

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Socio-Economic Characteristics And Food Security Status Of Farming Households In Ikolomani Division, Western Kenya

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ABSTRACT

In Kenya, like many Sub-Saharan African countries (SSA), majority of the people are food insecure. This study therefore examined the socio economic characteristics and their influence on food security of farming households in Ikolomani Division Western Kenya. A three-stage random sampling was used to select a sample of 211 households for the survey. A semi-structured questionnaire and focus group discussions were used to gather information and descriptive analysis conducted to describe the socio economic characteristics. The study revealed that household size, age, land size, educational status and gender of household heads as well as household food production capability were determinants of household food security. With respect to number of meals eaten by day it was revealed that 40 % of households were food insecure. It was concluded that the design of food security strategies should be multi dimensional such that focus should be given to the identified determinants in order to achieve sustained food security.

Key words: food security, socio economic characterics

INTRODUCTION

Even though food is a basic need of life, the burden of food shortages for poor households has rapidly risen in the past few years. The World Food Summit (WFS) and the Food and Agriculture Organization (FAO) of the United Nations reaffirmed in 1996 the right of everyone to have access to safe and nutritious food and the fundamental right of everyone to be free from hunger (Eide, 1999). To adequately address widespread food insecurity and poverty agenda, the Millennium Development Goals (MDGs) were launched in 2000. In fact, the first Millennium Development Goal aims at halving extreme poverty and hunger by 2015 (Migotto et al.,

2005). Nevertheless, hunger continues to be widespread and the right of everyone to adequate food is extensively violated.

Current progress reports by IFPRI (2005) indicate that an estimated 852 million people worldwide are still chronically malnourished; among them 170 million children under 5 years. The MDGR (2006) reported that by 2002 the proportion of people living in extreme poverty in developing world decreased significantly in Asia but poverty levels in Latin America, Northern Africa, Western Asia and Sub Saharan Africa declined marginally. Currently many Sub Saharan Africa countries are now showing potentials for long-term growth and would raise standard of living (MDGR, 2006). Nonetheless, chronic hunger measured by the percentage of people lacking the food needed to meet their dietary needs has declined in the developing world. However, progress is not fast enough to reduce the number of people going hungry, which increased between 1995-1997 and 2001-2003. Table 1 shows the proportion of people living in extreme hunger across different sub regions of the world.

In many African countries, food security at national and household level is gloomy. Whereas 14 % of the global population is undernourished, 27.4% of the population of Africa is undernourished (FAO, 2003). Though there are more undernourished individuals in India alone than in Africa, it is in Africa that one finds the highest prevalence of undernourishment. In more than a dozen countries, the rate of under nourishment is above 40% while it exceeds 50% in those countries emerging from armed conflict (Todd, 2004).

Table 1: Prevalence of under nourishment in the World 1990-2003

Sub regions	1990-1992	1995-1997	2001-2003	2015-target
Sub-Saharan Africa	33	34	31	18
Southern Asia	25	23	21	14
CIS Asia	16	NA	20	9
Eastern Asia	16	12	12	9
South East Asia	18	14	12	10
Oceania	15	14	12	8
Latin America and Caribbean	13	11	12	7
Western Asia	6	9	10	4
Northern Africa	4	4	9	3

Source: MDGR (2006). CIS is commonwealth of Independent states; NA data not available

Kenya, like many Sub Saharan African countries, has been experiencing decline in food production while the population growth rate has been increasing since the late 1980s. In 2006, the United Nations Development Programme (UNDP) ranked Kenya position 152 out of 177 countries on human development criteria. Besides, FAO (2002) had ranked Kenya a low-income food-deficit country (LIFDC) at position 51 out of 61 along with war ravaged countries in sub Saharan Africa. According to Oniang'o (2001), 89 % of Kenyans, majority of who live in rural areas, are food poor. Majority of these people are women engaged in subsistence farming. Social and economic challenges including education, gender disparities, land sizes and income levels hamper efforts by households to attain food security.

Socio-economic characteristics and resources for individual households have been identified as basic factors influencing the food security status of households (Sanusi et al., 2006). Rural households continue to face poor economic conditions which adversely affect their food security situation. The returns to land have been on decline while population has rapidly increased. The income from off-farm activities has not been adequate to meet household needs (Akinsanmi and Doppler, 2005). The impact of this is that the food situation has gotten worse. Poor socio economic conditions impede food availability and access (Sen, 1986). This researcher observed that people suffer from hunger because of lack of entitlements. Entitlement makes provision for direct access to food or a means by which to acquire it. This means food security depends not only on own production but also ability to buy food, accessibility, how accessible the markets are, the prices of foods notwithstanding. Finally it also means that poor households have limited sources of entitlement hence food insecure.

The aim of this study was to examine the socio-economic characteristics and their influence on household food security in Ikolomani division Western Kenya. The objectives of the study were to identify the socio-

economic characteristics of households and establish the relationship between the socio economic characteristics and household food security.

Conceptual framework of household food security

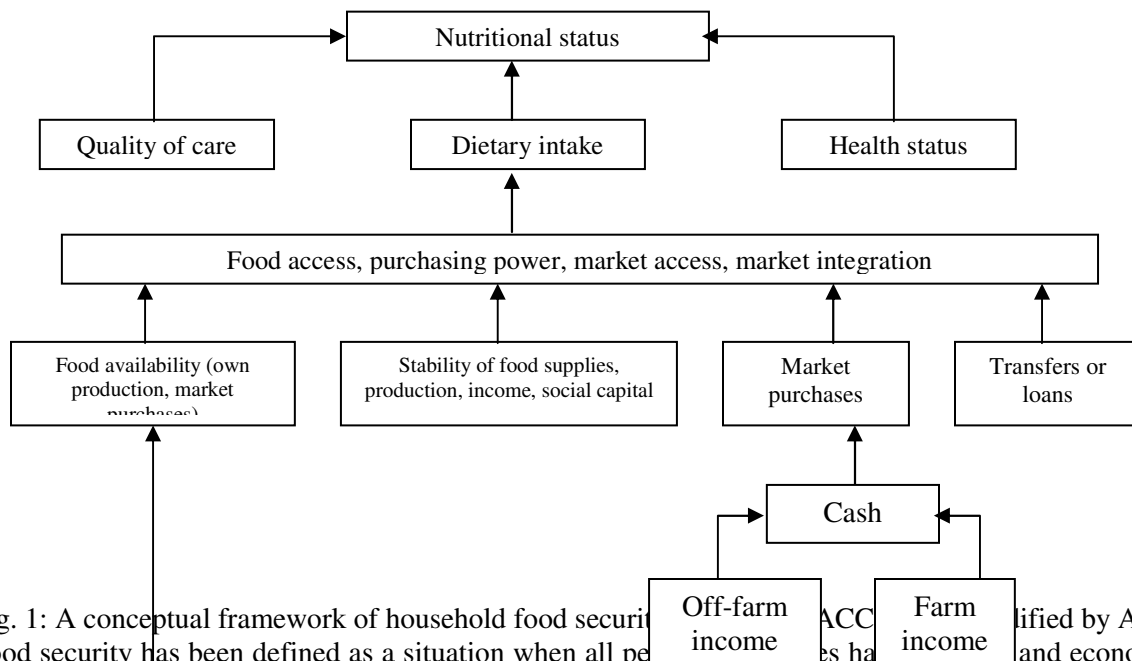


Fig. 1: A conceptual framework of household food security (Adapted from Sen, 1986; modified by Author). Food security has been defined as a situation when all people have sufficient and economic access to sufficient, save and nutritious food needed to maintain a healthy and active life (FAO,1996). This definition implies the food security is a broad concept and is more than food production and food

availability, food accessibility, nutritional status and economic access to those food supplies through their own production, through the markets or other sources, and utilization of

those food supplies is appropriate to meet the dietary needs of individual households. Food accessibility is ensured when all households have sufficient resources to obtain appropriate foods for a nutritious diet. It is dependent on household's resources including capital, labor, knowledge and prices (Fig. 1).

Measurement of Variables

The dependent variable and explanatory variables used in the study are:

Food security: Two objective methods of food security assessment have widely been used in food security studies (Maxwel and Frankenberger, 1992). One is to assess household food security from the number of meals eaten. The other method is to undertake food consumption recall for individual members of a household and analyze each food mentioned for calorie content. Duration of food stocks from own food production has also been used in this study to

Indicate status of household food security.

Farm size: Farm size is the total land cultivated by the household measured in acres. The larger the farm size, the higher the production level. It is thus expected households with larger farm size are more likely to be food secure than those with smaller farm sizes. The expected effect of this on food security is positive.

Own food production: This is the total quantity of food produced by the household from their own farm in kilograms. It consisted only of food crops. The expected effect on food security is positive.

Age of household head: The age of the household head is expected to have an effect on household food production. It is expected the younger household members are stronger and able to cultivate bigger farm sizes and generate more income from off-farm employment. However, the expected effect of age could be positive or negative.

Household size: This is the total number of adult members in a household. The expected effect is negative.

Educational status of household heads: Education is a social capital which could impact positively on household food security.

Occupation of households: This refers to additional source of income to household from off-farm employment. The expected impact of this is positive.

Gender of household heads: Gender inequalities aggravate food insecurity and poverty. The United Nations estimates that the share of women in food production for the family is 80% in rural Africa. At the same time women direct their earnings to family needs, hence they are a key to ending hunger (Synden, 1990). Thus, the responsibility for nourishment for the family mostly lies with women. However, women are highly constrained as they do not control assets such as land and are not well exposed to agricultural extension and training. The expected impact of gender on household food security could be positive or negative.

Study area

The study was done in Ikolomani division, Kakamega District which borders Butere-Mumias and Bungoma Districts to the West, Nandi district to east, Vihiga District to the South and Lugari District to the north. The District lies between longitudes 34° 32" and 34° 57' 30" E of the prime meridian latitudes 0° 07' 30" N of the Equator. The District had seven divisions comprising of twenty-seven locations and ninety-seven sub locations covering a total area of 1,394.8 km square. A sample of 211 households was randomly selected in a random sample of three out of six locations in Ikolomani division. Ikolomani has a population of 92,104 people and covers an area of 142.9 square Kms and population density is 748 persons/ Km² with the highest population growth rate in Western Province at 3.1 % per annum (G.O.K, 1999; G.O.K, 2002). The average family size is 6 people per household while the average farm family size is 2.2 acres (G.O.K, 1999). The main sources of food are own food production, livestock keeping and market purchases. The division was chosen because it experiences severe food shortages throughout the year as a result of widespread poverty, rapid population growth rate and land degradation. The aim of the study was to establish the social characteristics of households and their influence on household food security.

Sampling procedure

Multi-stage simple random sampling was used to select locations, sub locations and households. A sample of 211 households was randomly selected for the study. Since Ikolomani division has six locations, a random sample of three locations was obtained for the study. The locations were Isulu, Shirumba and Iguhu. A total of six sub locations and twelve villages were randomly sampled. The sub locations were Iguhu, Malinya, Savane Makhokho, Musoli and Shitoli. A random sample of 35 households per sub location was done to select study population.

Data collection procedures and tools

The study used a pre-tested semi structured questionnaire. The questionnaire generated both qualitative and quantitative social information including sex, age, education, occupation, income, marital status and households' sizes. These variables were categorized and coded for subsequent quantitative data analysis. The questionnaire was administered by the researcher and assisted by two enumerators. The study was conducted in June-August 2006.

Data Analysis

The questionnaire generated both qualitative and quantitative socio economic data. Quantitative data was organized and analyzed statistically by use of frequency tables, means and percentages. The Statically Package for Social Sciences (SPSS) computer software version 11.0 was used to generate the descriptive data such as percentages, means and frequencies. The descriptive statistic helped to establish the centre and spread of the data hence its relationship with household food security. Simple regression analysis and analysis of variance (ANOVA) were used to determine the association and influence of household socio economic variables on household food security. Significance was accepted at 5% probability level ($P < 0.05$).

Results and Discussion**Socio Economic Characteristics of Households and food security**

The human resources available to the farm household determine farm productivity and household income (Akisanmi and Doppler, 2005). The educational level in Ikolomani Division Western Kenya is low hence a barrier to better off-farm activities. In addition low education impedes transfer and adoption of agricultural innovations. Household heads with no education were 23.8 % while those with primary level of level of education were 29.9%, these exhausted their food stocks in 3.2 months. Household heads with secondary level of education were 39%. Those with tertiary level of education were only 8.5 %. Majority of the household heads had attained up to primary school level of education. Household heads with primary levels of education exhausted their food stocks in 3.2 months. Those with secondary level of education exhausted food reserves in 3.6 months. Household heads with post secondary and tertiary levels of education exhausted

food stocks in 3.7 and 4.9 households respectively. Majority of the households had primary level of education. Further analysis of the findings observed that household with tertiary level of education took the longest time to exhaust their food stocks the shortest duration to exhaust harvested food were household heads with pre-primary education. The summary of socio economic characteristics of the households is summarized in Table 2.

The study revealed that 19% of household heads were aged 0-18 years while 40.2% of the household heads were 19-35 years. Household heads aged 36-55 years were 23.8% and 17.0% were over 55 years. Further analyses of the information showed majority of the household heads were aged 19-35 years. Household heads with over 55 years had the lowest age range. A large proportion of household heads, 64 %, were aged 19-55 years.

The survey revealed that 67.1% of household heads were men while 32.9% were women. Fig.2 shows the role of women in food provisioning. The study further established that the role of women in food provisioning was 59.5 % while that for men was 27.5 %. The combined efforts of men and women accounted for 10% while workers contributed only 3 %. Therefore, these findings revealed that though men were majority household heads, women's contribution to household food provisioning was higher than men in Ikolomani division. On household sizes, 11.5% of households had 1-3 members while 29.2% had 7-9 members. Households with 10-12 members were only 0.5%. Majority, 58.9%, of the households had 4-6 members. Further analysis showed that a large proportion, 88.1%, had 4-9 members.

Table 2: Descriptive statistics of households in Ikolomani Division Western Province

Variables	Number	% age	Male (%)	Female (%)
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Age of household heads				
0-55	175	83.0	57.1	25.9
>55	36	17.0	10.0	7.0
Education of household heads				
Nil	48	22.8	13.3	9.5
Primary	63	29.9	19.5	10.4
Secondary	51	39.9	30.0	9.0
Tertiary	8	8.5	4.3	4.2
Occupation of household head				
Farmer	147	70.0	47.8	22.2
Civil servant	50	23.8	15.8	8.0
Businessperson	13	6.2	3.4	2.8
Gender of household head				
Male	141	67.1	-	-
Female	70	32.9	-	-
Household size				
1-6	148	60.4	-	-
>7	63	39.6	-	-
Land sizes (Acres)				
<1	45	21.0	19.5	1.9
1-5	139	33.9	45.7	20.9
>5	27	12.9	8.1	4.7
Duration of food stocks (Months)				
0-3	20	9.4	6.2	3.2
4-6	101	47.8	32.0	15.8
7-9	58	32.2	21.6	10.6
10-12	11	5.2	3.5	1.7
Number of meals eaten/day				
1	3	1.4	1.0	0.4
2	62	29.4	19.2	9.7
3	129	61.1	40.9	20.2
>3	17	8.0	5.7	2.3

Source: Nyandiko et al., 2006

The information collected showed that households with less than one-acre farm were 21%. Households with 1 to 3 acres were 46.7% while those with 4 to 5 acres were 19.5 %. The households with over 5 acres was 12.9 %. Majority of the households had 1-3 acres while those with more than 5 acres were proportionately smaller. Households with less than one acre of land size exhausted food stocks, on average, in 1.8 months. On average, households with 1-3 acre land sizes exhausted food stocks in 3.2 months while those with 4-5 acres of land exhausted food in 4.9 months. Households with over 5 acres exhausted food stocks in 4.8 months.

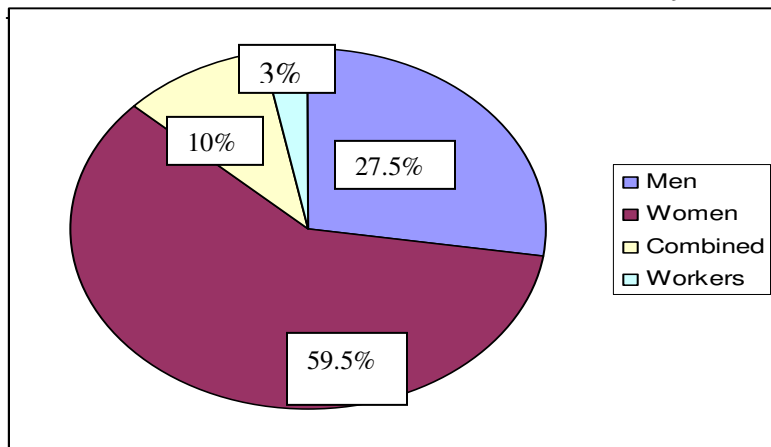


Fig. 2: Proportion of men and women in food provisioning (Source: Nyandiko et al., 2006)

Based on the recommended number of meals consumed by day about 39 % of the households in the area were food insecure and 61% were regarded as food secure. The area could also be regarded as food insecure given that majority of the households, 94.8%, exhausted their food reserves from their own production in less than six months. Given that the area has one of the highest poverty levels in the region, the ability of the residents to purchase food from the market is highly limited. Despite limited control over resources, 59.5% of women were responsible for food provision compared to men (27.5%) or combined efforts by both gender (10%). Only 1.2% of land was registered under women in contrast to 81.3% by men (Fig.2).

Determinants of food security status of households in Ikolomani

Results from the survey data revealed that four of the seven variables included in the regression model were significant in explaining the variation in the food security status of households in the study area. These variables are age, educational levels, land size and quantity of food and its duration. There were significant differences between age of household heads and food stocks. The Association between education and duration of food stock was significant at 5% level. There was no significant relationship between household member sizes and food stocks. There was relationship between gender of household heads and duration of footstock but was not statistically significant. The association between land size and duration of food stocks was highly significant. On educational level of household heads and number of meals consumed by day the relationship was significant. The study revealed no statistical significance between households’ member sizes and number of meals eaten. Therefore household socio economic characteristics including age, educational levels, and land sizes had significant influence on food stocks hence on households’ food security in the study area. The level of significance used was 5% probability level.

Table 3: Summary on the effects of socio economic characteristics on food security

Source of variation	Df	Mean square	F -value	Significance
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Age x food stock duration	3	1.682	3.241	0.032*
Education x food stock duration	3	4.427	10.259	0.000*
HH size x food stock duration	3	0.096	0.178	0.276
Land size x food stock duration	3	9.252	23.27	0.040*
Gender x food stock duration	1	0.296	1.902	0.170
Age x No of meals	3	0.962	1.902	0.072
Education x No. of meals	3	1.701	3.167	0.002*
HH size x No. of meals	3	0.102	1.150	0.250
Land size x No. Meals	3	3.107	7.261	0.007
Gender x No. of meals	3	2.016	1.218	0.165
Age x Acreage indigenous crops	3	0.137	0.867	0.021*

Source: Field surveys; Nyandiko et al., 2006

Note: * indicates significant at 5% level

Conclusions and Recommendations

This paper has shown that the socio-economic variables of farming households have implications on their food security or insecurity status. A large proportion of agricultural and food provisioning tasks were undertaken by women, who could be highly constrained in access to assets for food production such as land. This study has shown that education, land size, age and food stocks were significant determinants for household food security among rural farming households in the study area. Majority of the residents had primary level of education where over 50 % had attained up to primary level of education. This low level of education can impact negatively on household food and nutrition security. On average 68.7% of households cultivated between 0.1 and 2.9 acres of land.

Education and birth control efforts should be directed to the households in the study area. This would improve the rate of technology uptake, enhance consumption of balanced diets and have smaller family size necessary to impact positively on household food security. Market access should also be improved through provision of infrastructure that would enhance farmers convey their produce to the market. It's important for policy makers to consider the observed determinants as key to development programmes so as to enhance the capacity of households to achieve food security and the Millennium Development Goals.

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CAUSES AND EFFECTS OF THE DISASTER WITNESSED IN KENYA, 2007/2008

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Abstract

This article establishes the causes of the 2007/2008 disaster in Kenya. These were multifaceted, ranging from historical injustices to weak political institutions. The immediate trigger of the disaster was the outcome of the 2007 presidential elections between ODM presidential candidate, Mr. Raila Amolo Odinga and Party of National Unity (PNU) candidate, who was the then sitting president, Mr. Mwai Kibaki. The paper also brings into light the devastating effects of the disaster: The economy came to a standstill as transportation of goods and services were paralyzed. Socially, hundreds of Kenyans were killed, others lost their property while others were forced into camps of Internally Displaced People (IDPs). Politically, Kenya lost her international image. It is concluded that the disaster was not an accident. For Kenya to move forward, it is herein suggested that just policies be enacted and the citizenry be democratized to appreciate multi-ethnicity cum multi-partism.

Key words: Disaster, Accident, Nationhood, Trauma

Introduction

The term disaster refers to something very bad that happens and causes a lot of damage or kills many people. In most cases the destruction is by fire or flood or through violent means (Macmillan English Dictionary – International Student Edition). In this paper, the word disaster is used to describe the great destruction of human life and property by Kenyans against their perceived opponents following the outcome of the 2007 presidential elections.

Kenya regained her independence from the British colonial rule in 1963. Constitutionally, national general elections are held every five (5) years. Accordingly, constituents are expected to “democratically” elect their representatives to county councils, municipalities, parliament and presidency. Initially, glaring physical violence was never associated with general elections in Kenya until 1992, 1997, 2002 and worst of it all in 2007. Thus, from 31st December 2007, immediately the presidential election results were announced, which declared Mr. Mwai Kibaki the winner until end of February 2008, when a peace accord was signed, Kenya witnessed massive destruction of human life and property that shocked the whole world; it was a disaster that had never been seen before. Most of the disaster took place in the west of the Great Rift Valley which comprises three provinces namely: Nyanza, Western and Rift valley. Many people in this region were shot or slaughtered to death, beaten and/or raped, while the runaways were forced to become Internally Displaced Persons (IDPs) (Horiuchi, 2008; Nyanchama, 2008).

Strangely, people who had lived as neighbours for decades turned against each other with machetes, pangas and other crude weapons they could get hold of. They sang war songs against those they perceived as not their own blood relatives. The objective was to drive out the people they thought belonged to a different ethnic background, back to their ancestral homes (Bluntand Spenkle, 2008, Fish and Kroenig, 2008). Businesses and business premises, residential houses and crops in the field all went up in flames including human beings in hiding places such as the church (Nyanchama, 2008; Olouch, 2008). The youths blocked roads and demanded instant identification from all travellers in order to ascertain their ancestral origin. They also barricaded roads to cut off all forms of transportation from one place to another. Security forces were equally endangered and barred from rescue errands. The region was plunged into a disastrous war zone. Subsequent experiences were horrifying. The disaster devastated and shamed Kenya world-wide.

The remaining part of this paper is divided into four sections. The authors have addressed causes of the disaster, its effects, conclusions and the way forward in the first, second, third and fourth sections respectively.

Causes of the Disaster

The 2007 presidential elections in Kenya were the most closely contested between the Orange Democratic Movement (ODM) and the Party of National Unity (PNU) political parties. Several pre-election polls had observed that two presidential candidates, that is: Mr. Raila Odinga of ODM and the then sitting President Mwai Kibaki of PNU were ranking very closely as shown in the predictions of 8th December, 2007 in table 1.1.

Table 1.1: Pre-Election Presidential Predictions, Research Firm and Candidate

Research Firm	Presidential Candidate and percentage Rating		
	Raila	Kibaki	Kalonzo
Consumer	43%	39%	15%
Infotrak	43.3%	39.2%	15.2%
Steadman	46%	42%	10%
Strategic	43%	39%	17%

Source: Kirogo Sollo (2008:10).

In the last survey carried out by the Steadman Group on 19th December, 2007, a week before the voting day, scores were closer with a range of only 2% between the two top candidates: Raila scored forty five per cent (45%) while Kibaki scored forty three percent (43%). Moreover, there was a public pronouncement by the third presidential candidate, Mr. Musyoka, that there would be a tie between the first two candidates at the actual elections, 27th December, 2007. Some politicians and the common man alike were angered by the statement; they suspected foul play as PNU and ODM graced to win at all cost. Implicitly, the presidential results were likely to be contentious. When president Kibaki was announced the winner, amidst dispute by ODM adherents, the stage seemed ready for a fierce fight (Blunt and Sprengle, 2008).

Moreover, the manner in which election results were handled at the local tolling stations and at the Kenyatta International Conference Center (KICC) which was the central tolling station raised suspicion (Maathai, 2008). Various irregularities were observed with regret. For instance, the opposition party, ODM, had accused the president of ignoring the Inter Party Parliamentary Group (IPPG) agreement that consultations should be made in the appointment of the Electoral Commissioners. Further, on the first day results were announced, Raila was far ahead of Kibaki. These results were announced direct by Media houses. On the second day however, the Electoral Commission amidst rumour that results from some polling stations were altered, banned the media from announcing results directly to the public (Horiuchi, 2008). It was also reported that some results' forms presented at KICC were different from those signed by presiding officers at the polling stations. These reports made Kenyans anxious and temperamental. Feelings of mistrust and suspicion reigned among the opponents (Nyanchama, 2008). By the third day of vote counting, the PNU candidate was ahead of the ODM candidate, overriding the previous announcements that the later was leading. ODM adherents 'murmured loudly'. They complained of flawed results (ibid). The Chairman of Electoral Commission ignored the outcry, announced Mr. Mwai Kibaki of PNU the winner and was immediately sworn into office on 31st December, 2007 (ibid). In response, ODM followers and sympathizers took to the streets to present their frustration. This reaction plunged the country into bloodshed that culminated into great destruction of property and life (ibid). The first attacks were spontaneous (Maathai, 2008). In areas which were ODM strongholds, attacks were aimed at perceived PNU adherents who were mainly from the central region of Kenya. Later, the killings and destruction spread to other areas which were PNU strongholds. The attacks mounted by PNU adherents against perceived ODM allies were aimed at revenge. Accordingly, the UN High Commission for Human Rights Report (2008), noted that the irregularities witnessed during the vote counting exercise contributed to the disaster in Kenya, 2007/2008. Could this observation have been correct?

Furthermore, inflammatory tribal rhetorics and hate speech that plagued the electoral campaigns prior to elections cannot have created peace in Kenya after elections. Since 1992, hate speech seemed to have become a characteristic of Kenya's election campaigns (Tandon, 2009). This trend was propagated by politicians and their kins, directed against their opponents. The politicians used campaign platforms to sow seeds of discord and woo their kins to rally behind their preferred presidential candidate. Political analysts too, participated in propagating the hate speech. To say the least, towards the end of elections campaign period, the ODM Presidential candidate, was portrayed by a political analyst as mean and hungry for power (Mutua, 2007). The National Council of Churches of Kenya (NCCCK) noted that such statements were bound to bring hatred and conflicts among opposing groups. Soon, the NCCCK observation appeared to have been a prophecy, or, was it so?

Another important aspect in this period of turbulence was ethnicity (Horiuchi, 2008). Kenya is made up of over 40 different ethnic groups. The three largest communities in descending order are Kikuyu, Luhya and Luo. Other big communities are Kamba, Kalenjin, Kisii and Meru (Nowrenjee, 1993). Apparently, ethnic identity influenced constituents to vote for candidates from their ethnic groups, leadership qualities

notwithstanding (Cariou, 2007). In addition, the common perception in Kenya at this period was that the Kikuyu community had dominated the country's economy and politics for too long (Cariou, 2007; Nowronjee, 1993). Thus when the electoral commission announced that Mr. Kibaki, who is a Kikuyu, had won the elections, his opponents were anxious to remove him by all means including violence (Nyanchama, 2008).

Moreover, the land issue has haunted majority of Kenyans since the 19th century. Out of Kenya's eight provinces: Rift Valley, Nyanza, Western, Central, Nairobi, North Eastern, Coast and Eastern, the Rift Valley province covers 40% of the land mass. It is also the agricultural hub of the nation (Nowronjee, 1993). Prior to the colonial period, the area was home to pastoral-nomadic groups namely, the Masaai, Kalenjin, Samburu and Turkana (ibid). During the colonial rule, most of the Rift Valley became known as "white highlands", secluded for European ranches and farms (Ogot, 1972; Moi, 1986).

Special rules and regulations were established by the colonialists to safeguard their interests. These undertakings had a profound effect on land ownership and tenure in the Rift Valley (Nyanchama, 2008). For example, labourers were hired from the neighbouring provinces to work in the white highlands (Kanogo, 1987). The colonial administration consequently instituted policies barring Africans from owning land in the highlands while labourers were restricted into "native reserves" (ibid, 1987). As a result, the pastoralist groups found themselves excluded from areas they had originally considered their homelands. These dealings dislocated and disinherited the natives from their original lands (Nowronjee, 1993). After independence, British settler interests' were safeguarded. No effort was made to deal with ardent claims of either the pastoral or labourers' ethnic groups (Kanogo, 1987). This issue is painfully unresolved to-date. During the post-election violence, reference was made to it. Natives argued that "immigrant" ethnic groups should return to their native lands (Nyanchama, 2008). This ideology funned forceful eviction of the "outsiders" residing in Rift Valley and hence the outrageous killings and destruction of property. Although similar situations had surfaced in previous elections of 1992, 1997 and 2002 in Kenya, the scenario of 2007 was most intense; it precipitated in the subsequent disaster.

Furthermore, prior to the 2002 general elections, there was a consensus on the need to change the constitution of Kenya. After elections, Kenyans contributed keenly to "a people driven constitution", famously known as the Bomas Draft. The draft was in favour of devolution system of government. Unfortunately, the government was not in favour of the shift. This mismatch led 7 out of 8 provinces to vote against the government in the 2005 referendum (Lome, 2008). Henceforth, the Kenyan citizenry could no longer trust the government to enact the people's changes. When the same government was to remain in power, opponents were highly disenchanted. Many of them took to the streets to express their frustration (Horiuchi, 2008). They thought the commission had been compromised (Nyanchama, 2008). They also suspected that both the judiciary and the electoral commission served the interests of the government (Maathai, 2008). For any grievance, therefore, the masses were most reluctant to go to the courts for justice (Okoti, 2007). In the course of expressing their anger, fury and disappointment among others, properties worth billions of shillings were destroyed and hundreds of people murdered.

Moreover, since the beginning of the millennium, unemployment in Kenya had been escalating by day (Horiuchi, 2008), to the extent that many educated youths were unemployed. By end of 2007, unemployment rate in Kenya was more than 50% (Nyanchama, 2008). These youths were like a time bomb ready to explode with least provocation (ibid, 2008). Their frustrations in the course of searching for a job or capital for self employment were beyond sanity. These youth were vulnerable to misuse by politicians and people with power. The youth easily demonstrated and caused disturbances and destructions witnessed after the 2007 general elections. They formed the bulk of the fighters, nay, the mayhem and subsequent murders.

Be that as it may, Kenya's 2007/08 disaster suffered multifaceted contributory factors (Nyanchama, 2008). True to say, the presidential results of 2007 were contentious. Nonetheless, they may have acted only as a trigger (Blunt and Sprenkle, 2008; Nyanchama, 2008). The events that ensued led to irreversible damages, losses and demise. In our opinion, the disaster was not an accident. The underlying socio-econo-political grievances were too strong. They were like the geographical monsoon winds which in their season not only propel boats but also occasionally force the ocean tides beyond the water banks unto drowning many persons and properties alike.

Effects of the Disaster

The effects of the disaster were many and widespread. They touched all fabrics of the nation and beyond. From the economic front, it was reported that no one had been spared: hand cart pushers, hawkers, neighborhood shopkeepers, multinational companies, real estate tycoons, hoteliers, farmers, airliners, road and rail transport users, commercial sex workers, heavy and light industrialists and virtually all types of businesses were disrupted (Aluanga, 2008; Nyanchama, 2008).

The Secretary General of Central Organization of Trade Unions (COTU), Mr Francis Atwoli, noted that, approximately 60,000 persons lost their jobs especially those who worked in the horticulture industry in Naivasha, Kericho and Limuru. They vacated, deserted and/ or were dismissed; some among them were murdered. The tourist sector which earns Kenya about 25% national income was hard hit by the disaster (Gottlieb, 2008). A spokes woman for the Kenya Tourist Board, Rose Masonye –Kwena, estimated that 120,000 jobs were lost in the industry during the mayhem disaster.

At the same time, the World Bank estimated that up to 2 million Kenyans were driven into poverty as a result of the disaster (ibid, 2008). In Nyanza province and especially Kisumu city, various businesses were burned down. The mob looted a number of supermarkets, shops, homes and petrol stations. In areas such as Eldoret town and Kisumu city, markets and business premises were burned down. Foreign investors hurriedly moved out. Local investors were displaced if not murdered. Movements of people from one place to another were paralyzed (Nyanchama, 2008). The losses were also felt by suppliers of goods and services in institutions of higher learning. A source at the procurement department at Kenyatta University noted that suppliers had lost businesses worth millions of shillings (Ndegwa, 2008).

From the social perspective, many people lost their homes, livelihoods, and properties, while others lost their important documents such as school certificates and identification cards (Horiuchi, 2008). The first week of January 2008 (1st to 7th) was reported by the press as the “darkest week in Kenya’s history since independence” (Lome, 2007). The week witnessed intense bloodshed, loss of property and displacement of many people. According to official estimates by the police, over 1,500 persons lost their lives while over 300 thousands others were displaced (Barasa, 2008; Machio, 2008). These were recorded data; most likely, the unrecorded figures were higher. The Nakuru District in the Rift Valley Province hosted most of the displaced persons. Other destinations included Nyahururu, Naivasha, Nyeri, Limuru, Kiambu and Murang’a (Horiuchi, 2008).

In his testimony, the then District Commissioner for Uasin Gishu, Mr. Bernard Kinyua, reported that about 52, 611 houses and 58 vehicles were burned to ashes and over 200 people were killed. He cited the hottest spots of the disaster in the District to have been: Burnt Forest, Kwa Mumbi, Turbo and Moi’s Bridge. In Kuresoi area, schools, residential houses and churches were burnt down. Another area intensely affected by the disaster was Trans Nzoia District. The worst hit zones in the district included Gitwamba, Geta and Salama (Barasa and Kirago, 2008).

The disaster was also felt in Western province. According to Mr Abdul Mwasera, the Provincial Commissioner, over 68 persons were killed. Here, armed youths set several homes on fire and destroyed a private hostel which accommodated students of Masinde Muliro University of Science and Technology (MMUST) in Kakamega town (ibid, 2008).

By January 23rd 2008, the disaster had escalated and torched other areas that had earlier seemed peaceful and safer. Such locations were Naivasha and Nakuru towns where violence was more pronounced (Gottlieb, 2008). The barbarity and murderous ruthlessness shown by Kenyans against each other were terrifying. Scenes of bodies burned and others half eaten by animals rotting in the killing fields were psychologically tormenting (Mutuma, 2008). Tales of losses by the survivors were thought-provoking. The story of a woman whose children were burnt alive tells part of the disaster saga - her four children in Naivasha were all burnt to death at once (Atsiaya et. al., 2008). A similar fate befell Bernard Ndege Oringa, who lost his 2 wives and 8 children at once. Importantly, Kenyans lost trust in each other by virtue of the fact that many cases of attacks were perpetuated by people who were known to their victims. For example, many youth victims reported that they had schooled together with their attackers while the raped noted that they knew the rapists (Namunane, 2008).

The education sector was not spared either. Primary and secondary schools could not open as scheduled. Some primary schools in Nyanza province delayed their opening date by a month. Other institutions of higher

~~learning suffered the same fate. To say the least, the University of Nairobi (the nerve center of academic pursuit in Kenya), postponed opening dates from January 7th to 21st 2008 for graduate students. The undergraduate students resumed classes on February 18th instead of January 7th 2008 (Ndegwa, 2008). According to the University of Nairobi Public Relations Officer, Charles Sikulu, the main reasons for postponing the opening dates were insecurity and unavailability of transport. Parents were cautious about the safety of their children. They did not release especially children attending boarding schools. In any case, some schools had become centers of IDPs while others were in the most volatile regions.~~

The disaster also affected the health sector. Hospitals experienced immense inflow of patients seeking treatment. Some hospitals were unable to cope with the numbers notably, Kenyatta National Hospital in Nairobi and Moi University Referral Hospital in Eldoret. According to Dr. Bukusi, a psychiatrist at Kenyatta National Hospital (KNH) in Nairobi city, the magnitude of the psychological trauma among the medics was beyond reach (Mukinda, 2008). In other instances, bodies of the deceased were left unclaimed in mortuaries for a long time.

The disaster also impacted heavily on those living with HIV and AIDS and TB. They were unable to access their medication. Records from doctors without borders (MSF) showed that, between December 31st 2007 and 14th January 2008, approximately 290 patients missed scheduled appointments at the MSF clinic and Mbagathi hospital in Nairobi Province (Machio, 2008). Coupled with rape cases, it could only be feared that this scenario created a sub-disaster within the disaster in Kenya; approximately 1.4 million Kenyans aged between 15 and 64 years live with the virus (Otieno, 2008). Consequently, the AIDS prevalence rate stands at 7.8 per cent up from 6.7 per cent in 2003 (ibid).

Politically, the effects of the disaster were felt beyond Kenya. Countries that depend on Kenya for humanitarian and commercial operations suffered most. These include Uganda, Rwanda, Sudan, Burundi and Eastern Democratic Republic of Congo (United Regional Information Networks (Irin, 2008). These countries experienced fuel shortages and other essential supplies during the disaster. Uganda's deputy Prime Minister, Eriya Kategaya, reported for example, that some factories were forced to lay off people due to lack of supply of necessary equipment.

Aid agencies serving these countries such as United Nations World Food Programme (WFP) encountered the greatest challenge during the disaster. A WFP spokesman in Somali noted that it was impossible to continue feeding 7 million people in Somali and 250,000 IDPs in Kenya if the roads remained closed due to insecurity in Kenya (Irin, 2008). According to United Regional Information Networks (URIN) at least three WFP trucks had been damaged and/or looted by mobs at impromptu roadblocks mainly in the Rift Valley by January 31st 2008 (Irin, 2008). CARE International in Somali, observed that their organization drew most of its workers from Kenya but the disaster had diminished everyone's morale with a number of staff being affected directly (Lome, 2008).

Conclusions

In our understanding, the 2007/08 disaster in Kenya had many underlying forces. These forces included: economic, social and political factors. The transport system in Kenya collapsed. Tourism came to a stand still. Businesses ceased in operation. Inflation rate escalated till this day. Socially, the question of land which had remained unresolved for as long as over two centuries grieved people and made them impatient to persevere any longer. Unfortunately, their reactions were too violent leading to rampant insecurity and disaster. The Education system was interrupted. Moreover, many people were displaced and/or murdered.

Glaring formidable inequalities in Kenya propelled the masses into a revolution pitting the "have nots" against the "haves". For example, high cost of living and massive unemployment especially among the youths in Kenya had risen to catastrophic scales. The poor who are also the majority could hardly afford basic needs such as food, clothing, shelter, good health and education. These deprivations left Kenyans susceptible to violence; most of the affected struck with the least provocation in 2007/2008 leading to the subsequent disaster.

Politically, the government's reluctance to change the constitution to include the wishes of the masses angered majority of the citizenry. The people felt frustrated that the government was bent on safeguarding the status quo at the expense of good governance and democracy. In the absence of an alternative reaction, they took to violence and hence, the disaster. Moreover, Kenya as a nation lost international image. She was no

~~longer a haven of peace especially in the Eastern region of Africa. Some people fled the country to seek refuge in the neighboring Uganda while many others were forced into concentration camps as IDPs.~~

Way Forward

Although Kenyans experienced traumatic ordeals during the disaster, she can emerge stronger in the following ways: Create and sustain a culture in which all Kenyans are treated fairly. Discard the culture of impunity for the few top class people. Say no to negative ethnicity: Enable Kenya as a nation to derive her strength from diversity. Demonstrate and enhance a culture of nationhood. Engineer continuous mass education to enlighten Kenyans on their rights and justice. Enable the citizenry to embrace and appreciate concepts such as unity, humanity and integrity, multi-ethnicity cum multi-partism. Resolve the land issue by enacting clear land policies that will protect the poor and the landless. Support the church and other religious institutions to rise up to their task of encouraging Kenyans to exercise their moral authority. Initiate paradigm shift in the way we socialize the youth. Our education system for instance should be integrative, allowing students to interact with others from different communities. Remove the Quota System in schools. Encourage and allow Kenyans to work, live, settle and visit anywhere in this country.

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CAUSES OF VIOLENT CONFLICT AND THEIR IMPACT IN EAST AFRICA: New Management Paradigm

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Abstract

Decades of violent conflict and exposure to risk continue to rake devastating effects on the population of Eastern Africa with new emerging trends in hazard impacts as realized in the tendency to describe violence occurring across the region as ethnic. The recent Kenya's political melt down is such one example that threatened the country's economic life line and that of other neighbouring countries like Uganda, Burundi, Somali, Tanzania and Sudan. Increased religions' fundamentalism has also become a distinct part of conflict dynamics in a region that has been traditionally tolerant to multi-faith practices.

More disturbing however, is the social, economic and political cost that is the outcome of these conflicts as reflected in terms of ethnic identity, poor distribution and utilization of natural resources and political rights and representation. Worse still, approaches to conflict management in the region have always relied on relief response by the Humanitarian Agencies with the hope that affected communities can attain recovery given time. Despite this, it has become apparent that relief response must go hand in hand with social-economic development where effective means of managing conflicts are rooted in the social structures with specific indicators in normative cultural transformation and transition to reduce conditions from which conflicts have arisen. This paper therefore explores various causes of conflicts in the region, the way the effects affect human development and suggests approaches for change that can bring about sustained development.

Introduction

The political melt-down in Kenya after the disputed election results of December 2007 and the subsequent civil strife, the socio-economic threat to its people and those of the neighbouring countries like Uganda, Tanzania, Rwanda, Burundi, Sudan, Ethiopia and Somalia came as an eye opener to the population of the region that, "We cannot remain islands of peace and sovereign entities in stormy waters" (Raila Amolo Odinga, Kenya's Prime Minister: 2008). Apart from Tanzania, Kenya is one of the East African countries that were perceived as relatively peaceful. It was and still remains an important point of entry to other war torn countries like Sudan and Somalia. At the same time the economic lifeline of the landlocked countries like Rwanda, Burundi, Sudan and Uganda literally depends on a peaceful Kenya. Indeed it is said that conflict is an endemic feature of human history and development (Drabek, 2005). Disputes over the access and control of territory, material, economic and natural resources have been among the dominant sources of conflict World Wide, and, in fact in some instances, conflict has resulted into some of the most successful democracies and civilizations. However, the East African region holds some of the major Africa's forgotten conflicts that have continued to cause untold atrocities and heinous crimes of the 21st century. It is also ironic that after the attainment of independence and over forty years of foreign Aid to the region, there has been continued suffering and devastating losses with new emerging trends in hazard impact. This has enormous consequences to human settlement and shelter, the infrastructure, disease outbreak and depletion of the environment. Such occurrences have also continued to put a lot of pressure on scarce resources, and create dependency among households and nations with more complex and vulnerable environment.

Incidentally approaches to conflict management have always been focused on relief response and humanitarian assistance which in reality does not address the underlying issues, with massive costs, at the expense of long term development plans. This is because of the fact that conflict has never been perceived as a constructive force which is inherent in societal development but as an evil that has to be eliminated and as such strategies and mechanisms for a peaceful conflict management have hardly been developed. (Duffield, 1994). Miall et al., (1999), goes on to add that systematic approaches of dealing with structural conflict should always focus on removing the structural contradictions and injustices that tend to push certain groups and individuals into marginal circles of representation and participation. This enhances a conducive environment for human freedoms security, and development. (Agbassy-Bonn, 1995, Yonda, 2005). Although people of East Africa region tend to blame negative outcomes of violent conflict on the past colonial rule, where there was no right to expression and freedom to participation, issues of peace building and sustainable development largely depend upon viewing conflict as windows of opportunity for addressing the underlying issues to conflicts. This normally calls for a transitional approach that can create socio-economic and political

relationships which are stable and durable. The focus of such a transition should therefore be empowering individuals and groups to access opportunities of advantage and growth. This paper therefore makes analysis of the nature of conflict in the Eastern Africa region and suggests applicable approaches in mitigating conflict hazard impact.

Conflict, vulnerability and sustainable Development

It is evident that issues which contribute to emergency of conflict and its violent expression may not be necessary the same issues as those which maintain the conflict. This therefore, may be part of the reason that conflict management approaches should be more proactive, coordinated, with the main focus on the underlying issues. Similarly, and with reference to the East African situation, conflict management should be well defined so that operational approaches are well articulated to create more comprehensive management programme approaches, in order to mitigate hazard impact. (Fisher et al., 1999); I.A, 1996), UN: 2000), Annan, 2008). Some of these concepts include the following:

Conflict and the concept of peace

It is generally understood that a conflict arises when parties disagree on perceived incompatible goals (Miall et. al., 1999). Again, social conflict comes about when there is a struggle over values and claims to scarce status, power and resources (A.I: 1996). The word conflict also has a negative connotation as we tend to think of it as the opposite of things like cooperation, harmony, accords or peace. However the negative understanding of conflict and, the equating it to violence never allows us to distinguish between forms and causes of conflict for appropriate responses (Duffield, 1994, Tambila et al., 2001) Munya, 2001).It is also a normal assumption that conflict is usually accompanied by violence. This consists of actions, attitudes, structures or systems that cause physical, psychological, social or environmental damage, and therefore prevent people from reaching their full potential (Galtung, 1996). Most of the times, it is also assumed that when people are not in conflict, there is peace. “Shalom”, a Jewish word for peace means “Everything that is given by God, in all areas of life to create complete **tranquility**” (NCKK, 2001) People of the Great lakes Region of Africa also use the word “Kindoki” for peace, which refers to “a harmonious balance between human beings, the rest of the natural world and the **universe at large.**” Social Scientists on the other hand generally describe peace as relationship between any people, which is characterized by respect, justice and good will, and where individuals have a sense of “themselves and at peace with themselves”. (<http://cn.wikipedia.org/wk/peace>) This makes the description of peace as something that can easily be attained. However, recent thinking has indicated that one concept or idea that often complements peace and applications is sustainable development and at this level, peace is defined as, “What happens when all people are free to develop themselves in the way they want without having to fight for their rights” (<http://cn.wikipedia.org/wk/peace>).This is achieved through a set of many different elements such as good governance, healthcare, quality education, gender equality, disaster preparedness, a functional infrastructure, a vibrant economic growth, rule of law and justice, application of human rights, including environmental and political issues. This must also be reflected in improved standards of living for all. (<http://cn.wikipedia.org/wiki>).Democratic peace pushers on the other hand are of the opinion that if communities continue promoting social-economic growth, political freedoms, equality and justice, a continued level of peace is attained. (NCKK, 2000)

A number of things are however clear in all these contributions that peace is not something humans have to achieve now or someday. Peace should be natural and spontaneous in the human affairs once certain things or conditions are met. It is however fragile and must be sought, treasured and sustained in our everyday lives. We can therefore conclude that issues of conflict relate to contradictions, attitudes and behaviour that may develop negative perceptions in us. Peace building therefore should assume that conflict is a natural part of human existence and its goal is to transform destructive ways in which we deal with conflict for more constructive outcomes.

The concept of peace and sustainable development

A number of findings in various studies, have indicated that issues of conflict are a reflection of social values and the state of socio-economic and political development of a given society (Millstein, 1993, NCKK, 2002, 2003, I.A, 1996). This is by the fact that certain patterns of production and consumption tend to push certain social groups or individuals into marginal cycles of participation and access to opportunities of advantage.

These expositions are potential for increasing vulnerability to conflict since they never address the principles of equality and human development for sustainable development. In the above referred context, sustainable development is the ability of any given system to produce benefits that are sufficiently valued by the users and all stakeholders, using available resources, while maintaining the sustainability of these resources for present and the future generations (FAO, 2005). For this to be adequately achieved, management approaches to conflicts should focus on the sustaining of livelihoods at household levels, accompanied by livelihood analysis programmes to circumvent difficulties and help people to understand better their actual assets, how these assets impact their lives and their abilities or inabilities to withstand shocks during a crisis (Segura, 2004).

The concept of Vulnerability

Violent conflict usually has an element of human intent, negligence, error or involve a failure of a given system, that put a given population or an individual at risk. Therefore a risk factor for our purposes can be defined as, "The probability of harmful consequences and the expected loss of lives, property, livelihoods and the disruption of the environment, as a result of an interaction between natural or human hazards and vulnerable conditions". (DFID: 2002). Two elements are therefore essential for the risk outcome. These are the probability of an assurance of a given threat- hazard, and degree of susceptibility of the element exposed to the source of threat- Vulnerability (Twigg, 2000) Incidentally, vulnerability is said to be a reflection of the state of the individual and collective physical, social, economical, political and environmental factors that shape the lives of the people. Therefore the concept of risk reduction should be based on a mitigation element that ensures the building of societies that are resilient to conflict hazards. This would ensure that developmental activities do not increase vulnerability, but promotes sustained development (NCCK 2001, ISDR 2004, 2005) (UN, 2005)

The concept of risk reduction in conflict management therefore should focus on putting in place institutions and structures that support community based approaches in order to reduce vulnerability. This empowers the community to spontaneously cooperate for all the intended interventions. (ISDR, 2005).

Emerging trends and hazard impact

The nature of conflict in East Africa region has its history in the legacy of the colonial rule as characterized by structural inequalities. These inequalities are reflected in ethnic identities political rights and representation, and the distribution and utilization of the national resources. These discrepancies have continued to generate violence but more disturbing is the human and the social-economic cost that is normally involved.

At sub- Sahara Africa level for example, 80% of the World's refugees are Africans. 70% of the African refugees are children and women who tend to suffer more in times of a crisis. In addition to this, 5 million Africans died as a result of violent conflict between the years 1996 and 2007. This is interesting because the continent was accounting for 80% of the total number of peace keepers deployed around the World for the same period. The budget for this deployment was well beyond Africa's own capacity and the expense of long term development programmes. (Gulting, 1996); NCCK, 2005); Ivan, 2007; Doucet,1996), <http://esteasternafrikanca.no/article/view/4980/?Treemenu=188>). East Africa itself is said to experience some of the most dehumanizing conflict in human history. In four months alone between April and July 1994 over 800, 000 Rwandese were reported dead and almost half of the population compelled to flee their homes and country. The United Nations termed this occurrence as genocide. Although Rwanda has achieved its transition from conflict through a new constitution, the continued presence of illicit arms is still seen as a serious threat to security, particularly in the Great Lakes region.(NCCK, 2003). The twenty year conflict in Northern Uganda between government forces and the Lords Resistance Army has also caused tens of thousands of lives and displaced over a million people. This has been viewed as the most neglected humanitarian crisis in the world, which is marked brutality and the abduction of school children of whom girls are taken as sex slaves and boys recruited into the guerilla army. An attempt to peace talks has always been derailed by suspicion and hardliner stunts from the warring parties (Lake, 2006). Somalia has had no functioning government since the ousting of president Siad Barre in 1991, who had been perceived as a dictator. This has submerged the country into a state of anarchy, despite of the efforts of a transitional government put in place in 2006. Islamic militants who are loyal to the union of Islamic courts are

continuously waging war against the government forces. In addition to this militia groups have taken up piracy in the Indian Ocean (<http://easternaficana.no/article/view/4980/?Treemenu=188>).

In Sudan, there has been a state of near permanent civil war since the country attained independence from the British. A rebellion fueled by grievances of the Local Black Africans over the use of natural resources has raged into Darfur and since 2003, two million persons have been displaced and over two hundred thousand reported dead (Norwegian church Aid, 2006). Tanzania has relatively remained peaceful over the years although the “vijiji vya Ujamaa” process caused several tensions, numerous deaths and a failed coup attempt in 1992/1993. Chachage: 2001). This is because Tanzanians have a very negative attitude towards conflict which is seen as a force for destruction. However there has been sporadic conflict over election procedures with Tanganyika main land and the island of Zanzibar trading accusations over unprocedural elections. This country also suffers instability from its neighboring countries, including threats from cross border trade in small arms and light weapons. This has created the existence of militia groups. (NCKK, 2005; Chachage: 2001).

Kenya also has had a long ugly history of political violence. This has been compounded by diverse ethnic composition and the social-cultural characteristic that influence restlessness during election time. The situation is also perpetuated by a culture of political patronage, worse by the fact that the country has a poor constitution which has been in place since independence. Issues of high level corruption are also said to undermine any developmental strategies. (NCKK, (2005); Un, (2000); Gurr, (1993);

There are also serious emerging conflict threats for the region including terrorism where there is the infiltration by the so called Al-Qaeda terrorist networks. The effects were experienced during the 1998 bombing of the American Embassies in Nairobi Kenya, and Dar-es -salaam, Tanzania. Another terrorist attack was also experienced in Kikambala Kenya at an Israeli Hotel in 2002. This development is worsened by high levels of insecurity as a result of porous borders and the inability of related governments to combat the attacks. The recent occurrence of piracy activities in the Somali waters of Indian Ocean is also a new emerging threat of the international magnitude and concerns are drawing the attention of the United Nations and world’s super powers

Lastly, the region has a tendency to describe violent conflict as ethnic. This is misleading as it tends to overlook underlying causes to the conflict and if encouraged it will continue to divide the region into small ethnic pockets.

(I. A, 1996). It is for these reasons that there is a need for putting in place strategies that would address causes of conflict in the region. Some of the suggested approaches include the addressing of vulnerable conditions to conflict, effective management of resources and community involvement and participation. (I.A, 1996); (Twigg, 2000); (UN, 2000, GoK: 2003); (ISDR, 2005). It is therefore important for us to understand some of the causes of conflict and related issues.

Causes of conflict and related issues

We have seen that conflict arises because of a perceived incompatibility over goals or interests between parties. There are however two major distinctions as to the sources of these incompatibilities.

Proximate or Immediate Causes

This refers to the events which may trigger immediate violence. For example the perceived stolen election’s results in Kenya triggered “spontaneous” ethnic violence across the country in December 2007 which has the continued to affect good governance of the country. (I. A, 1996).

Underlying Causes

These are the fundamental and long term causes which create conditions in which immediate triggers of conflict occur. For example the ethnic clashes over the disputed election results in Kenya were the outcome of perceived injustices, covering a period of over forty years.

Though the two sets of causes are obviously interconnected, it is the identifying and the understanding of the underlying causes which should be of great concern to the conflict analysis and management (NCKK, 2003). A number of theories have therefore been advanced as to the explanation of the underlying causes of conflict. These are categorized into three major groups for the purposes of this paper.

Structural Theories

These theories assume that the organization of the society itself creates the causes and conditions for conflict. One such example of structural theory is the historic materialism theory which relates conflict to the

organization of the means of production. Galtung expands further by adding that violence in this set up, is built up around unequal, unjust and unrepresentative social structures. These structures over time tend to produce social groups that have low income, low education, poor health and low life expectancy. It is also further indicated one party's behaviour and attributes prevents another from realizing full potentials and capabilities. The human and social costs of this kind of a silent and indirect conflict are normally of a higher cost than that of direct physical harm.

Agency Based Theories

These theories locate the causes of conflict at the level of individuals or collective agency based on human behaviour. An example of one these theories argues that aggressive behaviour is innate and biologically programmed in the human species. Another set of supporting theories adds that early differentiation between 'self' and 'other' manifests itself in a deep psychological development and relates to group formation and differentiation, particularly in the areas of imaging, perceptions, stereotyping, and dehumanization.

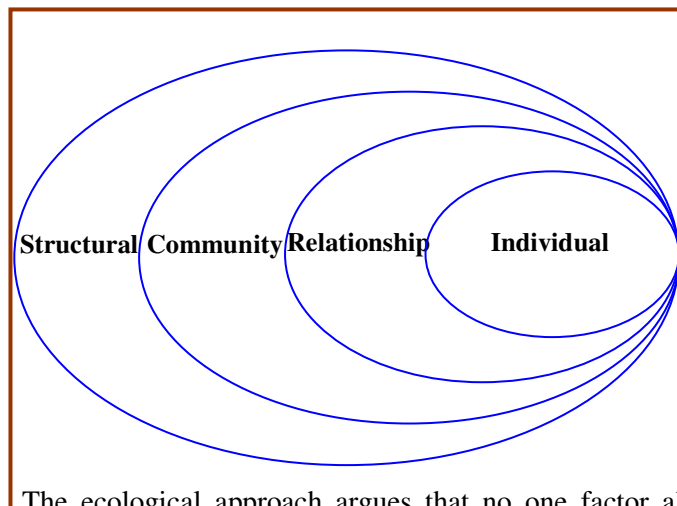
Another set of these theories is the 'basic needs theory' which differentiates between positions, interest, values and basic needs. Basic needs become the major focus here. These are essential for identity, security and recognition. The satisfaction of these needs is essential for human development and social stability and human beings will seek to satisfy these basic needs and when social institutions fail to address them or violate them then this can give rise to protests, rebellion and violence.

Social Discourse Theories

This set of theories emphasizes the central importance in the very language people use and the social practices people engage in to generate identities that pin point 'us and them', 'insiders and outsiders'.

Therefore, approaches to conflict management should aim at recognizing grievances, needs and issues of all stakeholders in a conflict situation and should systematically continue to address structural realities that present. (AI, 1996, Heise, 2001). More recently though, experts are using an ecological model to understand the inter-play between individual, situational, socio-cultural and economic factors that combine to cause conflict. (Figure 1)

Figure 1: Ecological Framework for Understanding Conflict



The ecological approach argues that no one factor alone causes conflict, but rather a number of factors combines to raise the risk factor (Helse, 1998). This helps planners and development experts to promote approaches of managing conflicts that recognize difference, diversity and otherness (International Alert, 1996).

Issues involved in conflict

We have already seen that the more risk factors present, the greater the likelihood that a conflict will occur. It is then important for us to look at some of these risk factors or issues that are likely to be sources of conflict.

Resources Distribute and Utilization

The severe economic crisis of the late 1990's made reforms in the region inevitable. Agreements between IMF and the World Bank changed state controlled economies into the market economies. This also changed

the modes of interaction between state and society and within society (Lugalla, 1995). Many believe that these economic reforms and multi-party systems were hijacked by a few to create unfair competition. Firstly, these economic reforms introduced into the society private ownership and a culture of exclusion (Peter, 2002). Secondly, this increased unequal access to profitable but scarce resources and continued fighting for good positions in the new economic and political order. Thirdly, the new systems of reduced control gave not only room for more economic and political freedoms but also to more violent ways of dealing with competition. Fourthly, the gap between the poor and the rich increased and the accumulation of wealth by a few became obvious. This as it were, seemed to divide the society into “winners and losers”. The poor started to suspect that a few influential people were restricting the majority access to the national wealth and had continued to distribute opportunities among their clientele.

Governance and Political Leverage

It is normally perceived that good governance makes violent conflict less likely. That is why democratic governments would want to go out of their way to create a combination of institutions, structures, legal procedures and norms which allow people to express their concerns and pursue their interests within a predictable and relatively equitable context. This again rests upon legitimate use of power (NCKK, 2000). Good governance is said to take place at three levels: the family, the society and the corporate with the aim of enhancing efficiency, effectiveness and sustainable leadership. This requires a network of social relationships, characterized by common values and interests that are achieved and retained without coercion and which do not need to be maintained by threats or use of force.

However, political competition has become a race of individuals or group interests which has been compounded by conflict of identity. Governments and donor agencies have their own political agendas and internal systems that are often set up to protect these agendas, are lacking. This makes it difficult for civil actors and the community at large to gain access to information, which has increasingly continued to undermine the rights and entitlements of the common people. In addition to this lack of transparency of institutional actors, undercuts the ability of the civil society to monitor progress and enhance accountability.

Ideology and Religion

The term ideology has often been used more in the public world of politics while religion refers mainly to the world of spiritualism but in the recent years there has been an increasing overlap between the two terminologies. Religion is particularly relevant to conflict because many religions contain strong claims to exclusivity, where communities confront each other as competitors for unnecessary supremacy. In addition to this, religious beliefs have continued to be used by leaders as a means to political ends.. In some instances, explicit alliances are made between ideology and religion so that the latter becomes a sort of state religion as we have witnessed in Islamic court issues in Somalia. This infact has been considered as “Global fault line” for conflict since the era of the cold war (I.A, 1996).

Incidentally the Eastern Africa region was over the years tolerant to multi-faith religions but external influences has led to the dividing of the people along religious beliefs thus making religion a distinct part of conflict dynamics. (<http://easternafrika.nca.no/article/view/4950/?Treemenu=188>)

Social Identity

Many explanations of the causes of conflict focus on the importance of social identity. This is particularly true of the basic human needs and the social discourse exposition which regulates “An abiding source of selfhood the core of which makes life predictable”(I.A 1996). For example a study done by African Peace Forum and NCKK in 2003 in Kenya indicated that there is a correlation between individual/group goals and aspirations and incidences of violence, hence the focus on survival needs by militia groups. However, if given fair competitive opportunities, these individuals/groups would rather engage in peaceful activities for inner peace and self development. This study reinforces the fact that there should deliberate efforts to stimulate genuine human and Community development through enhanced participation, capacity building and empowerment to reduce levels of vulnerability to conflict. Secondly, other Identities as a member of a group are often described in terms of ethnicity, religion, Ideology, language and geographical location. The existence of a group one does not belong to, and which displays antagonistic views and values to one’s own group can create tension, threats or conflict. Incidentally, rivalry or threat to a group identity tends to persist over a long period of time with these feelings and perceptions being handed over from generation to generation. It is also a fact that the identity based on conflict is normally deep-rooted, intractable and very resistant to resolution.

In the more recent years, ethnicity has been singled out as the most important element of our identity and the underlying courses of most of on-going conflict.

Discussion

An important point for East Africa at this level is that conflict is an integral part of societal interaction and development. It is incidentally an integral part of all civilizations around the world. The more dynamic societies are the more complex interests, identities, opinions and demands become. This is by the virtue of the fact that a human-being is essentially a social animal with different values in the way they think, believe and react. These interactions no doubt create some sort of communication gaps and perceptions that must be continuously identified and mitigated for the building up of new social norms that encourage partnership, communication and cooperation (USAID, 1994). It is therefore important that conflict is seen as a window of opportunity for addressing underlying issues and for the rebuilding of livelihoods and the planning, and reconstruction of the physical and social-economic structures that can enhance resiliency and promote risk reduction approaches. This calls for networks and relations which are stable and durable. This type of foundation can help in the transforming of conflict into sustainable peace (UN, 2000, ISDR 2004, 2005, Yonder, 2005, Annan, 2008). This involves the following consideration.

Human development, Human Rights and socio - economic growth.

Until the last two decades, human development and human rights followed parallel paths in both concept and actions. The former was dominated by economists and the latter by political activists, lawyers and philosophers (UN, 2000) Today however there is general feeling that the two present new opportunities for effective partnerships and alliances in conflict risk reduction because human rights enhances moral legitimacy and the principle of social justice to the objectives of human development. Similarly, human development in turn brings a dynamic long-term perspective to the fulfillment of rights because it directs attention to social-economic growth.

Violence therefore is an obstacle to sustained human development and also contributes to the abuse of human-rights and dignity. This is because human rights are essentially the ultimate focus and ultimately contributes individual entitlements. Their fulfillment therefore contributes to the overall goal of social-economic growth. Human development in turn is dependent on appropriate enabling environment that enhance people's capabilities to cope and at the same time widen their range of choices. Thirdly, human rights and human development share a common vision and a common purpose which is to secure freedoms, the wellbeing and the dignity of all people. In this scenario competition should not be understood in terms of power struggle and exclusion but as a principle that requires partnerships and cooperation in order for people to create benefits for all. Fourthly by attending to the process of human development through the realization of human rights social-economic development analyst can get a fuller assessment of what is feasible, projected changes, given resources, policy concerns and institutions capacities that prevail within a given society (UN, 2000).

The multi-disciplinary concept in conflict management

It is common knowledge that conflict hazards always have disproportionate greater impact on poor and weaker systems and institutions. Hazards would not necessarily cause extensive damages if a given country's infrastructure, settlements and services are not so vulnerable to them (UNDP, 2000) This is evident in the slow-on-set nature of conflict hazards which do not require an prolonged type of relief response. It actually requires long term commitment by institutional actors to working with civil society to achieve given goals and a reciprocal commitment by the civil society actors to engage with institutions pro-actively. This however should not limit the civil capacity to maintain their independence and the ability to advocate for appropriate change (Agbassy-Boni, 1995). Management approaches that cover the grassroot adequately and the participation and involvement of local communities and their institutions has also shown that the identification of priorities that are cost effective become the focus for development through needs assessment programmes. This is by the mere fact that, "Development is like a tree that has well nurtured foundation and where grafted new ideals and concepts can bear new healthy buds" (DFID: 2003, NCKK: 2005).

Regional cooperation and experience sharing

Conflict hazards like social affinities are reflected in regional characteristics which are grounded in the predominant geographical conditions. Historical and common political features also contribute to the need for shared experiences with different countries or regions. This calls for regional dialogue and cooperation so that there are added depths and combined force for informed policies and approaches. Regional institutions can

therefore tap, as well as channel broader international expressions of intent into coordinated and better suited practical activities that are pegged on sharing of traditional knowledge, modern and scientific technologies for more appropriate transfer of effective strategies.

Coping strategies, livelihoods and conflict

Livelihoods comprise the ways in which people access and mobilize resources that enable them pursue goals necessary for their survival and long-term well being and thereby reduce the vulnerability that is created and compounded by conflict (Boudreen, 1998, Young et al.2001). Empirical evidence from many countries has also shown that less vulnerable households in crisis tend to have more diversified income streams and those initially more diversified tend to make faster and greater gains in income growth. (De Waal: 1990, Segura, 2004) However, it is now common knowledge that long term conflict may last for years and inflict almost permanent damage on livelihoods. Similarly deliberate exploitation of civilians in times of crisis tends to undermine productivity and self sufficiency for ill intended purposes (Lautze, 1997) Therefore studies on human growth, development and behavioral responses in terms of coping and adoptive strategies have recommended the adoption of a wide range of strategies in conflict management. This strategy should encompass economic, social, political and behavioural responses that take into account outcomes that make people perceive related benefits, costs and trade offs.

Recommendation

In relation to nature of conflict, issues involved and the destructive outcomes that hazard can create it is more important for the East African region to focus on approaches and strategies of peace building modalities that are hinged on four operative principles of human development cycle. These are namely comprehensive programmes; which takes the overall picture of conflict into consideration, interdependent activities; that involve a system of interconnectedness between people, roles and activities, strategic planning, where people are given opportunities to respond practically to emerging dynamic social situations and meeting immediate concerns and needs, and lastly sustainable *approaches*; where peace building initiatives responds to and transforms recurring cycles of conflict crises(Evans, R, 2004) Peace builders around the world are therefore recommending a life cycle approach to human development (Figure 2) that takes into account a “systems approach” that combines the developmental activities and the empowering of individuals and communities. This type of approach contributes to conflict management in that individuals are empowered to realize their full potential and at the same time accommodate different interests, identities and opinions for more harmonious relationships. (Figure 2).

Figure 2: Life cycle approach to human development

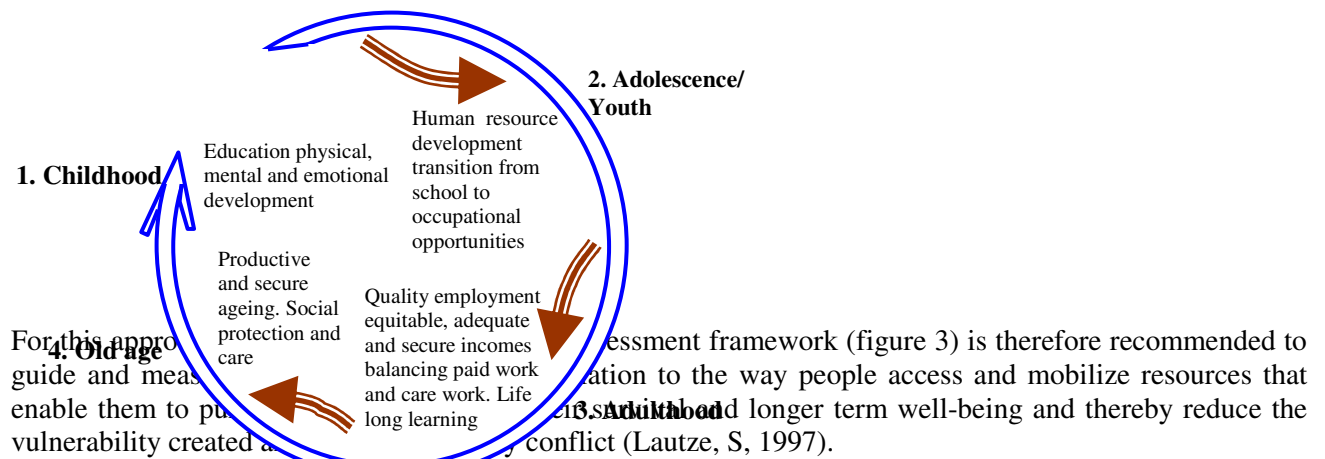
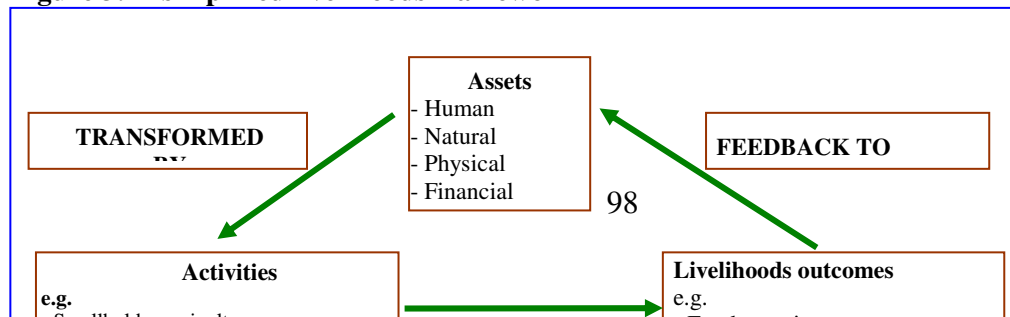


Figure 3: A simplified livelihoods framework



(Source: Segura, 2004).

Conclusion

Conflict driven emergencies in East Africa characteristically have multiple causes including political breakdown, exploitation and military offensive strategies which have the years compound vulnerability. Involved costs are also devastating to any given country with long term negative impact on socio-economic and political development. Therefore more importance should be laid upon mitigating both structural and non-structural conditions which give rise to perceived incompatibilities.

Emphasis should also be laid upon long-term directional strategies that can enhance developmental paradigm shift given that only cultures that can help people anticipate and adopt to environmental changes have superior outcomes based on appropriate decisions and effective analysis. We must also bear in mind that nation building and hence regional cohesiveness based on shared beliefs, thoughts, social patterns and technology of a given population and consensus is paramount (Peter et al., 1992).

This shift in approaches has to be seen through a socio-economic and political transition that speaks to the will of those who prescribe it, for their welfare and for the common good of a given nation and beyond. It is also obvious that the current conflict issues in the region are largely hinged on inadequate access to the exchange of entitlements as some given conditions do undermine the rights of individuals. There should be a deliberate effort to promote institutions that enhance and protect individual rights. This can be achieved by multi-dimensional frameworks that can adequately mainstream conflict risk reduction measures into multi-sectoral and bilateral development measures including those that directly relate to poverty reduction, natural resource management and utilization, and, urban planning and rural development. Lastly the region needs a new crop of leaders empowered through the provision of executive sponsorship along with finance and other organizational resources, who can adequately reshape existing structures, policies and programmes and who can also initiate changes that are beyond talk and slogans into strategic thinking and action (Saffold, 2005).

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ETHICS, TRUTH-TELLING AND MEDIA COVERAGE

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Abstract

The media's core business is to report events taking place in society. This business is though not without a problem, ethically speaking. It is the problem of whether or not it (the media) should always report the truth. In this paper, this question is asked and discussed. It is acknowledged that the media can face a dilemma because it is expected to be honest and hence report the truth but at the same time it has to be mindful of the wellbeing of the society, meaning, it may be required to hide certain truths. Two ethical systems or theories; the absolute and the relative theories form the basis of answering this question. Explored are three issues; rights – that the public has a right to truth, consequences of truth telling – that to some extent the consequences can be for the good of the public, and the fact that secrets can be difficult to keep. It is concluded that it is not prudent to adopt a rigid formula or position that the media should always report the truth.

Key Words: Ethics, truth-telling and media coverage

Introduction

The media is often dubbed the “fourth estate” ostensibly because it has the task of reporting on significant events taking place, including exposure of corruption, deceit, crime and hypocrisy, the task that constitutes a public check and balance on those in positions of power and influence in society. This task is more important today because of the current era of social transformation and globalization as there is a lot to be reported, for example terrorism, piracy, poverty and sexuality. As the media performs this task many ethical issues arise, among them whether or not to always report the truth.

Whether or not truth should be told is a key ethical question that is asked in virtually all spheres of human endeavor. It is asked in, for example, medical practice because of the honesty that is perhaps required between a physician and a patient for the treatment to be meaningful and/or fruitful; business transactions because the relationship between business persons and their customers ought to be perhaps founded on truth and trust; political affairs, for it can be asked whether the ruled should be told the truth by the rulers. In this paper, the question is asked in regard to the task of the media of reporting events that take place; whether or not the media should at all times report the truth. As an example of how the media's reporting truthfully can be problematic, let's consider the following imaginary episode which can and indeed does happen in real life situations.

A takes place and the media is aware of it. If the event is known to the public there is a possibility that it will lead to thousands of death due to a possibility of violent reactions. Because there is rumour doing rounds about it, the government grafts a statement denying that A took place and expects the media to report the denial.

A question that follows and which this paper attempts to answer is whether the media should report the truth as it knows it or report the government's denial and present it as the truth. This question is germane, not only for theoretical purposes but also for the practical ones. With the help of technology, it can be argued, it is near impossible to hide the truth and yet many things take place that one may consider unsuitable for the public to know. I answer the question by examining two lines of thinking; that truth should always be told, and two, that it shouldn't, implying that lies should sometimes be told. As a result, I, to some extent explore telling of lies by referring to Plato's “noble lie”, as a good example of how lies or fabrications can be used to achieve certain goals and purposes, and Kant's ethics that advocates truth-telling as a principle, condemning telling of lies. I try to find out whether and why it can be argued that some lies under certain situations are the right thing to do.

Ethics and truth - telling

Ethics studies moral values, problems and judgment. It is also known as moral philosophy. It is a branch of axiology, a branch of philosophy that examines values. The other branches of philosophy are logic (that studies the principles of correct reasoning), epistemology (that considers the acquisition and validity of knowledge) and metaphysics (that studies things beyond the physical or sense data). Ethics and/or morality

are concerned with rightness or wrongness of human action. The term ‘moral’ is synonymous with ‘ethical’, with morals coming from the Latin, mores and ethics coming from the Greek, ethos. Some ethicists have tended to make a distinction between them in the sense that ethics is seen as theoretical – philosophical study of morality, and morality as practical- the specific moral expectations in a human society.

There is no agreement on how to determine the rightness or wrongness of an action, that is, thinkers differ over the criteria to use to measure rightness or wrongness, goodness or badness. There are three approaches or lines of thinking, or theories that guide in making the judgment. One of them is the theory of virtue that began with Socrates, Plato, and then Aristotle in the 4th century B.C. It emphasizes the development within human beings of a moral or virtuous character by means of doing what a good person would do as virtue is the quality of excellence, righteousness and responsibility. A good action is that which accords with virtue. In contrast to this is the approach which emphasizes duties or rules (deontology); that the rightness or wrongness of an act should be judged by or on the basis of whether or not it conforms to a moral principle or rule. Immanuel Kant (1724-1804) is a major proponent of this yardstick as evidenced in his philosophy of ‘categorical imperative’; doing one’s duty. A good action is that done from for example a sense of duty, duty being a moral absolute that should always be obeyed. Then there is the approach that is subscribed to by among others Jeremy Bentham and John Stuart Mill which puts emphasis on the consequences of actions as the key determinants of goodness or badness of an action. As William Frankena (2001) puts it, to the consequentialists an action is right if and only if it produces, will probably produce, or is intended to produce at least a greater balance of good over evil.

Supposing then that there is a question of whether or not someone in need should be helped, a consequentialist will point to the fact that the consequences of doing so will maximize well-being, a deontologist to the fact that, in doing so the agent will be acting in accordance with a moral rule such as "Do unto others as you would be done by" and a virtue ethicist to the fact that helping the person would be charitable or benevolent (R. Hursthouse, 2007). Similarly with the question “should we tell the truth”, a consequentialist will look at the consequences, a virtue ethicist as to whether truth is a virtue and a deontologist as to whether there is a rule or principle regarding truth that should be always obeyed.

Now to the question of whether the media should always report the truth. Before answering this question, it is of essence to first answer what truth is, the purpose being to have a working definition, so as to eschew operating on an assumption that what truth is is known and understood. The question “what is truth?” is a philosophical one, inquiring in to the meaning and nature of truth. Truth is defined by the Cambridge Dictionary of Philosophy as “the quality of those propositions that accord with reality, specifying what is in fact the case” and Aristotle defined it in *Metaphysics*, according to Antonella Surbone (2000, p53) as “to say of what is that it is, and of what is not that it is not.” From this perspective, truth is something objective, implying the existence of an object with the underlying assumption that “truth corresponds to an external object and describes it accurately” (ibid). Truth is thus that which accords with reality or what the case is and a true statement is that which states what in reality there is. Hence, telling the truth is stating what the case is. It is therefore true to say that “A” is “A”, but a falsehood to say that “A” is “B”. This is, as already said, attaching to truth two things, objectivity and value – neutrality. Surbone observes regarding this thus; The basic assumptions of such dominant epistemology are that knowers are detached neutral spectators who acquire knowledge by observation, and present it in propositions; truth then is a kind of sameness, and falsity a kind of diversity from the given. Propositions can be verified by others, again through observation (ibid).

The media can fail to report the truth by doing two things: remaining silent, that is, failing to report an event or two, telling a lie; telling a falsehood. Keeping quiet is an act of omission and lying, an act of commission. Failing to tell the truth by keeping quiet does not elicit much debate among thinkers the way lying does. A possible explanation to this is that as an act of omission it has less quilt compared to an act of commission.

Lying, which elicits much debate is rightly defined by Sissela Bok as “an intentionally deceptive message in the form of a statement” (1979, p16). In this definition, the key word is ‘intentional’ which means deliberately passing a false message. The implication of this is that if one tells a falsehood un-knowingly, then it is not a lie, but just a falsehood. It is, when one knows, believes or thinks that what he/she is saying is not true that what is said becomes a lie. Elaborated, a lie is when **A** knows, believes, or thinks that **B** is not true but puts it across as the truth. However if **A** thinks or believes, mistakenly or otherwise that **B** is the

case when it is not but says it is true then he/she is not lying; if what is said turns out not to be true yet it was believed or thought to be, then one did not lie, but was only mistaken.

People can tell lies due to various reasons and purposes and, therefore they (lies) can be distinguished or categorized. Bok, for example, distinguishes white lies from non- white ones. A white lie she says is a “falsehood not meant to injure anyone, and of little moral import” (ibid). Non- white ones however are meant to injure. J. Thiroux (2001, P297) on his part distinguishes lies of omission from those of commission. Lies of commission, he says are direct statements that are outright lies and those of omission involve not stating certain information that is vital to a decision, relationship, or other important human activities. Lies of omission are perhaps “half truths”. A question can be asked as to whether telling lies, whether white or not, full or partial is bad and hence immoral? In other words, are lies right or wrong, moral or immoral? In The Republic Plato implies that lies are useful and hence a tool or a means through which certain goals and purposes can be achieved. The implication of this is that it is prudent at times to lie. He said, regarding whether or not spoken falsehood can sometimes and on some occasions be useful and therefore not detestable; We can use, for example, as a kind of preventive medicine against our enemies, or when anyone we call our friend tries to do something wrong from madness or folly. And we can make use of it in the myths we are engaged in discussing; we don't know the truth about the past but we can invent a fiction as like it as may be (P138).

To demonstrate how indeed falsehood can be made use of, he came up with the “magnificent lie”, commonly referred to as the “noble lie”, a lie that had the purpose of keeping the ‘ideal society’ intact and hence ensuring that there was justice in that state. The lie was that the Guardians, Auxiliaries and the Commoners were what they were in life because god arranged and wanted it that way. He observed thus;

...when god fashioned you, he added gold in the composition of those of you who are qualified to be Rulers (which is why their prestige is greatest); he put silver in the Auxiliaries, and iron and bronze in the farmers and other workers.....occasionally a silver child will be born of golden parents, or a golden child of silver parents, and so on. Therefore the first and most important of god's commandments to the Rulers is that in the exercise of their function as Guardians their principal care must be to watch the mixture of metals in the characters of their children. If one of their own children has traces of bronze or iron in its make-up, they must harden their hearts, assign it its proper value, and degrade it to the ranks of the industrial and agricultural class where it properly belongs: Similarly, if a child of this class is born with gold or silver in its nature, they will promote it appropriately to be a Guardian or an Auxiliary. And this they must do because there is a prophecy that the state will be ruined when it has Guardians of silver or bronze (ibid:182).

The above is ipso facto a concocted story, some kind of a myth of creation, a myth whose purpose and goal is not to attempt to explain the reality of things as they are but to distort it. Apparently, Plato justifies lies in this particular regard on the grounds that it can lead to justice in the state as it would keep people in their rightful places and positions. Justice would make the state stable since people would understand that their plight, position, or status is “divinely” defined, arranged or determined. Implicitly, Plato is underscoring the positive use of the “god talk” and perhaps suggesting that lies invoking god can most likely be believed. It can then be genuinely concluded that Plato viewed lying as the right thing to do in order to achieve certain plausible goals. He can hence be said to be one of those philosophers who think that truth can genuinely and rightly be withheld or distorted so long as certain specific positive goals can be achieved. An argument can be derived from this; that the possible consequences of telling truth ought to be weight or measured against those of not telling it. This is suggesting that consequences determine whether or not truth should be told.

Kant in Lectures On Ethics (p224) however strongly differs with this thinking; arguing that lying is always wrong and hence “truth must be the guiding principle in the exchange of our sentiments in social intercourse”. Without truth, social intercourse and conversation become valueless. Two reasons informed his position. First was that humans should treat each other as ends in themselves but not as means. Lying treats humans as means to an end and because of this, it is wrong. Second was his maxim of universality which is that a good action is that which can become a universal law. Lying, he held could not be a universal law because life would become quite difficult if everyone was to be lying. Lying cannot be universalized otherwise it would be impossible to take any statement seriously, meaning there would really be no ‘knowledge’ to be taught. He hence said;

If a man spreads false news, though he does no wrong to anyone in particular, he offends against mankind because if such a practice were universal man's desire for knowledge would be frustrated. For, a part from speculation, there are only two ways in which I can increase my fund of knowledge, by experience or by what others tell me. My own experience must necessarily be limited, and if what others told me was false, I could not satisfy my craving for knowledge (ibid).

As a principle therefore, lying is bad regardless of the circumstances. Lying to even a person who has lied to one, is wrong because it amounts to some kind of an injustice to mankind. He reiterated this by saying, "although I do a man no injustice by lying to him when he has lied to me, yet I act against the right of mankind, since I set myself in opposition to the condition and means through which any human society is possible" (ibid).

It is decipherable that to Kant, truth should always be told because, one, the opposite of it, lies, is an injustice to mankind and two, it would be difficult if everyone was to be lying. It follows therefore that going by this thinking; the media should report the truth as a rule because it is obligated to act morally irrespective of the feelings or inclinations to act otherwise. Reporting truthfully is acting morally and hence the media that reports truthfully to, for example avoid criticism or condemnation from people, would not be acting morally. It should report truthfully because it is the moral thing to do and hence an obligation.

There is a need at this juncture to look critically at the two opposing positions regarding the media reporting nothing but the truth, namely; the media should always report the truth and that the media should sometimes fail to report the truth.

The argument that the media should always report the truth

The claim or assertion that the media should always report the truth can be founded on a number of premises. The first one is that the public has a right to be told the truth more so over issues that directly or indirectly affect them. Truth is hence desirable. Denying the public the truth would be violating their right to know, which, it can be argued, is wrong. For two reasons, the public can claim to have a right to truth. The first one is that they are beings that can conceive themselves as existing entities and hence they are in a position to claim that truth be told to them. This means, they have the right to truth because they can claim it. They can claim it because of their status as rational, self-conscious, and autonomous beings; because they are humans. This is arguing along the lines of Peter Singer (1979, p82) that one characteristic or feature of a right is that it has to be claimed. Arguing along this line though calls for caution since one of its implication, which may not be palatable is that, humans, for example "human vegetables" or the mentally impaired, categories of humans who cannot claim their rights should be denied rights. Similarly it can be construed to mean that non-humans, for example animals have no rights because they cannot likewise claim them, a position that may not go down well with many people who are convinced that animals have rights in spite of the fact that they cannot claim them.

The second reason is that truth is a need to human beings. Knowledge, as Oruka (1991) convincingly puts it, is a primary need which can partly be achieved through truthful testimony. M. Bayles and K. Henley (1989, P20), seem also to agree with this position when they list knowledge along side life, health, procreation, rearing of the young, and relationship and friendship as the universal human goods. If it is agreed that knowledge is a primary need, then, it is wrong to deny children truth because it would be denying them the avenue through which they can attain a primary need.

It is however contestable whether something should be given to one just because the person has a right to it. Other considerations, it can rightly be argued, ought to apply in determining whether a right should be honored or not. Secondly, a person can claim to have a right to forego or forfeit a right, and as a result, one can warn that he/she does not want to be told the truth perhaps out of fear of that very truth. The media can also rightly claim to have a duty and therefore a right to deny the public the right to know, for reason of say care or responsibility. It (the media) can rightly claim that because of being a responsible and caring institution, it has a right to put the interests of the public above other considerations, even if it means withholding truth. This is to some extent pointing to a conflict of rights; the public has a right to truth and the media has a right to withhold it. Although the media has a moral obligation to tell the truth, and hence withholding it can constitute depriving the public its right, the media should act within a wider horizon in which principles such as care, and beneficence should come in to play in determining whether or not truth should be reported. Given this, it would be irresponsible and an abdication of duty for the media to report

the truth that it knows can be inimical to the public just because the public has the right to know and therefore entitled to truth.

Apart from truth fulfilling the rights and therefore, needs of children, in many ways it can have favorable consequences. For example, truth can enable the public make decisions independently and consciously since truth can build confidence in them. To elaborate this premise, if one knows the truth about himself/herself then he or she would be more vibrant in making decisions to determine his/her own destiny. If, for example the public knows the truth surrounding an issue or for example candidates seeking elective posts, then they (the public) would be in a better position to make an informed decision or vote wisely. The other favorable consequence is that the relationship between the media and the public would be strong as it can be founded on honesty and hence there would be trust and a lot to be known and learned from one another. Otherwise, if there is no honesty and hence no trust in what the media reports, then whatever is reported would be doubted, making the media a very unreliable source of knowledge. Although this premise is true because truth can yield favorable consequences that are being mentioned here, truth can on the other hand yield unfavorable results as will be seen in due course, making it premature to conclude that because of the would be benefits of truth, it (truth) should always be told.

Thirdly, it can be argued that the public should be told the truth because in the age of technology and globalization, there is no guarantee that the truth being hidden can be done so forever. Kant (op-cit, p225) rightly observes that secrets have a way of coming out. If and when the hidden truth comes out then there would be genuine fear that the consequences can be adverse, for example, distrusting everything one is told, this being an emotional harm. The argument then would be that because it is difficult, almost impossible, to keep secrets and therefore hide the truth, it is better that it is told earlier than later. This is so because the pain of knowing the truth later may be more than that of being told earlier. This is perhaps the most compelling and persuading reason to tell the public the truth because if the truth can eventually come out, it can be argued, then there is no point in hiding it. Better, one can argue, tell the truth and be trusted than hide, it leaks and be distrusted. However as much as secrets have a way of coming out, it is not impossible to ensure that it comes out at an appropriate or right time, with less impact.

The argument that the media should hide the truth

The claim that the media should sometimes hide the truth can likewise be supported. The first major reason in support of this claim is that the consequences of truth can be deleterious. Just as knowing the truth has led at, individual level, to divorces, suicides and murder among other unpleasant things, truth can lead to ugly incidents to the public. This, one can argue, provides a good reason for lying. A question can be asked as to whether it is better to tell the truth because it is a virtue and that it is always the best thing to do and mess up the public or fail to tell it and let the public go on normally. Kant as already seen would answer by saying that the truth should be told regardless of what it may lead to; and in any case secrets cannot be hidden forever. A consequentialist on the other hand would argue that if the consequences can be detrimental then truth should not be told, a position that is problematic.

The question is how one is to know that if truth is told then it will result into adverse effects. This question emanates from the idea that not all truths lead to non- favorable consequences and all people do not react in the same way when told the truth. One would therefore be right to recommend that news editors assess, understand and know the public mood before attempting to report the kind of truth that can negatively affect them. This means, in some cases the truth should be reported and in others it shouldn't; the measure being how the possible reactions are to be. In this regard, truth is something that should be earned; by virtue of the public's ability to withstand its impact(s).

The second reason supporting the claim that the media should sometimes withhold the truth is that truth is sometimes undesirable. Indeed even at individual level one may desire to know certain truths. The same can apply to the public. The public in a country that is emerging from war, for example may not desire to be told that another war is looming. The public can claim this as a right that ought to be respected. A tricky question however follows; how the media is to know that the public does not desire to know the truth. The subtle indicator is when the public does not inquire, ask certain things or when it is just disinterested. This is to say that the media should only truthfully report that which the public is inquiring or asking about. This argument can however hold only if it is the case that the public does not have a right to truth. If it has such a right then one is duty bound to tell them the truth whether or not they seek to know. It is also wrong to be categorical that because one has not asked to be told certain truths, then he or she does not desire to know

about them. It is possible that failure to ask is out of some reasons that are not linked to not wanting to know.

The clear way of knowing that the public does not desire to be told the truth is when it openly states that certain things are undesirable and unpalatable for example it may make it clear that it does not want to hear or be told things about same sex marriages. If the public were to state so, then it would be repugnant and hence immoral to insist on reporting it. The point here is that the public can claim to have a right to repudiate, forego or forfeit its right of being told the truth. This right can be exercised through silence or open expression.

Conclusion

The two systems of ethics discussed in relation to the media reporting truthfully can be summarized as, the absolute one (principle of duty) and the relative one (consequentialist ethic). The absolute theory advocates that actions, for example, truth telling, are good or bad in themselves. To the relative one, no action is good or bad in itself, only in relation to the consequences. Hence, in answering the question of whether or not it is moral to tell the truth, the absolute theory subscribed to by Kant answers by stating that truth should be told regardless of what may result from it; and in any case secrets cannot be hidden forever. The relative theory on the other hand states that if the consequences can be detrimental then truth should not be told but if they can be good, it should be told.

In examining whether or not the public should be told the truth, these two ethical systems were explicated. The paper explored three issues; rights – that the public has a right to truth, consequences of truth telling – that to some extent the consequences can be for the good of the public, and the fact that secrets can be difficult to keep. Analysis of these issues that are presented as premises of the conclusion that truth should always be told leads to this paper's observation that it is not prudent to adopt the position that truth should always be told because to a larger extent it can be inimical its consumers. In other words, it is not prudent to adopt a rigid formula or position that the media should always report the truth. It is hence with some hesitation to assert that telling the truth is moral regardless of its consequences. It is a smaller wrong; it appears to lie than to tell the truth that eventually harms. In some instances therefore, it would be prudent to encourage lying. This would be agreeing with for example, Thiroux op-cit, p302) that "people ought to be able to lie when they need to or when lying could prevent the occurrence of a more serious moral infraction, such as killing." In a way, this is disagreeing with the view that ethical standards should apply in all situations and at all times because there are moments the public should not be told the truth; when the public does not want to be told the truth and, when the truth could be deleterious. This inevitably calls for judgment on the part of news editors', judgment which though can be abused.

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TELEPHONE-BASED REHABILITATION OF LIFESTYLE BEHAVIORAL RELATED DISEASES BY HEALTH CARE PROFESSIONALS IN DEVELOPING COUNTRIES.

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Abstract

The recent development in the research studies that uses telephone-based counseling and rehabilitation in the developed countries, for example USA and Europe have began to bear fruits in specific lifestyle behavioral related diseases. The relationship between managing an individual lifestyle and restore it back to a positive lifestyle is in the hands of health care professionals. These areas include diabetes, hypertension, Asthma, obesity, weight loss, fitness, alcohol, cocaine, drug addicts of any kind and other lifestyle related diseases. In Africa in particular, this method of rehabilitation is not effectively in use, and many doctors do not have positive attitude towards its exploration. Telephone-based rehabilitation is a better solution to help and reach many people at a low cost, quality health care, but it must be facilitated from the hospital. One method that reduces the cost of running the rehabilitation centre for lifestyle behavioral related diseases changing and prolonging the lives of many people at risk in a broad spectrum. This technique if explored, reaches the individuals from towns and rural areas from one central point effectively. Health care professionals in developing countries should utilize this kind of method to rehabilitate those affected by the lifestyle behavioral related diseases for efficiency and to promote home-based rehabilitation. Currently the system that is in practice is the colonial introduced type of health care provision, mainly in Africa.

Introduction

The recent development in the research studies that uses telephone-based counseling and rehabilitation in the developed countries, for example USA and Europe have began to bear fruits in specific lifestyle behavioral related diseases. In a direct contrary situation is exhibited in developing countries where most health care professionals and the government have not come together to begin working on the way forward on the use of telephone-based rehabilitation of lifestyle behavioral related diseases . There is general agreement that one of the most effective and affordable means of providing quality health care is to make available, and encourage the use of, preventive care and health-promotion services. Research shows that health maintenance organizations are more effective at providing preventive care and health-promotion services than traditional fee-for-service indemnity plans. A recent literature analysis of managed care performance since 1980 published in the Journal of the American Medical Association cites six studies which have found that health maintenance organizations plan enrollees receive more preventive tests, procedures, examinations, and health-promotion services than indemnity plan enrollees (Bruce D. Platt and Lisa D.Stream, 1996,8).

The advantages of telephone-based counseling are numerous. Telephone contacts can be tailored to client needs and can offer social support with some degree of anonymity, since there is no face-to-face contact (Zhu S, Tedeschi GJ, Anderson CM, Pierce JP, 1996,93-102). As an intervention, telephone-based rehabilitation can be effectively delivered using standardized protocols and can be done proactively, which encourages a certain level of accountability in clients. Telephone-based disease management protocols have shown promise in improving outcomes in a number of medical and psychiatric disorders, but this approach to continuing care has received little study in developing countries.

Interventions

The continuing care treatments: at the beginning with new patient(s), weekly telephone-based monitoring and brief counseling contacts combined with weekly supportive group sessions in the first 4 weeks, twice-weekly cognitive-behavioral relapse prevention (RP), and twice-weekly standard group counseling (James R. McKay etal 2005; 62:199-2071). These are done depending on the intensity of the negative life change on the individuals. After sometime with the improvement outcomes on specific person or group of persons, the number of telephone calls goes down until the person recovers. Follow-up should not be stopped at once even after the person has recovered, but at least once a month for a period of one year is necessary. This extra period of follow-up is required to assist the person where necessary and to be sure that the person has been rehabilitated, and can perform his or her normal duties.

From a client perspective, telephone-based rehabilitation is convenient, time efficient, accessible from work or home, and offers follow-up opportunities, allowing clients to develop a relationship with a counselor and receive a personalized approach. This program allows clients immediate access to health professionals who can screen for medical risks, assess the stage of readiness to change, provide lifestyle counseling, recommend health promotion and/or risk reduction programs, and link with their health care providers in the rural or town depending on where the client is calling from and the nearest health care providers.

The New Approach

A systems thinking approach to population health improvement in a managed care organization has previously been described by Pronk and O'Connor. In this approach, a population health improvement cycle provides a framework from which interventions may be systematically provided to specific populations. In order to ensure that interventions are delivered effectively and efficiently, useful information and specific resources have to be made available to all key stakeholders in the process. Efforts may be coordinated via centralized services, facilitated by health promotion staff, integrated with physician-based care plans, and monitored carefully by the health professionals working within that system. Telephone-based rehabilitation of lifestyle behavioral related diseases services designed to support behavior change efforts has to be centralized and systematically facilitate a process of access, communication, documentation, and intervention implementation.

It should be noted that the field of health is broad, including everything from birth to death and wellness to illness. Therefore, the health professionals must observe medical ethics when dealing with this telephone-based rehabilitation of lifestyle behavioral related diseases. Medical ethics is the discipline of evaluating the merits, risks, and social concerns of activities in the field of medicine. Ethical thinkers have suggested many methods to help evaluate the ethics of a situation. These methods provide principles that doctors should consider while decision making. Six of the principles commonly included are:

- Beneficence - a practitioner should act in the best interest of the patient.
- Non-maleficence - never do harm.
- Autonomy - the patient has the right to refuse or choose their treatment.
- Justice - concerns the distribution of scarce health resources, and the decision of who gets what treatment.
- Dignity - the patient (and the person treating the patient) have the right to dignity.
- Truthfulness - the patient should not be lied to, and deserves to know the whole truth about their illness and treatment.

Principles like these do not give answers as to how to handle a particular situation but guide doctors on what to consider in particular situations.

Health care professionals of the telephone-based rehabilitation of lifestyle behavioral related diseases that provide health services to individuals, are obligated to protect the privacy of individual health information in accordance with applicable law of the land, depending on the country of which such services are being offered and health care component level policies and procedures related to privacy and security of individual health information. All health care professionals must be aware and adhere to these obligations. Immediately the clients learn that their privacy information is fully protected, they will therefore seek for telephone-based rehabilitation of lifestyle behavioral related diseases without any fear and in big numbers. This will promote telephone-based rehabilitation of lifestyle behavioral related diseases in all developing countries and many people will be able to change their lifestyles minimizing the related diseases within communities of every nation in developing countries.

It is important to look at developed countries as an example to the developing countries, like Milio said; 'health interests of Americans will be better served if the impacts of policies, affecting health important aspects of environment and patterns of living, were assessed' (Milio, 1986). The developing countries should take this example seriously to improve on their health policies to enable them serve their people well

and equitably, both in towns and rural areas. The most poorly served communities in developing countries are those that are found in the rural set-ups. The communities receive so little from the government in terms of health care set – ups and concentrating much in towns neglecting rural areas. The approach to telephone-based rehabilitation of lifestyle behavioral related diseases by health care professionals will be well addressed if they give both town and rural equal opportunity. So as to reach people effectively. This will improve peoples' health in all developing countries around the world. A part from telephone-based rehabilitation of lifestyle behavioral related diseases, other health serves should be addressed in the same way to cater for everybody a round the globe.

Health Professionals

To meet the diverse needs of members, lifestyle behavior change rehabilitation is provided by the full-time registered health care professionals, registered dietitians and pharmacists. Registered dietitians provide nutrition, stress management, prenatal health, and dental health counseling. Health care professionals, who have degrees in specialized areas of community health, exercise physiology, or psychology, provide counseling on stress management, smoking cessation, and exercise. Pharmacists provide counseling on polypharmacy and herb-drug interactions. Staffs who are Certified Diabetes Educators play an important role in educating and triaging members with diabetes. They also develop and administer nontraditional diabetes prevention education approaches.

Having staff with varying education backgrounds and clinical specialties available to assist members with lifestyle behavior change provides depth to the telephone-based rehabilitation program. It also increases customer satisfaction because members have instant access to health experts who can answer their questions on numerous topic areas.

The variety of these health care professionals integrated within a given telephone-based rehabilitation centres of lifestyle behavioral related diseases will ensure that quality assurance is achieved as they carryout their work.

Health care professionals, as they approach this system of telephone – based rehabilitation of lifestyle behavioral related diseases, they should take care of the general socio-economic, cultural and environmental conditions, living and working conditions, social and community influences. Individual lifestyle factors together with age, sex and heredity also determine health but are less important than the higher-level determinants (Evans et al., 1994; Marmot, 1998).

It is a very effective method if the health professionals use both face –to-face and telephone - based rehabilitation of lifestyle behavioral related diseases, but where face-to-face is not possible, they should not sit back but use telephone to reach out to people in need.

The detail of a call

Calls to the telephone-based rehabilitation of lifestyle behavioral related diseases should originate two ways. First, telephone-based rehabilitation of lifestyle behavioral related diseases members can self-refer, which means members take the first step to seek for counseling. Second, many receive a proactive call from a phone counselor via a clinic referral written by their health care professionals or in response to a health risk appraisal they complete at their worksite. 'All calls are triaged using outcome-focused, provider-approved protocols to assure high-quality, consistent care' (Jackie L. Boucher etal, 2000, 190). Phone rehabilitators can access pertinent member data (e.g., diagnosis, medications, laboratory values, and physician transcriptions) through a medical record. Using screening skills, high-risk individuals are referred back to their health care providers for further medical management.

Individuals who have enrolled at the hospital and are admitted under telephone-based rehabilitation are assessed as to their readiness to change lifestyle habits to stage-match educational strategies and programs using the Transtheoretical Model of Behavior Change developed by Prochaska and DiClemente (Prochaska JO, 1984 and DiClemente CC, Prochaska JO, 1982). This model helps provide the framework for predicting willingness to change so that lifestyle behavior change counseling can be individualized to facilitate members in modifying and maintaining new behaviors.

Conclusion

Telephone-based rehabilitation of lifestyle behavioral related diseases is an ongoing intervention in the

developed countries (it is an example to the developing countries) that allows individuals immediate access to health professionals and continued contact to support lifestyle behavior change at a level that allows a large population to be reached. Telephone-based rehabilitation of lifestyle behavioral related diseases is an effective form of step-down treatment for most alcohol, cocaine and other similar dependence patients who complete an initial stabilization treatment, compared with more intensive face-to-face interventions. However, high-risk patients may have better outcomes if they first receive face to face counseling after completing intensive outpatient programs.

Integration of hospital approach in a telephone-based rehabilitation centre of lifestyle behavioral related diseases meets provider and patient needs by reinforcing clinic-based education, catching patients at teachable moments, and providing ongoing support to make lifestyle behavior changes. Thus, it allows the health professionals providing the telephone-based rehabilitation to act as an extension of the clinic-based care delivery team, ensuring continuity of care.

Developing countries should move very fast to rescue their citizens from dieing due to lifestyle and behavior related diseases by adopting telephone-based rehabilitation of lifestyle behavioral related diseases as explained in this article. Otherwise, developing countries are on their way to sink into lifestyle behavioral related diseases losing its citizens pre-maturely, and it will be difficult to restore it later. The time is now to move with technology and reach out to people both in town and rural equitably.

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Muslim Girls/Women and HIV/AIDS in Kakamega District, Western Kenya

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Abstract

In most Muslim societies, girls and women face greater risks of the HIV/AIDS infection than men. The economic and social status compromises the ability to choose safer and healthier life strategies. Gender roles powerfully influence the course and impact of the epidemic and affect the extent to which AIDS affects their vulnerability. Thus, the paper aims at discussing the impact of HIV/AIDS on the Muslim girls/women in Kakamega district, Western Kenya and the role played by Muslim girls and women in the prevention and care of HIV/AIDS. The enquiry is guided by the Conceptual framework of Women's Rights within the Islamic Context demonstrated by the web of family relationships (Qur'an 2:184, 228; 4:32; 30:21). The methodology employed to collect data consisted of qualitative techniques like oral interviews, informal group discussions for primary data and document analysis method and internet information for secondary data. The data revealed that gender inequalities, the different attributes and roles assigned to women/girls and men in society affect their ability to protect and cope with HIV/AIDS impact. The implication here is that, the proportion of women/girls living with HIV/AIDS has risen steadily. Therefore, women- initiated and women- specific programmes need to be integrated with other services in order to effectively assist in the reduction of the spread of HIV/AIDS.

INTRODUCTION

The article examines Muslim Girls/Women and HIV/AIDS in Kakamega district, Western Kenya. The main objectives of the article are to examine the Impact of HIV/AIDS on Muslim girls/women in Kakamega district and the role played by these girls/women in the prevention and care of the HIV/AIDS infected and affected persons. The article covers the Introduction, Conceptual Framework, situational analysis, Methodology, Findings, the Way forward and Conclusion. The study was carried out in Kakamega district, Western Kenya which has a population of about 650,000 people and a third of the population are Muslims (KKDDP; (1994-1996) (2002-2006). Kakamega district was chosen purposely because it is an area with a high Muslim population which has been left out in the fight against HIV/AIDS yet the first HIV/AIDS was diagnosed there in 1984 (KKDDP; 1994-1996; 2002-2006). The methodology employed to collect data consisted of qualitative techniques: oral interviews and informal group discussions for primary data and document analysis and internet information for secondary data.

CONCEPTUAL FRAMEWORK (THEOLOGICAL CHALLENGE)

The Conceptual Framework adopted is "The Women's Rights within the Islamic Context demonstrated by the Web of the Family Relationships" (Surah 2:184, 228; 4:32, 30:21). This concept states that the approach to protection of women's rights in Islam is best demonstrated by reference to the web of family relationships, which encompasses a range of reciprocal rights and obligations. Though the Holy Qur'an stipulates clearly the rights and relationships of the husband and wife and children and parents in the family, cultural influences bring variance in the rights and relationships between family members and the community at large. Hence, culture has a big role to play in the HIV/AIDS menace among Muslim girls / women in Kakamega district. Thus, women's rights should not be seen as stand- alone claims made by women, but as claims arising from a system of mutual rights and obligations guaranteed by both religion and law. Women's rights in general are not unreciprocated burdens placed on society, or gratuitous favors done to them. The rights are compensatory gestures arising from an equitable distribution of claims and burdens within the society. An example which clearly highlights this principle of reciprocity is the husband-wife relationships, the underlying principles of which are described in the Qur'an in terms of mutual respect, security, and compassion, all demonstrative by Allah's signs understood only by 'those who reflect' (Qur'an, 30:21;2:184).

Islamic law assigns laws and duties to both the husband and the wife: the rights of the wife are the husband's duties, and her corresponding obligations are his rights in relation to her. Women have right even as they have obligations according to what is equitable (Qu'ran, 2:228). The obligations of the wife includes devout obedience, and conscientious guarding of her chastity (Qur'an 4:32). Her main obligation is to contribute to the success of the marriage, taking care of the comfort and well being of the husband by

avoiding conduct that may offend him. The husband is required to discharge the reciprocal obligations of loving and caring for his wife, treating her well and providing for her needs such as food, clothing and shelter. It is in this context that the chapter discusses the protection and care of Muslim girls and women against HIV/AIDS.

Marriage in Islam is only for those who can afford it and those unable to afford the expense should exercise patience until such a time as Allah will put them in a better financial position. Free mixing of grown –up boys and girls is not allowed. Islam prohibits pre-marital sex in all its forms. The Qur’an states: “So marry them with your guardian’s consent and give them their marriage portion as wives, they being chaste, not committing fornication, or having illicit friendships”(Surah 4:25;5:5).The man should possess sufficient wealth to pay mahr (dowry) and maintain the wife.

Islam permits Muslims to marry more than one wife (up to four) provided justice is done between them. Thus, no Muslim is encouraged to practice polygamy because of the conditions involved. Islam demands complete monogamy because it is not humanly possible to love, treat, and maintain different people equally, fairly and justly (Surah 4:5). This explains why many Muslim women who are HIV positive and in polygamous marriages in Kakamega suffer more compared to these in monogamous marriage. The family relationships require control and regulation of a healthy existence and sexual morality. The holy Qur’an reminds humankind with the following guidelines:

Your wives are your tilth,so you may go to your tilth as you please but you should take care of your future and refrain from the displeasure of Allah. Know it well that One day you shall meet Him... (2:223) And one of His signs is that He created for you, of yourselves, spouses so that you may console yourselves with them and find rest and peace in them. He has set between you love and mercy... (30:21). Our Lord! Grant us in our spouses and our offsprings the comfort of our eyes and make us a model for the God-conscious ... (25:74).¹

Islam has laid down regulations on the internal organization of the family and made a man its head and overall supervisor. It is his responsibility to perform the duties of husband ship, to bear the expenses of the home, to look after the health and comfort of the wife, to give her the best that he has and, if he has more than one wife, to be just to all of them. These are the natural demands of marriage and they must be fulfilled because of the promise that man has made to the creator. It is in line with these demands of marriage that Muslim men in Kakamega must provide medical care to their wives and daughters, a responsibility they are not performing especially in cases of HIV/AIDS. This is a violation of the religious obligation enjoined on them by Allah. Similarly, it is the responsibility of the wife to have full regard for the needs and sentiments of her husband, to look after his house and children, to protect the marriage bed, to become a real partner to him, thus truly sharing his joys and sorrows. These again are the natural demands of marriage and the woman is bound to fulfill them because of her contract with Allah. Muslim women in Kakamega suffer many tribulations under their husbands in the name of obeying this demand. That is why many of them give in to their husbands’ sexual demands even when their husbands are HIV positive or have unprotected sex in polygamous relationships thereby exposing themselves to the HIV/AIDS virus.

These roles are complementary, that is, helping each other to have discipline and order as well as a warm atmosphere in the family. The Qur’an says:

Men are managers of the affairs of women because Allah has made the one superior to the other and because men spend of their wealth on women... (4:34).

Wives have the same rights as the husbands have on them in accordance with the generally know principles. Of course, men are a degree above them in status, and above all is Allah, the All-Mighty, the All-Wise (2:228).

Islam has also bestowed the following rights for woman: “Inheritance from her own family and husband ,Mahr(dowry) from the husband; Upkeep and maintenance from the husband; access to the husband’s property during his lifetime; Equal freedom in marriage; Her matrimonial independence; and Her right for the release from the marriage tie obtained upon payment of compensation. Depending on these Qur’anic injunctions for women, Muslim girls/ women in Kakamega should fight for their rights and deliver themselves from the religio-cultural bondage they suffer under their men. The Muslim men should adhere

to the Qur'anic injunctions by providing for the rights of women in all circumstances. They should come out of the patriarchal cocoons and adhere to the Qur'anic teachings.

SITUATIONAL ANALYSIS

Since its first identification at the beginning of the 1980's, HIV/AIDS has been understood and addressed in two main ways. First, it has been treated as a purely medical problem with a scientific focus on the biological effect of the virus, and developing ways to tackle it through medical interventions. Secondly it has been treated as behavioral problem which can be solved by the individual acting on information: the result is a focus on AIDS-Education campaigns. HIV/AIDS does not affect all nations or people equally and it flourishes under the conditions of under-development –poverty, disempowerment, gender inequality and poor public services. Every single country in the world has been affected by HIV/AIDS. These include Muslim countries and according to United Nations Development (UNAIDS), there is an estimated 300,000 people living with HIV/AIDS in North Africa and Middle East. Therefore, anyone can be affected with HIV/AIDS including Muslims.

According to Muslim girls and women in Kakamega District, HIV/AIDS is believed to be a curse from Allah due to the immoral behaviour (sexual immorality) of some members of the Ummah(Zamzama Amunga,O.I). Therefore, it is a viral disease resulting from sins committed by community members and not caused by witchcraft as believed by some people in the villages. The HIV/AIDS pandemic should thus be addressed by referring to the Qur'an which has guidance on morality. The Muslim women argued that HIV/AIDS among them is mostly spread by men who get infected and in return infect their wives. According to the World Health Organization (WHO), reversing the spread of HIV/AIDS demands that women rights are realized and women are empowered in all spheres of life. This will then enable them overcome the consequences/impact of HIV/AIDS and facilitate their prevention of the epidemic and care of the infected members of the community. This article explores in detail the impact of HIV/AIDS on Muslim girls/women in Kakamega District and their role in prevention and care of the HIV/AIDS infected and affected members.

Methodology

The sample for the research consisted of 40 Muslim women and 10 Muslim girls from fifteen years and above. These were randomly sampled from two Mosques in Kakamega town (Jamia Mosque and Tawakal Mosque).The data used in this chapter was collected between Oct-Dec 2006.The oral respondents provided information about the impact of HIV/AIDS on Muslim girls and women in Kakamega, the preventive methods used and the care offered to those already infected. The oral interviews were conducted by the writer with the assistance of the Muslim women leaders. The oral questions were easily reframed to encourage free informal discussions other than just eliciting questions and answers. This was supplemented by secondary data. The data obtained was then interpreted within the articulation of the "Concept of the Women's Rights within the Islamic Context." Through description, comparison and interpretation as methods of data analysis, conclusions from the data were made.

Findings

The Impact of HIV/AIDS on Muslim girls and women in Kakamega District

The impact of HIV/AIDS is most severe among young adults and particularly women whose early deaths have serious consequences on the economy, education and social development. HIV/AIDS is not just a health issue but also a social problem affecting each and every member of the society. Gender inequality is a factor which increases susceptibility to HIV/AIDS infection. Girls and women are more susceptible for social norms dictate that they should submit to their partners' demands to have sex. Following the (Abstain, Be faithful Use Condoms) "ABC" of HIV prevention, is all the more difficult in situations where women are likely to be punished with violence if they either deny their spouses sex or propose using condoms. Oral interviews revealed that many Muslims men in Kakamega do not accept to use condoms because they believe condoms kill the unborn child and murder is prohibited in Islam (Mwajuma Ali & Jamila Harambe, O.I ; Surah 2:178-179; 5:35). They refuse to use condoms claiming condom- use increases sexual irresponsibility. Besides, sex is a husband's right in Islam. Therefore, Muslim women are forced to have unprotected sex even if they are in a polygamous marriage thereby increasing the chances of HIV/AIDS infection.

According to the Shariah, if a Muslim man desires intercourse with his wife, she must comply, if she does not, she is guilty of nushuz, recalcitrance. A wife who is Nashizah is no longer eligible for nafaqa;

maintenance and financial support. In addition, the Qur'an asserts that the husband of such a woman may beat her. In the face of this, the vast majority of Muslim wives agree to have unprotected sex as commanded by Islam. They therefore, expose themselves to destruction and death. In turn, the women may give birth to or infect their innocent children at birth thereby increasing the number of those infected. Religion in this case is oppressive to the women. The women need to liberate themselves from this. The Qur'anic Surat which compels women to submit to men's demands no matter their condition should be re-interpreted by women themselves for their own good. Women need to be educated and empowered more in terms of spiritual matters.

It was also observed that the youth have a negative attitude toward Condom use despite their availability through the Ministry of Health outlets and Non-Governmental Organizations (NGOs). The youth's attitude is due to the costs, adult discouragement and poor access to distributive points. Hence, young females found infected must have contacted it during the onset of adolescence. This is propounded by the fact that most communities in Kenya are overridden by cultural and religious taboos that continue to mystify sex and associated issues. Sexuality in most patriarchal communities is predominantly a male prerogative. Women hardly make any decisions on sex and this one sided issue increases the risks of transmission. Similarly, inhibitions also prohibit women from denying their spouses sex on demand. In this context, therefore, Muslim women in Kakamega district are confronted by religious and cultural oppression in the face of HIV/AIDS.

Oral interviews revealed that some Muslim women argue that they are at an advantage because they follow religious teachings and ideals thereby avoiding being infected by HIV/AIDS. The few who are infected only get it after marriage. They, therefore, consider HIV/AIDS as a disease of "other people" especially prostitutes and other "loose people." Most of them do not seem to accept the reality of HIV/AIDS and only view it as a myth. They feel that they cannot get AIDS since they are not in that category of "loose and unreligious people." In the words of Mwajuma Amboko (O.I), "Sisi wanawake waislamu tuna bahati ya kuwa tunafuata dini sana na hivyo si rahisi sisi kupata ukimwi-We Muslim women are lucky because we strictly adhere to the religious teachings and therefore we cannot easily contract the HIV/AIDS virus." Despite these views and the awareness campaigns, some of the respondents indicated that community members and relatives were infected with the virus.

The worst impact of HIV/AIDS is the fact that those infected are sick all the time and hence, they spend their earnings on treatment. Those who were working become too weak to work and hence fail to earn the family livelihood. This renders the family to be financially incapacitated making the children to drop out of school and miss education. The family may have no food, clothing, and some of the children may end up as street boys/girls. Others may resort to witchcraft to avert the situation or accuse others of bewitching them. The children are therefore, left without parental care and subsequently lose their opportunity to advance their education. This is in line with Shisanya's(1996) observation which states that many people dying of HIV/AIDS are highly educated and trained. Therefore, mothers have a greater responsibility of looking after the sick family members and children.

AIDS brings general impoverishment to the household, and communities leading to poorer nutrition and less access to health care. In other words, HIV/AIDS affects the economically productive people. The Muslim girls/women suffer most because they are the ones who take care of the sick all the time. Those employed have to work for long hours to raise money for the upkeep of their families while those unemployed will have to seek for jobs, either as house maids or farm labourers in order to raise money for the same. The girls will engage in wage employment to raise money for their education and food (Shakila Seif, Liin Muhed, O.I).

Most HIV positive women/girls in the Muslim community conceal their status due to the stigma that is attached to it. Many times when a couple gets infected, men may refuse to accept their responsibility in the infection and blame the women as the ones who brought the disease to the family. If they are the ones infected, they are denied medical treatment by their husbands as they are accused of being immoral, no matter the mode of infection. This corroborates with the women's desk survey, that in some communities, women are blamed for their husband's infidelity and HIV/AIDS status and some may even be divorced. At times, they are sent back to their maternal homes to seek treatment where they may be left to die (Jamila Asman O.I). Thus, the stigmatization of women AIDS sufferers is more pronounced than among their male counterparts. This explains why many Muslim women conceal their status in order to secure their marriage.

Unfortunately, their health deteriorates when they conceive. This call for behavior and attitude change among the Muslim men. They should take responsibility of their actions and stop blaming women for everything. They should treat women as equal human beings as enjoined in the Holy Qur'an (Surat 2:233; 24:33).

It is the responsibility of the Muslim mothers to take care of their sick daughters. Many a times, they are not assisted by the fathers to take care and provide medical care for the sick daughters. Instead, the mothers are blamed by their husbands for not educating their children on how to protect themselves from HIV/AIDS. The denial of medical care by Muslim fathers is a violation of the girls' right to safety and health. This is an absolute right for the Muslim girls and women given the enormous risks that a woman takes in fulfilling the reproductive role, beginning with menstruation, then sexual intimacy, pregnancy, childbirth and breast feeding. Thus, HIV positive women are discriminated against when trying to access care and support. Meanwhile, the burden of caring for ill family members rests mainly with the women. Discrimination in care coupled with women's own indispensable support roles makes many women seek assistance by themselves for their own illness more than with HIV positive men. Without women-specific programmes being integrated with other services such as social support, and nutrition, women's particular needs will not be attained and vulnerabilities will increase and render any agenda to effectively assist in the reduction of the spread of HIV/AIDS hopeless.

The practice of polygamy which is acceptable in Islam, divorce and remarriage provide a conducive environment for the spread of Sexually Transmitted Diseases (STDs). Yet, there is no acceptable behavior that protects women against being infected with STDs particularly HIV/AIDS. It is taken for granted that a woman should not challenge, on health grounds, the type of a woman her husband marries. This is particularly disturbing considering the current HIV/AIDS epidemic in the country. An infected woman who is divorced could remarry into another polygamous family and thereby infect her now co-wives. If nothing is done, this practice is likely to increase HIV/AIDS at an alarming rate. There is a potential danger in polygamous marriages when a new wife comes into the family. The consensus of the Ulama (Muslim scholars) rules in favour of permitting medical verification and tests in circumstances such as this. In Islam, it is a principle that one should not do harm nor permit harm to be done to oneself. It is in line with this that the Shar'ia recommends investigation of the character and condition of a potential partner before the contract of marriage. Anwar (2001) when discussing the status of Muslim Women in Northern Nigeria notes that women should seek medical care and protect themselves against STDs and HIV/AIDS.

According to Mwanahawa Muhammed (O.I) though Islam guarantees inheritance to every person in the family as stipulated in Surah 4:11, some Muslim widows may lose their social security after the husband's death. Some of them could be disinherited by their father in-laws or brother in-laws after their husband's death as a punishment for having caused the death of their son/brother. This is a cultural influence which affects the women negatively as it leaves them with many problems before they also Succumb to death. This practice has no basis in Islam and should be done away with through education and empowering of women.

Some people especially the young men spread the disease consciously and willingly. Once one is infected, he takes revenge by going on "a spreading spree" due to the attitude of "I will not die alone". The infected people take revenge on unsuspecting victims who were not originally affected; hence the revenge is antihuman. Some even take loans so as to have enough money to induce unsuspecting girls and women into sex. The most commonly used preventive measure of STIs is the Condom. However, men do not like the condom and they dismiss it as a fallacy. The condom is, therefore, not common among the married couples. Married couples may thus not be using any preventive measure. The few who use it, the condom is not a hundred percent perfect because it is known to leak, burst or be expelled. In cases where family resources like land, employment, family property and medical insurance are under men's control, they may deny their wives medical care. In such circumstances, women infected with AIDS are on the receiving end. As such, once AIDS hits, they undergo double jeopardy of losing relatives and taking the extra burden of children or surviving relatives.

As peasant farmers, HIV/AIDS impacts on the Kakamega Muslim women in various ways. These include reduction in the quality and quantity of labour, loss of skills and experience and sale of productive assets. These contribute to food shortage as women spend most of their time caring for the sick yet they form the bulk of the farm labour. Productive labor time may be lost to attendance at funerals and observing mourning

customs. Labour shortage has already produced many documented effects at the household/ level including less land cultivated, delays in planting and weeding, more pests, loss of soil fertility, fewer crops per household, decline in livestock production and lower yields. There have also been shifts from cash crops to food crops for household subsistence and from labour intensive crops such as bananas and beans to less demanding and often less nutritious foods such as cassava and potatoes. Livelihood security is made more fragile when household resources are used to raise money for health care, funeral costs and basic needs.

The other impact of HIV/AIDS on Muslim girls/women in Kakamega is on education. Education is charged with protecting the “window of hope”- the uninfected children who are the next generation of workers and parents. Schools provide the opportunity to teach HIV prevention skills and increase the potential for young people to make choices and plan for their future. Therefore, Education accelerates a range of socio-economic changes which reduce susceptibility to HIV/AIDS infection through improving the skills of girls and boys. However, AIDS reduces the number of children who enroll and stay in school, and widens the gap between male and female enrolment. In Kakamega, the female children remain at home to nurse their sick mothers and siblings while the male children continue with their education. In some cases, the AIDS orphaned girls do not enroll in school or their enrolment rate is quite low. On the whole, the Muslims girls are not empowered due to lack of education. Yet the Holy Qur’an and Hadith enjoin all Muslims irrespective of sex to seek knowledge from the cradle to the grave.

Therefore, HIV/ AIDS is a disease whose impact on the whole marriage, family, community and country at large is enormous. Those mostly affected are young adult women. They are affected economically, socially and educationally. These effects are propounded by cultural and religious taboos which are gender biased.

The Role of Muslim girls /women in the Prevention and care of HIV/AIDS infected and affected persons in Kakamega District

The Kenyan government and the Non-Governmental Organizations (NGOs) have attempted to prevent HIV/AIDS infection through creating awareness of the epidemic. However, these efforts have been fruitless as HIV/AIDS continues to spread. The major mode of infection particularly in Kenya and Kakamega District as already shown is hetero-sexual sex, unprotected sex with an infected person. Muslim girls/women prevent and care for HIV/AIDS infected and affected persons by:

Parental guidance

Through the oral interviews, it was revealed that Muslim girls and women in Kakamega have tried to avert the virus through parental guidance to the youth. Mothers and aunts have the responsibility of guiding the youth especially girls about the consequences of pre-marital sex which can lead to HIV/AIDS infection. They advice them to remain chaste before marriage to avoid Allah’s curse. In the words of Farida Muhammed,(O.I,10/12/06) Sisi akina mama na shangazi tuna jukumu la kuwaelmisha na kuwaelekeza vijana kuhusu maisha ya ujana ili waweze kujiepusha na mapenzi kabla ya ndoa ili wasipate magonjwa ya zinaa ,hasa mimba za mapema na ugonjwa wa Ukimwi ili wasipate laana ya Mungu-We mothers and aunts have the obligation to educate and guide the youth about the adolescence stage so as to enlighten them on the consequences of premarital sex such as STDs, unwanted pregnancies and HIV/AIDS so that they escape Allah’s wrath. They base their guidance on the moral teachings found in all the books given to the prophets of Allah with the Holy Qur’an as the final and universal one. These books of Allah teach people to avoid fornication and adultery so as to avoid STDs and HIV/AIDS. Muslim mothers and aunts advice their children to abstain from sex, to go for HIV/AIDS testing before marriage and to remain faithful to their marriage partners. Thus, the only true solution to AIDS is a ‘moral solution’ also dubbed “zero grazing”. This is the only safe way to live as a family. In general, a strong and safe nation strengthens the home and family, it prospers and its people are blessed all round. By making marital faithfulness a virtue, people save themselves from pain, sorrow, disease and premature death. In the midst of the AIDS crisis, if people would once again get back to Islamic morality, then they could be delivered from this disease. Islam commands sexual purity (chastity) for men and women at all times before marriage, during marriage and after the dissolution of marriage. Those guilty of illicit practices are shut out of the marriage circle of chaste men and women (Surah 24:1-26).

It was also revealed that most Muslim fathers compete with their sons over girlfriends and hence it is difficult for the father to educate the sons about HIV/AIDS. The sharing of girls by fathers and the sons increase the risk of infection as the fathers infect the mother while the boys infect the young girls (Mwanahawa Muhammed, (O.I)). Notably, several matters are discussed among peers and age mates and

only among members of the same sex. This leaves mothers with the double role of educating boys and girls about HIV/AIDS. However, some issues are difficult for them to explain to the boys. This in itself is a set back in the prevention of HIV/AIDS.

The role of mothers in educating the youth is supplemented by trained personnel on “Home- Based Care” most of whom are women. They provide treatment to those infected, advice them on how to eat nutritious or balanced diet to maintain their health and how to live positively in the community with those infected and affected. They also provide general information on preventive measures. This advice has assisted in the behaviour change and hence reduced infection. This can be achieved through control of other Sexually Transmitted Diseases (STDs) through the peer group approach where young girls and women are trained on anti- HIV/AIDS work separately from men and they sensitize others in their environment. Peer counseling is a very effective means of raising awareness (Mwatumu Muhammed, O.I, 30/10/06). They are also advised to “talk about sex, get to know each other and abstain or postpone premature sexual experiences until marriage. The girls are advised on how to remain chaste and a virgin for virginity is highly valued in Islam (Surat: 4:25; 5:5; 24:3, 27-34). Those who loose their virginity before marriage are looked down upon by their husbands and other members of the community. Some are even divorced and end up being promiscuous thereby increasing the chances of being infected with the virus. The Muslim community and the general human community should uphold the virginity virtue so as to curb the spread of the HIV/AIDS virus.

Aunts also teach Muslim girls about matters of sex in the hope of making them “good wives” when they marry. Unfortunately, some of the girls end up experimenting on what they are taught before marriage thereby putting themselves at the risk of contracting the virus. Some girls are also married off early because of the value attached to virginity and this interferes with their education and rights as a whole. Girls should be allowed to pursue their education and marry when they are mature enough to make their own informed choices. Thus, the whole Muslim (community) Umma and the general society at large should openly and critically discuss sexuality and avoid inhibitions that surround the subject. All concerned should improve and improvise physical and psychological methods of support for AIDS victims, like individual counseling to prevent psychological morbidity. This will be achieved if people honestly face the reality of AIDS and avoid mystifying it.

On the whole, Muslim girls and women in Kakamega district hold the view that HIV/AIDS can be prevented through educating the Ummah about modes of HIV transmission, means of preventing or reducing the likelihood of HIV infection, Condom promotion and distribution, STD/STI treatment and Care for the infected persons. This reduces susceptibility to infection and increases effectiveness of prevention work. Eventually, it reduces the number of people infected with HIV/AIDS virus. The involvement of HIV positive people in this endeavor will act as role models to other people. Muslim girls /women in Kakamega have played a very big role in terms of caring for family members and educating their children. This is in line with the Prophet’s saying that “the mother’s lap is the first school of every child” and a famous Prophet’s saying is “Paradise is at the feet of mothers.” This is to emphasize the important roles that women play in the community.

The writer concurs with the above scholars and Muslim men’s argument that Condom distribution may lead to sex experimentation and further spread the disease. This is because giving Condoms to the youth is like giving them a license to engage in pre-marital sex under the guise of protection. It is like telling them they should not be moral but practice “protected sex.” One should bear in mind the defects of the Condom and hence one can contract the virus even when using the Condom. At times the youth are given the Condoms without any guidance on their use or information about their disadvantages thereby putting them at risk of contracting the virus. Like Jamila said, Tulipewa condoms na watu wa family planning baada ya semina nami nilizipanga vizuri na kuwapa vijana wangu bila kuwambia ni nini na nikawaeleza kuzigawe baina yaona watumie---when we were given Condoms by the Family planning personnel after the seminar, i wrapped them up and gave them to my sons without saying exactly what they were and told them to share them amongst themselves and use them.”

Socio-Psychological Care

Muslim girls/women take care of their husbands, children, relatives and themselves. They ensure that the infected members take drugs (ARVs) as required and other medicine for related illnesses. They take care of them in hospitals and at home. At times husbands desert their wives whenever the tragedy strikes especially

if it is a daughter or son who is infected. The women are accused of not having taught the children well on matters of sex. If the mothers are the ones who are sick, some of them are sent back to their biological homes to seek treatment and some even die there.

Those infected by the HIV/AIDS virus are also taken care of by the “Home-Based Care” personnel, from the Magharib and Tawakal Women Groups. They mainly assist the patients by offering treatment (ARVs) and medicine for other associated illnesses, food and dressing and educating the patients on how to live positively and maintain their health through eating a balanced diet to boost their immunity. They advise the infected persons not to give up but to look forward to life with dignity. They also sensitize the general public on how to live with those infected by adhering to the preventive measures and giving them a sense of belonging. Hence, those infected are not segregated by other members of the community but live together the way they used to before infection. The infected members get treatment at Kakamega District General Hospital. These groups are however town-based and therefore, those in the village do not get this kind of assistance. Care and support for the infected people makes AIDS more visible which counters denial in the general population (Mariam Muhammad, O.I, 26/11/06). This calls for more personnel to reach out to the villages where we have many infected and affected persons who are suffering in silence and without help/care.

The care of the HIV infected persons by Muslim women and the “Home- Based Care personnel” are in line with the qualities of a good Muslim which are love and compassion for the other person. People with HIV/AIDS cannot be denied these elements of love and compassion for visiting and caring for the sick is another good deed that is highly recommended by the Prophet. The prophet said, “Whoever visits the sick person is walking along the high road to heaven” and “A visit to a sick person is only complete when you put your hand on his forehead and ask him/her how he is. The Prophet also said, “If you enter the house of such a person, then only speak good words, for truly the angels will confirm what you say, and they will open up the way of heaven to you”(Bukhari,Tirmidhi and Al-Nasai). People with HIV/AIDS need love, compassion and affection, and therefore, those affected should not be afraid to embrace them or touch them. Therefore, Muslim women should take care of the HIV infected members while remembering what is expected of them by Allah

Muslim women in Kakamega also take care of orphaned children due to HIV/AIDS. This is one of the meritorious acts in Islam- the care and feeding of orphans and the needy. The Qur’an is full of exhortation to care for the needy and orphans. It is also full of warnings against misappropriating orphans property. The Muslim community is called upon to hasten towards serving orphans and the needy. The Qur’an says: “Have you seen he who denies religion? He is the one who repulses the orphans and encourages not the feeding of the needy” (Surah 2:177; 4:3-10; 107:1-3). One of the most frequently repeated prayers of the Prophet was for Allah to instill in His heart love of the needy. Thus, the extended Islamic family system provides security to these children through sharing of each others burden. These children often have their education, feeding and general care financed by other family members. However, this kind of support is not so far- reaching because it is not enough for all the orphans. In general, prevention and care of HIV/AIDS infected and affected persons makes the disease more visible thereby reducing denial in the general population. It helps those infected to live positively including practicing safe sex. This reduces the impact of the illness and death.

The Way Forward

There is need to accept reality and enhance HIV/AIDS educational programs for all Islamic communities. These programs must emphasize Islamic morality and should inform people about methods of protection from this life threatening disease. HIV/AIDS is an issue for all communities, irrespective of gender and religion and hence it is more important now than ever that the issue should be discussed openly. From the field research, it emerged that women make up to 90% of those serving and providing care and support to HIV/AIDS affected and infected persons. All religions recognize the dignity of women and yet their interpretation of sacred texts is from a patriarchal perspective. The human interpretation of the Holy texts is linked to the stereotypical role of gender inequalities. Women with HIV/AIDS continue to be treated with contempt, stigmatization, blame and discrimination. Women should re-read these Holy texts and interpret them for themselves so that they can understand them better and liberate themselves from the religio-cultural bondage of oppression.

To curb the epidemic in their community and the society at large, one has to follow the path of Allah. If one is single, he or she can exercise self-control and abstain from sex. However, if one is married, they can also exercise self-control and remain faithful to their partners. The possible solution lies in faith and adherence to religious teachings of the Qur'an (Surah 59:7) and Sunnah of the Prophet. The children and youth should be sensitized about sexual matters right from the Madrassah. The Alims in the Madrassah should not concentrate on teaching Qur'anic recitation alone but also enlighten the youth about the reality of sexuality and the HIV/AIDS menace so as to prepare them in terms of prevention and care. This will help curb the spread of the HIV virus.

Since HIV/ AIDS can be spread without one having outward symptoms of the disease, the infected person has a moral obligation not to infect others by informing those who may be endangered. Even though it is medical ethics to keep the patient's condition confidential to the extent of not informing the patient himself or herself, the AIDS carrier may unknowingly infect others. As long as others may become infected by the HIV carriers, they have a right to know who is infected and who is not. Hence, those infected should declare their status and abstain from sex. The basic medical advice according to Runck is: the person should seek regular medical evaluation and follow-ups; stop all sexual activity including intercourse and mouth to mouth kissing; inform the spouse and any other present or former sex partner of their potential exposure to AIDS; encourage them to be tested for AIDS; not share tooth brushes, razors or other items that could become contaminated with blood; not donate blood, plasma, body organs or any other body tissue or fluids; clean blood or other body fluids spills with freshly diluted household bleach; inform one's doctor, dentist or eye-doctor that you have the AIDS virus and that they should protect themselves; and keep one's body as healthy as possible by eliminating drug abuse such as intake of tobacco and alcohol, by keeping good diet and getting enough rest and exercise. These measures will keep the immune system as strong as possible.

For the Islamic perspective on HIV/AIDS to be effective, it should address women's empowerment including their sexual empowerment in the context of the patriarchal paradigm. A new paradigm that promotes women's right to know (be informed), to say no, (refuse) or otherwise to determine the sexual independence is required. Thus, the Muslim Ummah and the mosque committees should provide knowledge on the human disaster since keeping quiet about AIDS or shying away from it is like condemning its followers to death. Everybody has to be an active partner in combating HIV/AIDS spread. The culture of silence on sexuality and sexual taboos should be broken.

Muslim women should increase their advocacy with religious leaders and governments for gender equality and women empowerment. There should be capacity building for women of faith and their organized groups to lobby against discriminative practices and gross violation of women's human rights against rape and violence. The United Nations especially UNIFEM (United Nations Development Fund for Women) should strengthen partnership with Faith-based organizations in addressing issues of gender and HIV/AIDS. Religious leaders have a moral obligation to pay greater attention to the plight of women, orphans and vulnerable children.

The Qur'an has much to say concerning the morality, judgment, and the consequences of sexual misbehavior. Hence, Muslims should allow the Holy Qur'an with all it has to say about morality and sexual behavior to directly address the AIDS crisis (Surah 4:15-18; 17:32; 26:2-10). In line with sexual immorality, is the problem of dressing. The present western life style of dressing in miniskirts, sleeveless blouses and generally transparent dressing are avenues that contribute to sexual immorality. These dresses are very scarce and revealing thereby inclining men towards the wearers. Girls/women wear these scanty clothing because of sensuality and not because of poverty. The desire to be fashionable makes these women to imitate non-Muslim ways. This is coupled with immoral television programmes, video shows and discos, where the youth emulate what they watch on TV and video shows. While it is sinful to watch irreligious films, it also induces them to imitate the ugly and disrespectful behaviour of the actors and actresses. Dance which is regarded as progress is the most successful means to attract men towards women. It arouses sexual desires and is very immodest behaviour. Alcohol is another contributing factor since one is not able to control him/herself when drunk and therefore, can easily engage in sexual immorality. All these forms of dressing and entertainment should be banned in the Muslim community in order to curb the HIV/AIDS menace as they are against the Islamic teachings.

All Imams and religious leaders should commit themselves to making interventions for the infected and affected by HIV/AIDS. They need to identify, set up and support grass root initiatives to control the spread of the HIV/AIDS pandemic. Establishing a functional Muslim health body and intensifying the engagement of Imams and Muslim leaders in reflection, development and dissemination of the Islamic standpoint is the best prescription in HIV/AIDS to guide the interventions by Muslim communities. Thus, the Imams and religious leaders have a moral obligation to pay greater attention to the plight of women, orphans and vulnerable children. All NGOs like the Supreme Council of Kenyan Muslims (SUPKEM), United Nations Development Fund for Women (UNIFEM) and United Nations Development (UNAIDS) should support this endeavor.

The practice of wife inheritance which is widely observed in Kakamega district among all faiths should be stopped. However, if it must happen, the widow or widower should be tested first before remarriage. The ritual of purification where the widow is to have sexual intercourse with another man to cleanse her (Khukhala Makhola) (cutting ribbons) which happens before the actual inheritance should be discarded. If the widow or widower is already infected, he/she should not marry again to prevent infecting other people. Thus, there is need for the general public in the district to improve on safe sexual practices with widows and widowers during cleansing rites before remarriage to curb the spread of HIV/AIDS.

There is need for those who want to marry to go for HIV/AIDS testing and obtain “a certificate” before the wedding can be performed. If one or both future spouses are found to be infected, then the pastor, priest or Imam has good reason to refuse to perform the marriage ceremony. This should go hand in hand with continuous follow up support and counseling to patients living with HIV/AIDS in order to enhance positive living. Those infected with HIV/AIDS should be provided with antiretroviral drugs for opportunistic infections. However, the Muslim women in Kakamega argued that anti-retroviral drugs (ARVs) are contributing to HIV/AIDS infections since one who uses them does not show symptoms of infection. This makes the infected persons infect other unsuspecting people. The medical personnel should design anti-retroviral drugs in a way that they increase one’s immunity but not hide the symptoms of infection so that the general public can tell who is infected and who is not and take precaution.

The role of the media is important in the fight against HIV/AIDS menace. Hence, all forms of media such as Newspapers, TV, radio, films, drama, concerts and videos should be used to carry the message which should be concrete and directed at breaking sexual taboos. AIDS awareness should be part of reproductive health information and should be inculcated in the programmes of all public gatherings as keeping quiet about it will not help. Women- initiated and women- specific programmes and re-interpretation of the sacred texts that oppress them should be the focus.

The “Cash Transfer Programme” under the Ministry of Home Affairs spearheaded by the Vice President should be extended to all areas, especially in the villages where many people are poor other than being confined to towns. This programme aims at financing families so that they can take care of HIV/AIDS orphan and widows/widowers by keeping them in their families/localities other than taking them to orphanages. This is meant to ensure that those infected and affected by HIV/AIDS are not segregated but incorporated in the extended family. The programme is meant to limit the stigma attached to those infected and lessen the suffering of the susceptible and vulnerable groups.

Men should discard the cultural practices that oppress women and stop hiding under religion as they violate women’s rights. They should re-interpret the Qur’anic teachings to benefit themselves, women and the whole society. There should be dialogue between husband and wife and parents and their children to save women from marital rape that sometimes leads to HIV/AIDS infection. Women should be empowered to use contraceptives to prevent unwanted pregnancies and vertical transmission of HIV/AIDS from the mother to baby. Infected spouses should minimize chances of infecting their spouses and other members by using condoms. Awareness should also be created among the children to enable them abstain from pre-marital sex which can expose them to HIV/AIDS infection.

The HIV/AIDS decision makers should Redefine HIV/AIDS “High risk”, Expand decision- making, Exercise leadership, Invest HIV targeted funds, and Strengthen HIV/AIDS programmes. This is meant to enable women have access to confidential voluntary counseling and testing.

Conclusion

HIV/AIDS is a terminal disease which affects the whole family and society. The rates of HIV infection are increasing among girls/ women in every region in the world. Young girls and women are vulnerable because of the denial and neglect of their rights, gender inequality, social, cultural and economic factors, pervasive violence and their reproductive biology. Muslim girls and women of Kakamega are no exception and they suffer the same consequences in the event of HIV/AIDS infection. Since HIV/AIDS is an on-going problem, there is need to built long-term development and humanitarian strategies to curb the epidemic. HIV/AIDS is not only an extra-ordinary issue to be addressed by scientists, activists and specialists but also an everyday issue to be tackled by everybody through their everyday work.

The efforts to prevent infection and care for HIV positive people by Muslim girls/women reinforce each other. Education about HIV/AIDS reduces the number of people who need AIDS care and support and challenges prejudice against HIV positive people, including the belief that they do not deserve or cannot benefit from treatment. Care and support for people with HIV/AIDS helps to prevent HIV infection by encouraging HIV positive people to practice 'safe sex' and makes the existence of AIDS more visible. Treatment with anti-retroviral therapy may also encourage more people to take HIV tests, reduce denial and promote positive living. There are however, some concerns that where effective anti-retroviral treatment is widely available, it may actually undermine prevention efforts, because people assume that AIDS is curable.

The gender inequalities, different attributes and roles assigned to girls/ women in Kakamega district affect their ability to protect and cope with HIV/AIDS impact. Gender roles largely influence the course and impact of the epidemic and the vulnerability of girls/women. Thus, girls/women's rights should be protected within the context of the web of family relationships which encompasses reciprocal rights and obligations.

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DISASTER PREPAREDNESS AND MANAGEMENT IN KENYA

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INTRODUCTION

The term disaster implies a great sudden misfortune or catastrophe which results in loss of life or property. There are two broad categories of disasters, namely, natural and human-made. These can further be divided into five sub-categories; a) climatically induced disasters such as. lightning, thunder, floods, storms, drought, wildfire, famine, and the like; b) geologically induced disasters such as earthquakes, tsunamis, landslides, volcanic eruptions, etc.; c) biologically induced disasters such as avian flue, swine flue, HIV and AIDS etc.; d) technologically induced disasters such nuclear accidents, airplane and automobile accidents, collapse of buildings, among others, and e) socially induced disasters such as famine, corruption, terrorism, wars, crises conflicts, drugs abuse and addiction, widespread poverty etc (Alexander, 2002).

The main thrust of this article is to show how the government of Kenya has in the past handled disaster-related problems. Indeed, there has been heavy criticism for either its lack of or inadequate preparedness and its ad-hoc and uncoordinated response to disasters. This remains one of Kenya's enduring development challenges. Disaster response initiatives in Kenya have tended to be for short-term cause mainly in the form of emergency relief services to the affected. Further, it is recognized that Kenya lacks the capacity to effectively deal with other problems related to natural and human-made calamities. There seems to be only a limited array of activities ranging from relief and rehabilitation to recovery and reconstruction when faced with disaster. Moreover, initiatives to shift the focus from emergency management response from national to grassroots levels have been limited. Additionally, there seems to be lack of assessment of the political, cultural, social, economic and environmental factors that predispose the country to vulnerability to disasters. If such assessment has been undertaken, then it has not been effectively disseminated to the masses. The significance of this article lies in the fact that it will not only give a clear picture of Kenya's state of affairs in disaster preparedness and management, but will also add to the available knowledge on the same.

THEORETICAL FRAMEWORK

The theoretical framework upon which this article is based is the Recognition-Primed Decision (RPD) model (Klein, 1998). The RPD model is about how people make quick and effective decisions when faced with complex situations. In this model, the decision maker is assumed to generate a possible course of action, compare it to the constraints imposed by the situation, and select the first course of action. RPD model combines two ways of developing a decision; the first is recognizing which course of action makes sense, and the second, evaluating the cause of action through imagination to see if the actions resulting from that decision make sense. Recognition Primed Decision making is highly relevant to the leaders or officers of organizations that are affiliated with emergency services. However, although the technique is rapid, it is prone to serious failure in unusual or misidentified circumstances. Besides, difference of being experienced or inexperienced plays a major factor in the decision-making processes.

STATUS OF DISASTER PREPAREDNESS AND MANAGEMENT IN KENYA

Disaster management in Kenya has not been seen as an integral part of development planning and disasters. The approach has been in an ad hoc manner responding to disasters whenever they occurred. However, in January 1998, the National Disaster Operation Centre was set up following the devastating effects of El Nino floods of November/December 1997. The El Nino induced floods caused some US \$ 151.4 million in public property damage. This compelled the Government of Kenya in collaboration with the United Nations Disaster Management Unit to develop a disaster management Policy tailored to the Kenyan situation. The goal of the National Disaster Management Policy was to establish and maintain an efficient, effective and coordinated system for managing disasters, in order to minimize losses and resulting disruptions of the population, economy and the environment. The policy recognizes the importance of effective coordination and communication at all levels and among all participating institutions (Republic of Kenya, 1996a; 1997). The policy further recognizes the need to develop capacity to respond to disasters and establishment of institutional framework that enhances co-ordination and development of appropriate expertise. It provides for the strengthening of linkages with Local Development Plans and Poverty Reduction Strategy Programs,

and the fact that disaster management is a multi-sectoral and multi-disciplinary issue involving national, district and local levels, the local authorities, private sector, state corporations, United Nations Organizations, non-governmental organizations, the media, volunteers, religious groups and development partners in disaster management (Republic of Kenya, 1996a; 1997). In Kenya, while cities of all sizes hold the potential for economic growth and social development, they also create new dimensions of risk. Urban risks need to be considered in terms of urban poverty and unchecked urbanization, urban settlement patterns and land use, building codes and regulations. The unplanned development and encroachment of cities on peri-urban areas and the impact on the environment should be a further challenge towards understanding urban risks (GOK/UNDP, 1997).

DISASTER PREPAREDNESS AND MANAGEMENT

According to Alexander (2002), disaster preparedness focuses on preparation of equipment and procedures for use once a disaster occurs. In brief, it is about planning for disaster. To plan for disaster requires that certain measures be put in place. Such measures include communication plans, proper maintenance and training of emergency services, development and exercise of emergency population warning methods, and maintenance of disaster supplies and equipment and organizations of trained volunteers among civilian populations. Organizational response to any significant disaster - natural or human-made, is based on existing emergency management organizational systems and processes. This involves the mobilization of the first wave of core emergency services such as firefighters, police and ambulance crews.

Disaster management (or emergency management) on the other hand is the discipline of dealing with and avoiding risks. In general, any Emergency management is the continuous process by which all individuals, groups, and communities manage [hazards](#) in an effort to avoid or ameliorate the impact of disasters resulting from the hazards (Alexander, 2002). It involves preparing for disaster before it occurs, disaster response (e.g. emergency evacuation, quarantine, mass decontamination, etc.), as well as supporting, and rebuilding [society](#) after [natural](#) or [human-made disasters](#) have occurred. Effective emergency management relies on thorough integration of emergency plans at individual, group, community, national and non-government level involvement since activities at each level affect the other levels. However, the nature of emergency management depends on local economic and social conditions ([Cuny](#), 1983). This involves four phases: mitigation, preparedness, response, and recovery. Mitigation efforts attempt to prevent hazards from developing into disasters altogether, or to reduce the effects of disasters when they occur while recovery phase is to restore the affected area to its previous state. Recovery efforts are primarily concerned with actions that involve rebuilding destroyed property, re-employment, and the repair of other essential infrastructure.

STRATEGIES FOR DISASTER PREPAREDNESS AND MANAGEMENT

There are several strategies for disaster preparedness and management and these include governance, education and training in disaster risk reduction, research, capacity building and gender and disaster network

Governance

Good governance is a prerequisite for effective disaster management since there is growing consensus that it is unethical to ignore the human cost of inaction and its implications for the right to life and the safety of those who are often the most marginalized. Governance includes the following aspects.

Government's commitment, strong leadership and guaranteed resourcing. It is the government's responsibility to recognize the importance and specificity of local risk patterns and trends while decentralizing responsibilities and resources for disaster risk reduction to relevant sub-national or local authorities. Political commitment for disaster risk reduction should be linked to clearly defined funding arrangements and there should be horizontal as well as vertical integration of disaster risk reduction issues at regional, national and sub-national level. Strong leadership promotes and supports dialogue, exchange of information and coordination at all levels with the aim of fostering a holistic approach towards disaster risk reduction. Good governance ensures the review of and periodic update of disaster preparedness and contingency plans and policies at all levels, with a particular focus on the most vulnerable areas and groups.

Local government advocacy for disaster reduction. The responsibility of mitigating hazards belongs to local government, and they must seek all available local resources, including but not limited to the donations, capital improvements projects, economic development funds, volunteer organizations, and public/ private partnerships. Local government is often the most neglected, but most important sphere of government in

disaster risk reduction. Local government's capacity in disaster risk reduction should be strengthened through national policy and financial support through development funding specifically aimed at risk reduction through enactment and enforcement of building codes, zoning ordinances and other measures to protect life and property, and public awareness (Ojwang, 1996).

Community participation. Although disaster preparedness is an important component of preventive development, its usefulness can only be determined, if the people who are so often affected by natural hazards are sensitized about the potential danger and empowered to respond effectively. Involving the local community and resources in reconstruction planning and implementation materially can strengthen community resilience. When people and organizations are linked in an equal manner, development policies are more likely to fit the need of the citizens. Communities can take steps before and after a disaster to increase the likelihood of sustainable development and mitigation by evaluating the existing and potential roles of local government agencies and community-based NGOs for future recovery efforts.

National and regional platforms. The establishment of national platforms for disaster reduction was requested in Economic and Social Council resolution 1999/63 and in General Assembly resolutions 56/195, 58/214, and 58/215. The expression "national platform" is a generic term used for national mechanisms for coordination and policy guidance on disaster risk reduction that need to be multi-sectoral and interdisciplinary in nature, with public, private and civil society participation involving all concerned entities within a country where all significant disaster risk reduction initiatives are thoroughly and independently evaluated and the findings made public. This ensures compliance by all those concerned.

Legal and regulatory frameworks. The citizen's fundamental right to the highest possible standard of security and protection against hazards needs to be entrenched into the legal or constitutional frameworks. Formal systems for monitoring and evaluating the effectiveness of official institutional arrangements should be put in place, with transparent procedures and findings publicly available on a regular basis. The right to information about hazards and risks and the effectiveness of measures taken to address disasters should be set out in policy and law, and systems be put in place to facilitate public access. Besides, the rights of all groups in society to participate in disaster risk reduction, decision-making, policy setting, planning and implementation must be explicitly recognized in policy, legal and institutional provisions and the ways and means of such participation should be defined.

Mainstreaming disaster reduction into national development. Each country requires adopting a policy and strategic plan for disaster risk management by integrating disaster risk reduction into mainstream sectoral policies and programs. It has been noted that very often, indecision prior to a disaster is as much a capacity problem as it is a management one. Improvement in governance and the management of the development process in general, and resource management in particular, could facilitate broad participation through public and private partnership and enhance capacities to develop sustainable disaster management strategies. Decisions need to be tied to broader national development policies or political objectives that could command public interest. More importantly, these efforts should be planned and implemented over an extended time period, reflecting foresight on expected long-term benefits (Hicks 1996).

Education and Training in Disaster Risk Reduction

The old Chinese proverb, "Do not give me a fish but teach me how to fish" holds true. Mastery of technology cannot be bought, it must be learned. No sustainable development can take place without a concerted focus on education in natural disaster reduction. Knowledge and training about hazards increase and contribute to the understanding and transmission of sustainable development, social and cultural values. Education builds a culture of safety and resilience at all levels. This is so because it is widely held that public education through a broad range of channels combined with the richness and validity of indigenous technical knowledge drawn from folk culture can significantly enhance local people's awareness and confidence and empower them to act decisively when faced with adversity (UNESCO/UNEP 1988). Education and training require sustainability over time and replicability in diverse sectors, levels or geographical areas. However, these can be most effective when linked to community needs through games and drama exercises as a means of imparting disaster preparedness information to children, the use of mother-tongue languages through electronic media (Signorelli 1990).

Research

Academic research focuses on transfer of knowledge and experience. This should lead to a closer association between the sources of specialist knowledge and the general public it is intended to serve.

Research related to hazards and disaster risks has expanded greatly over the years. Globally, particular significance has been given to the sociology of disasters and its multidisciplinary nature, reflecting the importance of human dimensions that in turn highlight the relevance of vulnerability in conditioning people's exposure to risk. There is a continuing need to promote applied research that assists in mainstreaming vulnerability considerations into development activities. More interdisciplinary research should be pursued such as research activities that marry the interest of disaster risks and environmental and natural resource managements concerns (Hicks, 1996).

Capacity Building

Investment in human resources and capacity building has a more lasting value than any investment made in technological systems towards disaster risk reduction. Currently, there is a shift in emphasis from emergency relief to capabilities building. To satisfy these requirements, more devotion lies on expansion of opportunities for NGOs, the private sector and distance education. The wide use of local experience and traditional knowledge has received great recognition as a means to engage people more directly in their own community efforts and as appropriate homegrown solutions to community needs. This has in addition provided target groups with skills, resources and technical abilities to enable them better help themselves (Lautze & Hammock 1996).

Gender and Disaster Network

Part of the reason for the weak governance of disaster risk reduction institutions is the low level of gender sensitivity in disaster policies and programs. There are gender differences in vulnerabilities, disaster impacts, coping strategies and response measures. Yet national disaster management frameworks lack explicit gender objectives (INSTRAW 1992). As such mainstreaming gender equality is urgently needed. The primary target group for disaster risk reduction training and education should be women and children. Equal access to appropriate training and educational opportunities for women and vulnerable constituencies, promotion of gender and cultural sensitivity training as integral components of education and training for disaster risk reduction is imperative (Armiño 2002).

CHALLENGES TO DISASTER PREPAREDNESS AND MANAGEMENT

According to Relief and Development Institute (1985), there are several challenges and these can be categorized into political challenges, socio-economic challenges and Technological challenges.

Political challenges

Risk versus uncertainty - An overriding choice facing a government is whether to spend now on preparedness or mitigation or, possibly, spend later on disaster recovery. Usually governments choose a mix of preparedness/mitigation and recovery programs to their own detriment. Politicians argue that mitigation often has little mass-appeal in electoral terms and thus, short-term considerations tend to dominate. In Kenya, for instance, major disasters occur rather infrequently. This is why politicians and government officials usually discount the possibility of having to justify a lack of expenditure on mitigation.

Lack of effective regional integration and collaboration in development - Since the 1960s when many African countries became independent, all regional R&D organizations such as the Commission for Technical Cooperation in Africa (CCTA), East African Freshwater Fisheries Research Organization (EAFFRO), and related inter-territorial research organizations have broken down. Yet, with the small size of many countries, the limited resources available, the potentialities for sharing information, and experience and participation in R&D activities of mutual interest, there is no reason why African countries should be more strongly linked to their former colonial masters than to their African neighbors.

Deficiencies in legal and legislative support of development programs - Disaster risk reduction mechanisms suffer from governance weaknesses particularly low compliance and enforcement of policies, laws, regulations, standards and codes. In their policy, legal and program documents, national disaster programs set out the key roles of non-state entities and communities in disaster management, but often citizens are mere recipients of disaster management activity outputs and do not adequately participate in the design and implementation of disaster reduction programs. There is need for economic incentives and legal and legislative instruments as a back-up for development projects in which maintenance of environmental quality and the conservation of resources are given high priority.

Corruption and deficiencies in governance - Problems of lack of accountability, waste of resources and lack of grass-roots democratic institutions and participation in decision making continue to plague African countries. In the past, more emphasis was given to top-down approaches to extension work and

development program execution which is lacking today. There is also inability to allocate funds to vital development projects often to the detriment of the masses.

Socio-economic challenges

Deficiencies in Planning - Sustainable development requires the adoption of holistic or systems approaches. This calls for multidisciplinary interaction involving all relevant disciplines and ministries working together in the planning process in an integrated manner. Besides, there exists weak linkages between National Planning and regional planning i.e. there is no attempt to mainstream disaster management in national development plans.

Inappropriate policies and strategies - Concern about the environment must be embodied in development policies and strategies. Policies must be formulated in relation to the objectives to be achieved, and the strategies to be adopted must aim at a range of alternative strategy options that ensure conservation of resources and as far as possible and enhancement of the quality of the resource base.

Weak knowledge management - There is inadequate attention to information management and communications, and training and research. The continued focus on emergency response in Kenya results in greater emphasis on post-disaster loss assessment than on anticipatory risk assessment. Most risk mappings undertaken are top-down processes with little participation by the masses. Most disaster management structures focus on one or two key natural hazards, mainly flood and drought. Policy frameworks rarely cover small localized disasters. Also, national disaster risk reduction plans neither focus on strengthening traditional coping strategies nor do they emphasize preservation of the local and traditional knowledge and experience that underlie these survival mechanisms.

Lack of financial support - Kenya generally suffers from inadequate financial support due to low priority accorded to disaster reduction in national budgeting; lack of dedicated disaster funding mechanisms; and limited use of risk spreading and transfer mechanisms such as micro-finance, formal insurance and private risk pools.

Poor and inadequate arrangements for information dissemination - In Budalangi, for instance, flood forecasts are not disseminated immediately they are received from the forecast formulation team. The response teams on the ground get the information late and it does not reach a wide audience. Sometimes unwarranted flood warnings are issued based on inadequate data and this makes the affected communities tense. There is no proper co-ordination and control of activities in the hydrological stations.

Poor infrastructure - During disasters, sites are inaccessible or roads are impassable making disaster response and recovery difficult and laborious.

Technological challenges

Development involves the application of science and appropriate technologies to the conservation, management, processing, and rational utilization of natural resources. In the past, many development projects have been either disappointing or total failures owing to attempts at horizontal transfer of technologies and use of inappropriate technologies in location-specific situations. Moreover, because sustainability was not an explicit objective of development projects, no serious effort was made to choose and develop technologies that ensure economic viability, ecological soundness, and cultural acceptability.

PRIORITY AREAS IN DISASTER PREPAREDNESS AND MANAGEMENT

Proceeding beyond emergency response - Investment in human resource development dedicated to risk reduction and support initiatives in disaster prone areas should be a priority area. Reliance on external emergency assistance impedes efforts to educate and involve local communities in disaster risk management (Bethke et al, 1997).

Incorporation of risk education in sustainable national development - There is need to broaden the base of association with the subject and the more commonly adopted topics of educational programs. The subject of risk needs to become more integrated elements of national economic growth and development (Hicks 1996).

Educating about the social dimensions of risk - There is need to address risk management within educational programs of public administration. Civil service functions could provide a more sustained basis for making risk management an essential element of expected government practice at all levels. Introducing risk awareness into secondary and primary educational programs through innovative programs of teaching science, geography, ecology and civil responsibility can be achieved (Hicks, 1996; Buchanan-Smith & Maxwell, 1994).

Institutional basis to transmit experience - Managerial and organizational responsibilities in identifying monitoring and managing risks are not sufficiently incorporated in educational and professional context. There is need to develop individual capabilities and create collective institutional capacities (Lautze & Hammock 1996; Hicks, 1996).

Sustained commitment to risk reduction, education and training - Need for long term vision to build education and training processes that contribute to culture of prevention. Investment in human resources development can only be sustained if risk management values are embedded within the education and training capabilities of disaster prone communities (UN ISDR, 2002).

Monitoring of resources and environment - For sustainable development to succeed there must be monitoring of the status of various natural resources and analyses of the data in order to predict the likely consequences of environmental change in the future. Related to this is the inventorying of natural resources so as to determine changes in biodiversity causes and remedial measures (UNESCO/UNEP, 1988).

CONCLUSION AND RECOMMENDATIONS

Effective disaster risk management depends upon a series of related action and the means to engage the informed participation of all stakeholders. It requires shared thinking at local, regional, national and international levels of society. Disaster reduction strategies will succeed only when people – governments, specialists, leaders and citizens – come to understand that disasters are more a failure of foresight or evidence of their own neglected responsibility rather than the presumed consequence of natural forces or some other-worldly act of God. In view of this, the following recommendations are made;

Encouragement of community ownership and responsibility while building on traditional coping mechanisms and build management and administrative capacity of local organizations. Enhancement of participatory decision-making, training in consensus building, advocacy, and conflict resolution while promoting an effective civil society to move from conflict to peace and development should provide the way forward (Webb and Rogers, 2003).

Improvement of access to decentralized emergency medical services at the community-level. Community based intervention should maintain the basic structure of healthcare system as much as possible. The focus should be on limited health resources on the most efficient, sustainable, and cost-effective means of minimizing risks (Lautze, et al. 2003).

Promotion of the development of community-based injury prevention and disaster mitigation strategies such as locating homes within areas that lessen vulnerability and risk, public education and awareness, and legislative controls that serve to prevent disasters among vulnerable populations (Barrs et al, 1998).

Promotion of education and training of emergency responders to effectively rise to the challenges that face the vulnerable communities. The training should be simple and brief, so as not to cause disruption of the attendees' ongoing work and public service and should include the most likely first responders to everyday emergencies e.g., boda boda riders, matatu and bus drivers, police, fire, ambulance, nurses, and doctors (Africare, 2004; ADPC, 2003).

Collaborative efforts should be to move a disaster-prone community from relief to sustainable development through the implementation of integrated multi-sectoral development programs. The transition from relief to sustainable development should involve the implementation of several measures focusing on poverty reduction, food security, environmental protection and community welfare that target vulnerable pastoral, farming and urban communities (Chambers, 1997).

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THE IMPACT OF URBAN PLANNING POLICIES ON URBAN AGRICULTURE WITHIN THE URBAN SLUM BELT OF KISUMU MUNICIPALITY, KENYA

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ABSTRACT

This paper highlights the plight of urban farmers who practise urban agriculture in the urban slum belt of Kisumu town and its peripheries, against a background of prohibitive, archaic, ambiguous and conflicting urban planning policies. The existing urban planning policy obstacles and their impacts are discussed; the benefits and impact of urban agriculture on poverty reduction as well as the existing intervention strategies that facilitate the development of urban agriculture are identified. It further establishes that urban agriculture is a main source of income for the urban poor within the income category earning less than Ksh. 2500 per month. In addition, the urban farmers in the income bracket earning less than Ksh. 2500 per month were engaged in farming to get food while those earning more than 2500 were mostly engaged for commercial purposes. It concludes that urban agriculture is generally perceived by urban farmers as being good except for a few constraints which face urban farmers such as non-supportive government policies especially Kisumu Municipal by-laws (1954) and livestock theft among other. A number of recommendations are suggested such as the enhancement of security measures to combat livestock theft in urban agriculture by law enforcers, creation of special programmes on urban agriculture, intensification of extension service provision by both government and NGOs, and the establishment of urban agriculture section within the governing structure of the Kisumu Municipality.

INTRODUCTION

Urban Agriculture is a well known and relatively widespread activity in most towns and cities in Africa. Urban agriculture is an adaptive response by urban households to improve their food situation and to diversify their livelihood options under conditions of persistent economic uncertainty and threats such as unemployment and declining purchasing power (Mougeot 1994, 2005; Foeken & Owuor 2000; Foeken & Mwangi 2000). In African cities, some 40% of its urban population are involved in urban agriculture (World Bank, 2002).

In Kenya, urban agriculture is increasingly being recognized as a livelihood survival strategy for reducing urban poverty in towns and cities (UN-Habitat, 2003). Urban poverty is estimated at 48% of the urban population and the situation is likely to deteriorate in future. Some of the reasons why people practise urban agriculture include provision of food, reduction of poverty, creation of employment and provision of food supplements to address HIV/Aids prevalence.

On legality of practicing urban agriculture in many African countries, Foeken (2006) points out that farming in town is an illegal activity. Likewise in Kenya, the practice of urban agriculture is not legally recognized and the government has made very little provision for research and extension of urban farming techniques (World Bank, 2002; UN Habitat, 2003; Kenya, 1986). Foeken (2005) further argues that in East African countries, whereas the national legislations do recognise urban agriculture, the local legislation especially the Municipal by-laws are yet to give it a formal recognition. However, in recent years this has been changing as there have been calls to integrate urban agriculture in urban planning policies. For instance, the current draft of National Lands Policy proposes an appropriate legal framework to regulate and govern urban agriculture (Kenya, 2006). On its part, the Kisumu Municipal Council also concurs on the socio-economic importance of urban agriculture but argues that integration of urban agriculture into the broader urban development plans is necessary only within a carefully regulated framework to minimise conflict.

Kisumu town has an estimated population of 345,312 (CBS, 1999), although the current population estimate is 500,000. The estimated growth rate is 2.8% per annum. The town experiences a high level of unemployment rate standing at 30% whereas 52% of population is engaged in the informal sector. The settlement and demographic trends are such that about 25% of the population occupies the old town section. The peri-urban area is densely populated and accommodates the rapidly expanding informal settlements of Kisumu. The remaining 25% of the Municipal population occupy the rural section that comprises about 80% of the total town area (UN-Habitat, 2005). **OBJECTIVES OF THE STUDY**

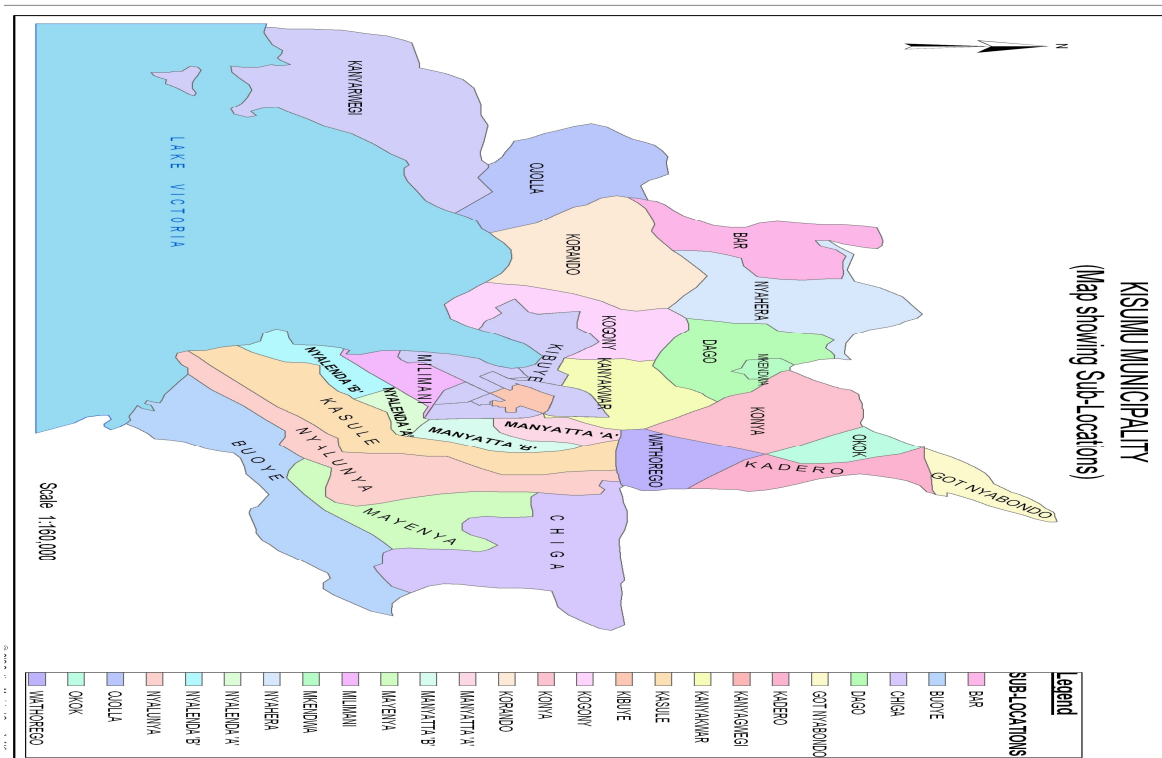
The purpose of the study was to identify impediments to urban agriculture and explore possible ways of developing it. The specific objectives were to:

1. To assess the benefits of urban agriculture and its' impact on poverty reduction.
2. To investigate existing urban planning policy obstacles and their impacts on urban Agriculture.
3. To identify existing intervention strategies to facilitate development of urban Agriculture.

METHODOLOGY

The study used a cross-sectional survey research design which had a specific point in time for referencing. The study was conducted within the urban belt of Kisumu Municipality. It covered the slum belt which included; Bandani, Manyatta, Migosi, Nyalenda, Nyawita and Obunga. Administratively, these estates are located in Manyatta A, Manyatta B, Nyalenda A, Nyawita, Migosi, Nyalenda B and Kondele sub-locatons.

Figure: shows the map of Kisumu Municipality



The target population studied was the urban farming community groups and individual farmers practising urban agriculture within the town. A sample size of 160 respondents was taken out of the 530 target population. A purposive sampling technique was used to select the sample whereby only groups or individuals with relevant information on urban agriculture were interviewed. The main data collection techniques were Household Interviews, Key Informant Interviews and Focus Group Discussions. Secondary data including information on existing urban planning laws were also used.

FINDINGS

Introduction

This paper attempts to highlight the problem of urban planning policies as an obstacle to the development of urban agriculture in Kisumu town. It identifies the Local government Act Cap 265, Kisumu Municipality by-laws of 1954, the Public Health Act Cap 242 and the Physical planning Act Cap 286, among others, as the main impediments to the development of urban agriculture in the town. The main findings of this study cover areas such as main features of urban farming, conflicts facing urban farmers, urban planning policies, and interventions towards development of urban agriculture, conclusions and recommendations made for future consideration.

Main Features of Urban Farming

The study found out that the perception of urban farmers on the practice of urban agriculture was that it was either good or very good since it provides income, food, self employment and reduces urban poverty. The main objective of those who engaged in farming was either to get income or food. Most farmers had farm sizes ranging from 1/8 to ¼ acre with only a few having large farm size more than 1 acre. Since most farm sizes were less than 1 acre and were found within municipality, they were not legally recognized as agricultural lands. According to the Agriculture Act Cap.318 section 37, plot sizes which are two (2) acres or less used for residential purposes within municipality or a former township or land used for recreational purposes are not catered for (Kenya, 1986).

The main types of crops grown were vegetable followed by cereals, fruits, fruit tree nursery and medicinal plants. However, the main types of livestock kept by farmers were poultry, sheep, goats, cattle and pigs. Most households kept combinations of all these types of livestock in varying proportions. The mean for each type of livestock was 17 for local poultry, 300 grade poultry, 6 local goats, 6 exotic goats, 14 sheep, 10 local cattle and no exotic cattle. Poultry was the most common livestock kept followed by cattle, sheep and goats. Pigs were the least livestock kept perhaps due to intense government campaign against roaming pigs in the last few years.

Our results show that urban agriculture was the main source of income for the income category earning less than Ksh. 2500 per month while those in the income category earning more than Ksh. 2500 per month had either rental houses or formal employment as their main source of income. Table 2 shows the percentage distribution of main source of income by level of income.

Table 2: Percentage distribution by main source of income by Level of Income

Main Source of Income		Level of income			Total
		<2500	2500 to 5000	5000 and above	
Farming	Farming	40.0%	34.0%	26.0%	100.0%
	Formal Employment	.0%	.0%	100.0%	100.0%
	Other	25.0%	25.0%	50.0%	100.0%
	Rental houses	.0%	50.0%	50.0%	100.0%
	Small scale business	28.0%	36.0%	36.0%	100.0%

Also, the study further revealed that the three main constraints facing all the income categories of urban farmers practicing urban agriculture included; non-supportive government policies, inadequate knowledge and skills, and land shortage in that order. It was further revealed that the main constraint for people within the income category earning less than Ksh. 2500 per month was non-supportive government policies; those in the income category between Ksh. 2500 to 5000 per month had inadequate knowledge and skills while the income category earning more than Ksh. 5000 per month had non-supportive government policies and shortage of land in equal proportions as the main constraints affecting them.

However, it was interesting to note that the income category that was affected most by non-supportive government policies as a constraint was those earning less than Ksh. 2500 per month. On the other hand, land shortage was a common constraint to all the income categories practising urban agriculture. In addition, wildlife destruction was a menace and a major constraint to those people farming in the swampy shorelines of Lake Victoria. Livestock theft was also found to be a major constraint to urban livestock keepers and the vice was being spearheaded by a cartel of thieves, mainly consisting of urban dwellers, who liaise with other thieves from outside the town. In addition, crop destruction by wildlife especially hippopotamus was cited as a menace to people farming near the lakeshores.

Threats facing Urban Farmers in Urban Agriculture

Most farmers experienced conflict with other people as a result of their activities in urban farming. The main sources of conflict for urban farmers were thieves, followed by neighbours, municipal council, landlord and government authorities in that order. The problem of thieves was perceived to be caused by urban poverty although it was revealed that, lately, livestock theft had increased due to emerging commercialization of livestock theft by a cartel of thieves within and outside the urban slums. Livestock theft was common but the Chief's Act CAP 128 was found to be inadequate on dealing with these thefts.

Livestock theft cases did not receive much support from the chiefs who instead advised the complainants to seek assistance from the police stations. However, the Chief's Act was found to be more effective in handling cases of crop damages by livestock. On the other hand, the main causes of conflict were found to be urban poverty, followed by land tenure factors, prohibitive government policies and lastly environmental concerns.

Urban Planning Policies

The urban planning policies that impact on urban agriculture can be categorized into two main groups which include; the national legislation and policies which consist of all relevant government Acts, and local by-laws and policies. These national legislation and policies include Local government Authority Act (CAP 265) , Physical Planning Act (CAP 286), Public Health Act (CAP 242) and to a small extent the Agriculture Act (CAP 318), Chief's Act (CAP 128), Land control Act (CAP 302), and the Water Act (ACT No. 9). On the other hand, the local legislation and policies that directly relate to urban agriculture in Kisumu town is the Kisumu Municipality by-laws of 1954. According to Foeken (2006), the Local Government Authority Act is the most important national legislation in relation to urban agriculture and it provides the local authorities with full decision-making power on crop cultivation and livestock keeping within municipal boundaries. Whereas the Agriculture Act, Land Act and Physical Planning Act offer the local authorities the legal provision for whether to allow urban agriculture or not, the other remaining Acts provide the framework for control of the activity (Foeken D. 2006). In Kenya, urban development planning and control is a functional responsibility of the Local Authorities which operate under the two Acts namely; the local Government Act (CAP 265) and the Physical Planning Act (CAP 286). However, our study established that the existing urban planning policies are prohibitive, ambiguous and conflicting.

The Local Government Act Cap 265

According to the Local Government Act Cap 265 sec. 155 (b) & (c), cultivation by unauthorized persons of land belonging to private persons, government and local authorities is prohibited. The same Act sec. 155 (b) and (c) allows for agricultural and livestock undertakings such as control of spread of animal diseases, planting of famine relief foods by any person to support themselves in any part of the country where there is likely to be food stuff shortage, and provision of services in urban areas (Kenya, 1998).

Sec. 155 (b) on agricultural and livestock undertakings states that every Municipal council or town council shall have power "subject to any other written law relating thereto, to engage in livestock and agricultural undertakings (including the provision of services for improving the agricultural and livestock industries in the country, municipality or township) and take such measures as may be necessary or desirable for preventing the outbreak and spread of any disease as defined in the Animal Disease Act." (Kenya, 1998).

And Sec 155 (c) further states that every Municipal council or town council shall have power "to require the planting of any specified crops by persons for the support of themselves and their families in areas which in the opinion of the country, municipal or town council are suffering from or likely to suffer from a shortage of foodstuffs" (Kenya, 1998). This section of the Act is ambiguous since it may be interpreted to mean that urban residents who suffer from food insecurity may be free to engage in agricultural and livestock undertakings to meet their food needs despite urban agriculture being a prohibited practice. In this regard, residents of Kisumu town where there is high food insecurity which is estimated at 53.4% would therefore be free to grow crops and keep livestock under this Act. (Kenya, 2004).

According to Foeken (2006), Section 155 provides local authorities with the power for every municipal or town council to engage in livestock and agricultural undertakings, which implies that by means of urban agriculture-friendly by-laws, local authorities may invoke this Act temporarily to provide its urban farmers with land for urban agriculture. In other words, the Kisumu Municipal Council has the legal possibility to engage in or allow the crop cultivation for the urban poor in areas where these urban poor are living. Section 154 (c) of the same Act is also prohibitive as it forbids, restricts or controls crop cultivation in unenclosed and unoccupied private or government land by unauthorized person.

Section 154 (c) states that every Municipal council shall have powers to "to prohibit the cultivation by unauthorized persons of any unenclosed and unoccupied land in private ownership and any government land and land reserved for any public road" (Kenya, 1998) Also, section 160 provides local councils with the powers to plant, trim or remove trees, flowers and shrubs in any public space. Sec 160 states that every Municipal Council shall have power to "...to plant, trim or remove trees, flowers and shrubs in or on any

public place; to prohibit or regulate the planting of trees and shrubs in public places; to require or provide for the maintenance, cutting or removing of any such trees or shrubs ; and to prevent the removal or injury thereof” (Kenya, 1998)

And lastly section 162 forbids, prohibits or controls the keeping of animals, birds and bees so that their keeping shall not be a public nuisance or injurious to health. Section 162 states that “..to prohibit or control the keeping of animals, birds and bees so that their keeping shall not be a public nuisance or injurious to health”(Kenya, 1998)

The Physical Planning Act Cap 286

Another major national legislation and policy is the Physical Planning Act, Section 29 (a) This section provides each local authority with the power to prohibit or control the use and development of land in the interest of proper and orderly development. However, certain phrases in the section are ambiguous, for instance, it is not clear how local authorities define the “proper and orderly development” and whether there is room for urban agriculture as a form of urban land use in the physical development plan (Foeken D. 2006). The Physical Planning Act therefore provides clear guidelines on urban planning and development but remains silent on urban agriculture as a land use category despite it’s being an emerging livelihood survival system for the urban poor. Also prohibitive is section 2 of the Land Control Act as it defines “agricultural land” as land that is not within a municipality or a township. However, this is conflicting since the same section of the same Act, allows for urban agriculture where it defines “agricultural land” as land in Nairobi area or in any municipality, township or urban centre that is declared by the Minister, by notice in the Gazette, to be agricultural land for the purposes of the Act.

The Public Health Act Cap 242

Other prohibitive national legislations and policies include the Public Health Act Cap 242. For instance, Sec 157 (1) empowers the Minister of Health to prohibit cultivation or irrigation within and around townships. Indeed the section provides the Minister of Public Health, after consultation with the Minister of Agriculture, with powers to prohibit growing of crops or irrigation of any land being within the boundaries of a township. Also, this article provides the legal backing for prohibiting irrigation with sewage water (Foeken D., 2006). Perhaps, it is crucial to note that this section of Act prohibits both urban and peri-urban farming especially crop production on health and sanitary grounds.

Sec 157 (1) states that “ ...growing of any crop or irrigation of any land being within the boundaries of a township or within miles of such boundaries is unhealthful or insanitary.....the minister after consultation with minister for the time being being responsible for Agriculture can , by order, prohibit growing of any crop or the irrigation of any land within any area, within the boundaries of a township....” (Kenya, 1986)

But the most important Act dealing with everything that causes nuisance or other condition liable to be injurious to health is section 118 (f), (g) and (h) of this Act.

Sec 118 (f) explains what constitutes a nuisance as “ any stable, cowshed or other building or premises used for keeping of any animals or birds which is so constructed, situated, used or kept as to be offensive or which is injurious or dangerous to health”(Kenya, 1986) Sec 118 (g) explains a nuisance as “ any animal so kept as to be a nuisance or inurious to health” Sec 118(h) explains “ any accumulation or deposit of refuse, offal, manure or other matter whatsoever which is offensive or which is injurious or dangerous to health” (Kenya, 1986)

These sections prohibit constructing cow shed, or building premises for keeping of animals as well as any accumulation or deposit of refuse and manure which is injurious or dangerous to health.

Also, section 168 (a) provides every municipal council to make by-laws for preventing and abating conditions permitting or favouring the breeding of mosquitoes and flies for prevention of malaria and other insect-borne diseases. Foeken (2006) argues that although , on first sight, there seems to be no direct link with urban agriculture, this Act provides the basis for prohibiting maize growing in towns as mosquitoes breed in the water that assembles in the axils of the plants. Section 168 (a) states “ every Municipal Council may, with the approval of the Minister, make by-laws for preventing and abating conditions permitting or favouring the breeding of mosquitoes and flies and generally, for the prevention of malaria and other insect-borne diseases” (Kenya, 1986)

The Kisumu Minicipality By-Laws (1954)

This is the main local legislation that relate directly to the practice of urban agriculture in Kisumu Municipality. The Kisumu Municipality by-laws appear to be ambiguous since it prohibits urban agriculture

while at the same time giving some limited and conditional permission to undertake some agricultural and livestock keeping. For instance, according to sec. (c) no. 292 no person is allowed to keep or graze any domestic animal within the municipality without permission or exemption by the Municipal council and, where permission is granted, grazing may only be done at a fee. Any domestic animal found grazing within the municipality in contravention to these by-laws is supposed to be impounded. Sec. (c) no. 292 states that “no person shall keep any domestic animal within the Municipality without written permission of the board” (Kenya, 1954)

By-law sec. no. 60 states that no licensed purveyor of milk shall sell milk for human consumption in the municipality unless such milk has been pasteurised, transferred, immediately after pasteurisation, to a sterile approved container and therein sealed to the satisfaction of the board. This by-law is prohibitive and is seldom practised within the municipality. Sec. no. 60 states that “No licensed purveyor of milk shall sell milk for human consumption in the Municipality unless such milk has been pasteurized, and transferred, immediately after pasteurisation, to sterilize approved container and therein sealed to the satisfaction of the board”(Kenya, 1954)

By-law sec. no 296 states that no person shall keep within any house, building or premises or in the vicinity thereof, any noisy domestic animal which shall be or may cause a nuisance to the residents in the neighbourhood. The by-law defines the term “domestic animal” to mean “horses, donkeys, mules, camels, cattle, sheep, goats and pigs. Sec. no 296 states that “No person shall keep within any house, building, or other premises or in the vicinity thereof, any noisy domestic animal, which shall be or may be a nuisance to the residents in the neighbourhood” (Kenya, 1954)

And lastly By-law sec. no. 300 states that the written permit of the board shall state the maximum number of domestic animals which may be kept, and also prescribe conditions under which such written permit has been granted. Sec. no. 300 states that “the written permit of the board shall state the maximum number of days, such animals which may be kept and may also prescribe conditions under which such written permit has been granted” (Kenya, 1954)

Mireri et al (2005) pointed out that the by-laws do not recognize urban agriculture as a legitimate land use within the municipality although about 80 percent of the municipality is rural in character with agriculture as the dominant land use. Further more, the sections of the by-laws that authorize urban agriculture are so stringent that most urban farmers would not meet them if they were fully enforced.

Other related Policies and legislations

The other related Acts that influence urban agriculture include; the Agriculture Act Cap.318, the Chief’s Act and Water Act among others.

The Agriculture Act Cap 318

According to the Agriculture Act Cap.318 (Kenya, 1986), agriculture (basic land usage) rules, sec. 48, the Act does not apply to plot sizes which are two acres or less used for residential purposes within municipality or a former township or land used for recreational purposes. It is evident therefore, that urban agriculture which mainly takes place in small plots and within municipalities is not covered by the existing agricultural Act. This implies that urban farmers appear to operate outside the agriculture Act in as far as the Act is concerned. Sec. 48 (no. 1) on the agriculture (basic land usage) rules state that “ these rules may be cited as the Agriculture (basic land usage) rules, and shall not apply to plots of two acres or less used for residential purposes only within a municipality or a former township, or land used for recreational purposes” (Kenya, 1986)

Also section 2 of the same Act, “agricultural land” is defined as all land which is used for the purpose of agriculture, not being land which, under any law relating to town and country planning, is proposed for use for purposes other than agriculture. According to Foeken (2006), this does not rule out the possibility of practising agriculture within a town’s boundary.

The Chief’s Act

The chief’s Act is another national legislation and policy that plays a role in relation to urban agriculture. According to section 10 of the Act, a chief may from time to time issue orders to be obeyed by persons residing within the local limits of his jurisdiction for prevention of either water pollution or spread of human or animal diseases. Sec. No. 10 (h) states that “ Any chief may from time to time issue ordersprohibiting the spread of disease, whether human beings or animals”(Kenya, 1987)

Section 11 of the same Act adds that the chief can suppress or control animal or insect pest or plant pests or diseases as well as restrict or prohibit the use of grazing by any form of stock in specific areas. Sec. no 11 (d) states that “suppressing or controlling animal or insect pests or plant pests, noxious weeds or weeds” (Kenya, 1987)

This paper highlights some of the major findings of this study on various aspects and impacts of urban planning policies on urban agriculture. Our results show that there was low awareness of prohibitive government policies on urban agriculture by most farmers. The only prohibitive government policy that impacted negatively on the farmers was the Kisumu Municipality (General) by-laws of 1954 while the Physical Planning Act CAP 286 impacted positively on urban farmers in that the department was allocating plot sizes with at least some space for kitchen garden. Although the Local government Act Cap 265 has previously been an impediment to urban farmers, it was revealed that with the upcoming review of the Act, it will be more accommodative and friendly to urban farmers. It was also revealed that there were more people who had not attended a policy oriented seminar on urban farming than those who had attended. There were more people who were aware of prohibitive government policies, who had at least attended a policy -oriented seminar on urban farming and urban planning, than those who were not aware and had attended any seminar.

The results show that the main local urban planning policy obstacle that impacted negatively on urban agriculture was the Kisumu Municipality (General) by-laws of 1954 which is a creation of section 77 of the Municipalities Ordinance CAP 136. Historically, it was revealed that the by-laws were more strongly enforced during the colonial days than it is today. It was also found out that the Municipal by-laws have not been amended or reviewed for the last half a century. These by-laws are obsolete yet they are still being used half a century later. The Municipal Council does not allow domestic animals to roam or graze in town and animals found roaming or grazing in town are impounded and the owners are charged Ksh.100 per cow per day as a penalty. There is however no section of the by-laws that clarifies on fee charged. Furthermore, the Municipal by-laws do not allow growing of tall crops such as bananas and cereals along the roads, railways and elsewhere within town because they hide thugs.

Another national legislation that was found to impact on urban farming was the Physical Planning Act CAP 286. Ordinarily, the Act offers the local authorities the legal provision for whether or not to allow urban agriculture. Section 29 (a) of the Act provides each local authority with the power to prohibit or control the use and development of land in the interest of proper and orderly development. The Physical Planning department is found to be concerned with physical planning of the town. The department approves development plans; allocate land for parks (where they plant trees and flowers), plan roads with trees along it and as open spaces in front of plots among others. Occasionally, the department, together with the Municipal environment department in-charge of landscaping, comes into conflict with urban farmers who leave their livestock to roam in town thereby destroying some of their trees and flowers along the roadside. This is frustrating the efforts of the Physical department to make Kisumu a “green town”. Results show that the department has attempted to integrate urban agriculture into urban development planning in two ways namely; setting plot sizes with provision for kitchen garden for vegetable growing and engaging urban communities in at least two stakeholder meetings as a pre-requisite condition in planning process. These efforts are in tandem with what other governments all over the world have done and are a positive trend in this direction.

Interventions towards development of urban agriculture by development Agencies

Training and Extension Support

Interventions in development of agriculture, through training and extension support, should be hinged on existence of a pragmatic and dynamic policy framework. At the moment, a number of development organizations are engaged in promotion of urban agriculture despite the fact that there is no proper legislation and policy framework to support their activities. Since the legality of urban agriculture is ambiguous in the current Laws of Kenya, the operation of these development agencies, including the government wings in-charge of extension, the Ministry of Agriculture and sister Ministry of Livestock, appear to work without express authority of the Kenyan Laws in urban centres. In deed, even the Ministries of Agriculture and Livestock which carry out a lot of extension activities in urban centres have not established a section for urban agriculture to date despite the increasing demand on the same.

This paper discusses some of its' findings on interventions so far done towards the development of urban agriculture. The leading development agency that conducted trainings for urban farmers was mainly Non-Governmental Organizations (NGOs) but followed closely by Ministry of Agriculture. These NGOs that trained farmers included Kenya Federation of Agricultural Producers (KENFAP), Community Mobilization for Economic Development and Advancement (C-MEDA), World Vision and Lake Agricultural Technology Centre (LAGROTEC).

Our results show that farmer-to-farmer methodology was the leading extension service provider to the urban farmers while the Veterinary Department was the main provider of veterinary services. The ministry of Agriculture and farmer to farmer were the only extension service providers available to low income farmers earning less than Ksh. 2500 per month. Ministry of Livestock & Fisheries (MOLF), Agro-veterinary shops (Agrovets) and NGOs provided extension service to farmers in higher income brackets more than Ksh.5000 per month. Ministry of Agriculture mostly served those with income more than Ksh. 5000 per month but was also the only organized government extension provider reaching poor farmers in the income bracket earning less than Ksh. 2500 per month. Farmer to farmer methodology was the only extension service available to low income farmers earning less than Ksh. 2500 per month apart from MOA. People whose main source of income was farming were served by all the extension service providers. People whose main source of income was small scale business were served only by farmer to farmer extension service.

The study further revealed that ministry of agriculture was the only extension provider who reached urban farmers with no education at all. This implies that Ministry of agriculture has cut a special niche in urban agriculture. Urban farmers with primary level education led in receiving extension service followed by secondary level, tertiary and lastly those with no education at all. Farmers who had primary level education were mostly reached by farmer to farmer and Ministry of Agriculture; those with secondary level education were mostly reached by NGOs while tertiary level farmers were reached mostly by Agro-veterinary shops. Ministry of Livestock & Fisheries served all farmers of different education levels equally. Depending on ones' level of education, farmers from all levels of education including those who had none were served by all veterinary service providers. Those with primary level education were served mostly by veterinary department and Agro-vets while farmers with secondary level education dealt mostly with private veterinarians. The Ministry of Livestock & Fisheries is the only one that served tertiary level educated farmers. It was also revealed that farmers whose main objective in farming was to get income mostly got extension service from MOLF, Agro vets NGO, farmer to farmer and MOA. On the other hand, farmers whose main objective was to obtain food were mostly served by farmer to farmer and MOA. On the other hand, the study shows that all the income categories were involved in farming either to get food or income. Farming was therefore a vital income generating activity for all the income categories. The income bracket earning more than 2500 per month were mostly engaged in farming to get income while those in the income category less than Ksh. 2500 per month were farming to get food.

Apart from interventions in training and extension support, our results further show that the Municipal council has made some positive steps by setting up public demonstration farming units in the Environmental Pedagogic Centres (EPC) where demonstrations are done to farmers on solid waste management and recycling to produce compost manure for kitchen gardening. The Municipal has also put in place a number of actions to be accomplished in their Development plan for the year 2004 to 2009 which include "review of council policy and laws on urban agriculture commensurate with practice demands, conducting a survey with a view to initiating agro-forestry projects, establish public demonstration farming units in ECPs, and awareness and sensitization campaigns within a period of five years" (Kenya, 2004). However, the Municipal Council needs to urgently review the Kisumu Municipalities (General) by-laws of 1954 to be more accommodative and friendly to urban farmers.

The study found out that there is some considerable NGO involvement in urban agriculture within the urban slums of Kisumu town. The NGOs were mostly involved in training of the farmers, provision of extension services, grants and farm inputs such as seeds, pesticides and farm implements. But, although NGOs were the leading provider of training on urban agriculture, most urban farmers still remained unreached by these trainings.

CONCLUSION AND RECOMMENDATIONS

This paper concludes that urban agriculture is generally perceived by urban farmers as either very good or good. And that non-supportive government policies especially Kisumu Municipal by-laws tend to impact negatively on urban farmers falling in the income bracket earning less than Ksh.2500. Secondly, urban agriculture is the main source of income for the income category earning less than Ksh. 2500 per month, which mostly represent the urban poor. Furthermore, in order for urban farmers to continue to derive their livelihood from urban agriculture in a sustainable and lawful manner, urban agriculture should be integrated in urban planning policies especially at the local policy level, by reviewing the Kisumu Municipal by-laws (1954) to become urban agriculture-friendly.

On the basis of the findings of this study, this paper recommends a number of issues to be tackled in order to promote and develop urban agriculture within the urban slums of Kisumu town and its peripheries:

- In recognizing the socio-economic value of urban agriculture, it is necessary that urban agriculture be integrated in urban planning policies to facilitate a well regulated development of urban agriculture which is the main source of income for the urban poor. In particular, there is need to review Kisumu Municipality (General) by-laws in a participatory manner with the urban farmers, concerned non-governmental organizations and relevant government institutions to make it more accommodative and friendly to urban farmers. This is necessary in order to keep in tandem with the on-going review of both the Local government Act CAP 265 and Land Policy Reform draft.
- Reduce livestock theft which is a major conflict in urban livestock keeping by enhancing security measures to curb the vice. There is need for law enforcers especially the police and provincial administration in urban areas to double their efforts as well as work together to break the network of cartels of livestock thieves in order to address this security concern.
- Extension service providers, both government and NGOs, to double their efforts and focus more on urban agriculture as well as come up with special programmes for urban farmers in order to maximize the returns and potential of urban agriculture.
- The government, particularly, the Municipal council of Kisumu should spearhead the development of urban agriculture as a livelihood survival strategy for the urban poor by setting up urban agriculture section within its governing structure.

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BOOK REVIEWS

Okoth, P. G. (2008); Peace and Conflict Studies in a Global Context, Kakamega, Masinde Muliro University of Science and Technology in collaboration with Scholarly Open Press pp.181

This book is edited by Pontian Godfrey Okoth, a professor of History and International Relations at Masinde Muliro University of Science and Technology. Contributors to this book are presented alphabetically as Alfred Sikuku Kamoet, Collins Kizito Matemba, Pontian Godfrey Okoth and Tabitha Wawira Mwaniki. All these authors are based at Masinde Muliro University of Science and Technology. The book comprises fourteen chapters which have been contributed as follows. Apart from the introductory chapter and chapter thirteen co-written by Okoth and Kamoet, the latter and Matemba wrote four chapters each while Mwaniki wrote three chapters. The book contains a detailed account of the salient issues in peace and conflict studies (PACS) including definitions of key concepts, perspectives of PACS, a detailed account of the nature, role, causes and types of conflicts and approaches to conflict management including peace building, peace keeping and enforcement of the same.

In this book many issues are discussed and it will not be wise to discuss each chapter in details since it will be philosophically uneconomical. Consequently, this review presents an overview of each topic. Later, the main weakness of the book is discussed in details. Chapter one sets the pace for the book by defining peace and conflict studies, its scope and origin. It is from this chapter by Okoth that the book draws its title. In chapter two, Kamoet examines some fundamental concepts of peace and conflict from various schools of thought including Marxist and liberal. He also presents a brief discussion of the Democratic Peace Theory. This theory shall be examined later in this review. In chapter three by Mwaniki, a brief definition of peace is given followed by an investigation of the various theories and perspectives of peace. She mentions the fact that the definition of peace is controversial. This forms part of the main weakness of the book which is discussed immediately after a summary of these chapters. Matemba presents the following as central issues in international diplomacy: national security, war on terror humanitarian interventions and internationalization of security. This he does in chapter four. In chapter five Kamoet examines the nature and role of conflict in society. He argues that conflict is interpreted from various perspectives which call for clarity in the usage of the term conflict. This is important because clear and accurate knowledge of anything is an advance on a mere general familiarity with it. In the absence of clear knowledge of the meanings of the concepts that we use, we are certain sooner or later to apply them wrongly or to meet with exceptional cases where we are puzzled as to how to apply them at all. Kamoet also uses the same approach when examining the causes and types of conflict in chapter six which he presents as including ethnic, environmental and religious conflicts. The same approach is applied by the same author in chapter seven when he examines the actors in conflict and conflict mapping. He identifies actors in conflict as comprising the national actors and the supra-national actors. In chapter eight, Mwaniki discusses the approaches to conflict management and response situations. She presents a detailed account on the steps one could follow when exercising the above issues. In chapters nine and ten, Matemba discusses in details the concepts of peace building and peace keeping, respectively. He illustrates these concepts with relevant examples which make the chapters interesting to read. The same approach is used by Mwaniki in chapter eleven when examining the concept peace enforcement. She defines the concept, gives the theories of peace enforcement, the role of some organizations in peace enforcement and the problems which peace enforcement faces. In the next chapter, Okoth discusses what he calls "terror phobia" and how it has shaped the U S foreign policy to Africa. The Post September 11, 2001 has led to the heightened US security concerns, political implications and foreign policy ramifications in Africa. One could easily say that this chapter serves as the ultimate illustration of the previous chapters; it is for this reason that this chapter is highly recommended for reading. In the next chapter, Okoth and Kamoet discuss the role of the international actors in mediating the Post Kenyan election violence of early 2008. This chapter serves to show that indeed true to its title, it is peace in a global context. It also indicates that the book is very current and well updated. Chapter fourteen written by Matemba deals with management of peace after the collapse of the Cold War with interesting revelations of the role of new concepts including the New World Order and Globalizations in explaining peace management in the world. Generally, the book is simple in presentation of issues, clear in expression and current in time. This makes it a must read for the readers it is intended.

The book is intended to serve as a textbook for both undergraduate and postgraduate students in the universities. It will also serve all researchers in PACS. This is necessitated by the fact that PACS is a relatively new discipline which arose after the collapse of the Cold War. Consequently, as the editor notes (2008: ii):

Indeed, if PACS is to continue to prosper, we in the field must draw on the best and most relevant work in the disciplines with which we have long been associated, such as history, political science, psychology and sociology. However, we must also seek, put and involve scholars from other disciplines thereby introducing additional areas of expertise and new approaches to education. Most importantly, we must pursue the new analytical perspectives that will broaden our horizons and bring us closer to understanding and solving the pressing local, national, regional, continental and global problems of the twenty first century. This book, *Peace and Conflict Studies in a Global Context*, has been written with these goals in mind.

Before reading this book one expects that key concepts including peace and conflict are going to be dealt with as promised in the title. However, a close examination of the book indicates that it only deals with the theories of peace and a full discussion of conflict. Peace, which is controversially defined, is however not presented. There is no one general definition of the term peace. The book should have dedicated a chapter to discuss the concept peace. Peace is generally defined as the opposite of war. Peace can be a state of harmony or the absence of hostility. Peace is used to describe the cessation of violent conflict. It can mean a state of quiet or tranquility, that is, an absence of disturbance or agitation. Peace can also describe a relationship between any people characterized by respect, justice and goodwill. While Martin Luther King Jr. and the civil rights movement carried out various non-violent activities aimed at ending segregation and racial persecution in America, they understood peace as more than just the absence of violence. They observed that while there was not open combat between blacks and whites, there was an unjust system in which the government deprived African Americans of equal rights. While some opponents criticized the activists for disturbing peace, Martin Luther King observed that, "True peace is not merely the absence of tension: it is the presence of justice." The definition of "peace" can vary with religion, culture or subject of study. Mahatma Gandhi suggested that if an oppressive society lacks violence, the society is nonetheless not peaceful, because of the injustice of the oppression. Gandhi articulated a vision of peace in which justice is an inherent and necessary aspect; that peace requires not only the absence of violence but also the presence of justice.

Peace can describe calm, serenity and silence. This understanding of peace can also pertain to an individual's sense of himself or herself, as to be "at peace" with one's own mind. This is what has been referred to as inner peace. People that experience inner peace say that this feeling is not dependent on time, people, place or any external object or situation, asserting that an individual may experience inner peace even in the midst of war. This is what is called stoic peace. The founder of stoicism was named Zeno. Zeno is supposed to have lectured in the 3rd century BC from a porch, and stoicism gets its name from this fact, since stoa is the Greek word meaning porch. The philosophy consists of advice to individuals for attaining inner peace in a crumbling world. Their philosophy can be stated in one sentence:

Learn to be indifferent to external influences.

The main effect of stoicism was to place responsibility for becoming peaceful directly upon the individual rather than upon society. If an individual can cultivate a frame of mind which makes him/her indifferent to the usual upheavals of the world, then he/she will be peaceful; and nothing that happens can alter his/her essential peace. Stoicism gives plausible advice for living only when one is living under special circumstances like those living in failed states such as Somalia. If one knows beforehand that he may be tortured for military secrets by the enemy in time of war, it makes sense to try to develop an attitude which will enable him withstand the torture.

Many different theories of peace exist in the world of peace and conflict studies, which involve the study of conflict resolution, disarmament and cessation of violence. One such theory that deserved attention in this book is the Democratic Peace Theory. It is true that Kamoet mentions it in brief in chapter two. This is a key concept in this field as it now occupies the thinking of major actors in world peace. The democratic peace theory also known as liberal peace theory is a theory in political science and philosophy which holds that democracies usually, liberal democracies never or almost never go to war with one another. The democratic peace theory is a relatively new development. This theory has its roots in the works of Immanuel Kant; mainly *Perpetual Peace* (1795). Kant's theory is that a majority of the people would never

vote to go to war, unless in self defense. Therefore, if all nations were democracies, it would end war, because there would be no aggressors. One explanation for Kant's claim is that democratic governments were scarce before the 19th century. Other writers who have been credited with the history of democratic peace include Dean Babst (1972) and Melvin Small and David Singer (1976). The latter two, wrote a paper from the findings they made from a research they carried out that they found an absence of wars between democratic states with "marginal exceptions." There have been numerous further studies in the field since these pioneering works. Most studies have found some form of democratic peace exists. According to Billy Clinton (1998), the best strategy to ensure security and build a durable peace is to support the advance of democracy elsewhere since democracies do not attack each other.

The above two issues notwithstanding, the book is well written and covers a fairly wide range of knowledge in the said issues. Illustrations given are meaningful and relevant. This book can be taken as a well organized guide to those with limited knowledge in the area of PACS. It is beneficial to students and researchers in the area of peace and conflict studies.

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Alberto Monti, Howard C. Kunreuther & Erwann O. Michel-Kerjan, Patrick Lagadec & Xavier Gulhou, Policy Issues in Insurance: Financial Management of Large-Scale Catastrophes, OECD Publications, 2008; 311pp.

The book is a publication of Organization for Economic Co-operation and Development (OECD). The OECD is a unique forum where the governments of thirty democracies work together to address the economic, social and environmental challenges of globalization. The member countries are: Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Korea, Luxemburg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, the Slovak Republic, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. The Commission of the European Communities also takes part in the work of the OECD.

In the recent years, there has been growing impact of major disasters on OECD and non-member economies. This has led to a demand for in-depth evaluation of possible strategies to reduce their large-scale damaging effects. It necessitated the OECD to establish International Network guided and led by High-Levelled Advisory Board aimed at addressing these problems and developing sound policies to tackle the problems. The book, therefore, supports the ongoing activities of the Network. It contains three parts written by different authors.

Part I, on Policy Approaches to the Financial Management of Large-Scale Disasters, 9-142pp, is written by Professor Alberto Monti. Monti is a Professor of Comparative Law at Bocconi University, Milani, Italy. Globally, it has been realized that the economic and financial impact of natural catastrophes and human-made disasters of both accidental and intentional nature has been on the increase over the past decades, the trend tending to higher degrees of vulnerability and exposure, leading to larger losses. The OECD Governments and non-member economies have therefore taken different policy approaches in order to manage the increasing financial burden of catastrophes leading to rapid change of situation in many countries. The book therefore aims at stock taking of different policy strategies and institutional approaches to the financial management of large-scale disasters in some selected OECD and non-member countries.

Chapter one of this part presents a comparative review. The author guides through a comparison of different policy and institutional approaches to the financial management of large-scale catastrophes, explaining the importance of coordination between public and private sectors in relation to areas of prevention, mitigation and financial compensation of disaster losses. He says that the comparison revolves around the various approaches of managing catastrophes costs after they have happened. His explanation focuses on the important aspects like the respective roles of public and private sectors, the types of perils and losses covered, and the pricing mechanisms.

Chapter two outlines survey of country approaches. The author aims at taking stock of the current institutional approaches to the financial management of large-scale catastrophes in selected OECD and non-member countries. He presents an elaboration of data provided by several countries that gave a response to the questionnaire survey of OECD.

Part II, on Reducing the Impact of Natural Disasters: The Insurance and Mitigation Challenge, 143-214pp, is written by Howard C. Kunreuther and Erwann O. Michel-Kerjan. Kunreuther is a member of the OECD High Level Advisory Board on Financial Management of Large-Scale Catastrophes. Michel-Kerjan is the elected chairman of the Board established in 2006 by OECD Secretary General, Angel Gurría. They are both lecturers and researchers at Wharton Business School, Center for Risk Management and Decision Making Processes, Philadelphia, PA, USA. The part revolves around the new scale of destruction from natural disasters witnessed in recent years, its impact on disaster insurance and the challenges and opportunities for utilizing mitigation measures to reduce future losses. It discusses the role of cost-benefit analysis in evaluating the effectiveness of mitigation measures and characterizes why people do not always voluntarily invest in their cost-effectiveness. It concludes by proposing the development of a new insurance product: the use of long-term insurance contracts for encouraging the adoption of measures that have the potential to reduce economic and human losses from large-scale disasters.

Chapter one presents a new era of large-scale natural disasters. The authors discuss the evolution of insured losses from natural disasters over the past decade, the relationship between insured losses and total economic losses as well as the causes of this increase in damage. They explain this by attempting to find out the key drivers of the sharp increase in both economic and insured catastrophe losses over the past 20 years. They also attempt to find out how development in hazard-prone areas and climate change have affected recent damages from hurricanes and flooding, looking at the prognosis for the future.

Chapter two discusses the role of cost-benefit analysis in evaluating mitigation measures for natural disasters. The authors attempt to analyze the different types of mitigation measures that can reduce the physical damage from hurricanes, flood, and earthquake and the costs of these measures. They also discuss the current operation of several insurance programs for providing coverage against natural hazards in the United States and other countries like France, Great Britain and Japan.

Chapter three discusses risk perception and choice in home-owners adoption of mitigation measures: the need for long-term contracts. The authors give a guide on how risk perception affects people and firms in their decisions as to whether or not to invest in protective measures. They also discuss the importance of social norms and interdependencies on their decision processes. They propose that given the reluctance of individuals to invest in cost-effective mitigation voluntarily, there is a need to develop innovative strategies that involve public-private sector partnerships. They explain that well-enforced building codes coupled with long-term insurance contracts and mitigation loans are important in this regard.

Part III, on Coping with Non-Conventional Crises: Strategic Leadership in a chaotic World, 215-311pp, is written by Patrick Lagadec and Xavier Guilhou. Lagadec is the Director of Research, Ecole Polytechnique, Paris and a member of Academic Technologies in France. Guilhou is Counselor of Commerce External in Paris, France. It consists of an analysis of specific operational strategies and programmes for the prevention and management of non-conventional crises, and provides useful guidance for policy action for an improved management of risks. It aims at clarifying the general terrain on which the major crisis issues of today need to be considered and managed, to identify some strategic points of reference, and to suggest the dynamics that must be engaged to consolidate the capacities of our decision-making systems. It addresses the question of crisis management today, covering both its familiar, consensual, and validated areas and those areas of knowledge and know-how that are much more uncertain.

Chapter one of this part guides through issues on the new world of risks and crises. The authors narrate the happenings of the break between the end of the 20th Century and the beginning of the 21st Century, how the period has been violent and disconcerting. They explain that the world used to be relatively stable before this period. They further say that the world certainly, could and did undergo serious breakdowns and crises: but those were charted, localized, manageable, and repairable within established frameworks. The authors in their discussion are quick to point out that the world is now in the grip of events which lie beyond normal categorizations. They further explain that the human race is now in the world that is losing its bearings, its balancing mechanisms, and its internal borders. They say it is because humankind is moving from the accidental – specific breakdowns within generally stable terrains – to the chaotic: a landscape that is

profoundly and permanently de-structured, a matrix of security problems responding to laws that cannot be understood. They further explain that crisis in the world has become the central operating mode, and which is generated by events, processes, and combinations that are increasingly off the scale. They also point out the two essential types of difficulties that come together to produce today's crises. First, shocks no longer fit their customary frames of reference: the difficulties that are being witnessed today in terms of scale, complexity, and speed "burst the seams" of our understanding and our vision. Second, the shocks are arising against a backdrop of contexts and moorings that are also shifting with increasing speed, which only compounds our loss of bearings, management capacity, and the collapse of confidence. They conclude by explaining that there can be "technical" solution, however sophisticated, to these emerging crises; and that issues must first be assessed and then appropriate responses be invented.

Chapter two deals with operational responses: between knowledge and invention. The authors narrate how in the face of a threatening crisis, the intellectual and managerial ability in people calls for preparation of plans. They further say that the plans set out actions and approaches that will be applied at each stage of the crisis. They define the plans as fine structures that involve a whole array of response, in the style of a victory parade where everyone marches in step to an impeccable choreography. They regret that it is unfortunate, reality rarely fits the plan's assumptions: warning signals are not recognized, managers disappear from the scene, and tools do not work. Further, they say the crisis unfolds on a battlefield fraught with difficulties, and not on a tidy avenue or square prepared for an orderly parade. As the experts point out, what matters is not so much the plan as the planning, a case that should be heeded so that failure does not arise. Their discussion in this chapter also points out the fact that the present grand systems sorely lack in elementary crisis or emergency culture, and the capacity to deal with unconventional crisis that demand reinvented responses.

Chapter three is a guide through strategic initiatives. The authors give an understanding of the issues and a clear grasp of the cardinal rules of management that are indispensable, but are not sufficient. They are quick to point out two kinds of obstacles that must be overcome in these turbulent fields, where paralysis is so common, are cultural and managerial blocks. They conclude by proposing that some strategic impetus should be given to the systems, not only to overcome the blocks but to put humankind in a position to be more creative, open and innovative. The systems will then be able to cope with the challenges of present time, not through blind groping, but through intelligent, positive and determined action.

Despite the authors having outlined clearly the large-scale catastrophic effects and the insurance aspect in OECD countries and some non-member economies, there were certain underlying weaknesses. The data collected in the questionnaire survey of OECD may not lead to fully accurate information since it is not representative of all the countries noting that many countries are affected differently as a result of large-scale catastrophes. There is need to improve on the data collection with a participatory approach of all the countries in order to gain useful and accurate information.

The financial compensation of the OECD countries in terms of large-scale disasters and losses is not clear. The element of favouritism to some countries may arise even in the future. This should be taken into consideration so that all the OECD nations are treated equitably in terms of prevention, mitigation and financial compensation so that the OECD is able to effectively manage the large-scale disasters currently and in the future. It is also known by OECD nations that private insurance in emerging economies is still underdeveloped and the insurance cost is too high. Strategies should be developed to make insurance cost affordable in such countries.

The natural and human-made catastrophes are on the increase, as discussed by the authors. They do not give solutions on how such cases should be reduced and handled in the future as they keep on increasing. Proper and accurate measures should be put in place to take care of the increasing catastrophes in the future on the international scene and in each and every OECD nation.

Apart from the OECD countries, there are many countries internationally that face large-scale catastrophes. They suffer great losses when large-scale catastrophes occur because they have not planned and put in place the kind of institutional and policy arrangements undertaken by the OECD nations. This may as well have an indirect impact to the OECD countries. The OECD should leave room for those world countries willing to join the organization to do so freely with no restrictions.

In several countries, there seems to be a lack of awareness and education regarding catastrophic risks which also applies to local government and public sector in general. The authors do not give the way forward to this. There is need to prepare and be ready for natural disasters and large-scale catastrophes.

All nations should be prepared financially in this area so that they are educated and enlightened for great improvement when it comes to catastrophic risks in order to minimize catastrophes and losses.

Leaders and their teams need to be prepared in these turbulent times, where we encounter non-conventional situations, typified by systematic breakdowns and resonance phenomena, so that they can be able to manage disasters. The turbulent times call for powerful and coherent mobilization, strategic options, and for innovative fundamental stances that cannot be improvised.

To date most insurance programs have focused on the financial component following a disaster, not on encouraging adoption of loss reduction measures in advance of the event. Countries should be educated and made aware of this so that they are ready at all times. For programs which combine both elements, like the US National Flood Insurance Program, policy makers are faced with the challenge of assuring that the required mitigation measures are really in place prior to the next disaster. Short-term considerations may lead political representatives not to enforce these measures because each politician comes with different agendas. The potential losses from natural disasters are likely to increase in the future unless there is a change in the political will.

The book is an addition of knowledge in the disciplines of disaster management, insurance and humanitarian assistance. The authors are commendable for their rich and great work in the areas of different institutional approaches to the financial management of large-scale catastrophes, the role of risk mitigation and insurance in reducing the impact of natural disasters, and the importance of strategic leadership in the management of non-conventional crises. It is an ideal book for students pursuing studies from undergraduate to postgraduate levels in the disciplines of disaster management, insurance and humanitarian assistance; as well as for scholars and researchers in the same fields.

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