

**THE IMPACT OF HUMAN ACTIVITIES ON THE LAKE ECOSYSTEM: A CASE
STUDY OF LAKE VICTORIA SHORE, NYANDO DIVISION,
KISUMU DISTRICT-KENYA**

BY

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DECLARATION

I **Natukunda A. Munialo**, declare that this work is my own research and it has never been submitted to any University or institutions of higher learning for any award of a degree.

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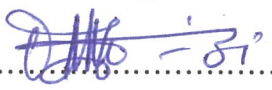
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APPROVAL

I hereby certify that this work has been done under my supervision and approved for submission to the Department of biological and environmental sciences of Kampala International University.

SUPERVISOR: **Mr. Musinguzi Danson**

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Date: 10/08/2012

DEDICATION

This piece of work is heartily dedicated to my beloved parents Mr. David Mukasa and Mrs. Miriah Munialo, brothers Josh, Amos, Paul and Timothy, special friends Shem, Rose, Caroh, Collinse, Liz and Bonnie.

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I dearly extend my sincere thanks to my entire family, my beloved parents Mr. David Mukasa and Mrs. Miriah Munialo for the moral and financial assistance extended to me during my studies.

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Finally and most importantly, the Almighty God who has given me life and the strength to compile this research report.

May the almighty God bless them all.

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ABBREVIATIONS

BMUs	Beach Management Units
EAC	East African Community
LVDP	Lake Victoria Development Programme
LVEMP	Lake Victoria Environmental Programme
NGOs	Non-governmental Organizations
WHO	World health organization

DEFINITION OF KEY CONCEPTS

Lake Basin

- Lake Basin is shoreline of a particular lake.

Catchments

- This is as a small reservoir that delays the flow of water downstream

ABSTRACT

The study was to investigate how human activities along Lake Victoria shores in Nyando division, have led to resources degradation, and to come up with solutions to reduce such effects on the lake ecosystem. The main objective was to determine the effects of human activities on the people and the aquatic environment along Lake Victoria shores in Nyando division-Kisumu Kenya. The methods used for data collection involved both qualitative and quantitative techniques. Questionnaires alongside face to face interviews were the tools used.

Findings indicated that human activities to were largely responsible for aquatic/ lake degradation. Circumstances of water pollution, wetland reclamation, and waste disposal into the water, uncontrolled fishing and increased construction debris disposal into the lake were as a result of human activities. The researcher noted that what used to be the native mangrove vegetation and wetland/lake shore bogs have been severely cleared for settlement and establishment of business centres. Lake Shore ecosystem. However, the knowledge of awareness amongst the local population in Nyando division regarding the lake degradation was low, with about 20% of the population completely un aware of any changes in the water ecosystem.

The researcher's fear was that most degradation noticed on the lake and aquatic ecosystem was anthropogenically induced and the population and demand for resources continue to increase given the increasing human population. Recommendations include: - the government must therefore continue to invest heavily in providing logistical support in order to provide residents of Nyando with the much needed funds and training on how to conserve Lake Victoria shores/resources and other lakes in Kenya irrespective of their region of origin, income status, gender, religion and nay other disparities. Kenya Government must invest in people by expanding access to funds, the neediest and providing for working poor, those unable to work and special vulnerable and targeting marginalized groups.

CHAPTER ONE

INTRODUCTION

1.1 Background to the study

Lake Victoria is the second largest fresh water lake in the world to as the fruit and it is endowed with enormous fresh water, fishery resources. It has a total surface area of 68,870Km². The lake water is shared by Kenya, Tanzania, and Uganda. Lake Victoria and its basin are endowed with a variety of natural resources that are of local, regional and global benefits. It is the largest inland water sanctuary and a source of drinking, industrial and irrigation water for Uganda, Sudan, Egypt, Kenya and Tanzania and it is the source of great river Nile. However, benefits have for a long time been threatened by environmental degradation due to human activities as manifested by reduced fish stocks and decline in biodiversity stocks.

In Kenya, Lake Victoria shore lies in Nyando division Kisumu district, Nyanza province. The main tributaries from inland are; river Sio, Nzoia, Yala, Nyando and Sondu Mirice. The threats facing the lake include eutrophication, over exploitation of fisheries, introduction of exotic species of fish and climate change. The population in the catchment is growing rapidly with the lake itself attracting people because of the economic opportunities it offers and the evenly expanding Kisumu town at the edge of the lake shores. The Lake shores area covers 193,000 km² with Tanzania occupying 44 per cent, Kenya 22 per cent, Uganda 16 per cent, Burundi 7 per cent and Rwanda 11 per cent. The size of the lake makes it a critical determinant of weather and climate in the region. The Lake Victoria shores is endowed with a wealth of natural resources, these include; people, land (abundant and fertile), forest resources, minerals, fish (particularly Nile Perch), wildlife (floral and fauna), rivers and streams and wetlands. Lake Victoria's importance to the region and globally is related to the following: it is the largest inland water fishing sanctuary, and a major inland water transport linkage for the three East Africa countries; it is a source of

water for domestic, industrial and commercial purposes and a major reservoir for hydroelectric power generation; it is a major climate modulator in the region, also rich in biodiversity; and it is a major source of livelihood to people in and around the Lake Victoria Shores.

In densely settled regions of Europe only a small fraction of the total shoreline is in a more or less natural state. Together with the input of gaseous pollutants (Howells 1990; Norton et al. 1990; Patrick et al. 1996; Schindler 1999; Roelofs 2002), urban waste water and nutrient loaded seepage from farm land (Uunk 1991; FAO 1993, Ongley 1996) an array of hydrological and morphological modifications have disrupted the eco-logical integrity of lakeshores. Generally, the 'natural state' of a lake shore section can be defined as a "state in the present or in the past, corresponding to very low human pressure, without the effects of major industrialisation, urbanization and intensification of agriculture, and with only very minor modification of physico-chemistry, hydromorphology and biology." (CIS WG2.3 2003). In central Europe such conditions presumably prevailed during the first half of the 19th century. Today, direct human pressures on the lakeshore zone and more indirect pressures coming from the catchments give rise to impacts on the biota on both sides of the shoreline (Table III). Up until now, the eutrophication of the littoral zone has been the focus of lakeshore quality assessment and water protection and management (see Examples from Lake Constance, Eutrophication chapter). Table III demonstrates, however, that there are many other impacts, mainly due to hydrological modification in the catchments or at the outflow of the lake, or morphological impacts in the lakeshore zone itself. This tentative overview of the effects of human activities on the lakeshore ecosystem provides some insight into the 'driving forces', that is the pathways and mechanisms that finally give rise to a deterioration of lakeshore habitats, biota and ecosystem function:- Lakeshore ecosystems are influenced not only by direct

pressures (i.e. pressures within the lakeshore zone, as defined above) but also by remote pressures from elsewhere in the catchment area of the lake or even outside the catchment.

1.2 Statement of the problem

The continuous encroachment and degradation of forests on the edge of lake Victoria shores in Kenya, Nyando division Kisumu District, and the related human activities such as over fishing, sand mining, urbanization, transport, settlement, among others along the shores or even on the river tributaries/banks and catchment areas around Kisumu shores have resulted into vegetation cover and soil, siltation of the water shores and water contamination/pollution. This has changed the ecological, social and economic functioning of the lake shore ecosystem. It has also caused the degradation negative impacts on the community livelihoods. Example there is noted disappearance of flora and fauna living along the Nyando shores due to human activities like agricultural productivity and construction. Urban activities such as manufacturing processes, food industries, restaurants, trading/markets produce a lot of wastes that end in the water and provide nutrients for growth of weeds and water Eutrophication effects. The researcher intended to document data on how changes in land use by man impact on aquatic resources and avail the necessary information to planners and decision makers in order to come up with suitable measures of protecting the resources therein.

1.3 Objectives of the study

General objective:- The study intended to examine how human activities along lake Victoria shores in Nyando division, have led to resources degradation, and to come up with solutions to reduce such effects on the lake ecosystem.

Specific Objectives

- i. To identify the human activities carried out along Lake Victoria shores, Nyando division

- ii. To determine the effects of such activities on the people and the aquatic resources/environment
- iii. To determine the strategies that has been put in place to control the effects human activities carried out on Lake Victoria
- iv. To find out peoples attitudes towards the management strategies that are in place to conserve the resources on Lake Victoria shores in Kisumu

1.4 Research questions

- i. What are the human activities along Lake Victoria shores, Nyando division?
- ii. What are the effects of such activities on the people and the aquatic environment?
- iii. What are the strategies that have been put in place to control the effects human activities carried out on Lake Victoria?
- iv. What are the people's attitudes towards the strategies/measures that have been put in place to conserve the resources on Lake Victoria shores in Kisumu?

1.5 Scope of the study

The study to asses the impacts of human activities on the Lake ecosystem was conducted in Nyando division, Kisumu province western Kenya. The area is located on the shore of Lake Victoria about 347 km from Nairobi city. The research was carried out between the months of May to June 2012. The researcher identified various human interactions/activities taking place along Nyando shores on Lake Victoria, and assessed how these activities were responsible for the deteriorating environmental conditions and declining resource potentials in the lake habitats. The study used both humans and non-human factors to bring out vivid observations, assessment of the conditions and necessary data.

1.6 Significant of the study

The study will benefit the following disciplines;

Provide concrete information to the ministry of Environment and national resources in that it will use the findings to design appropriate Environmental campaigns and approaches in combating lake shore degradation District and the country at large.

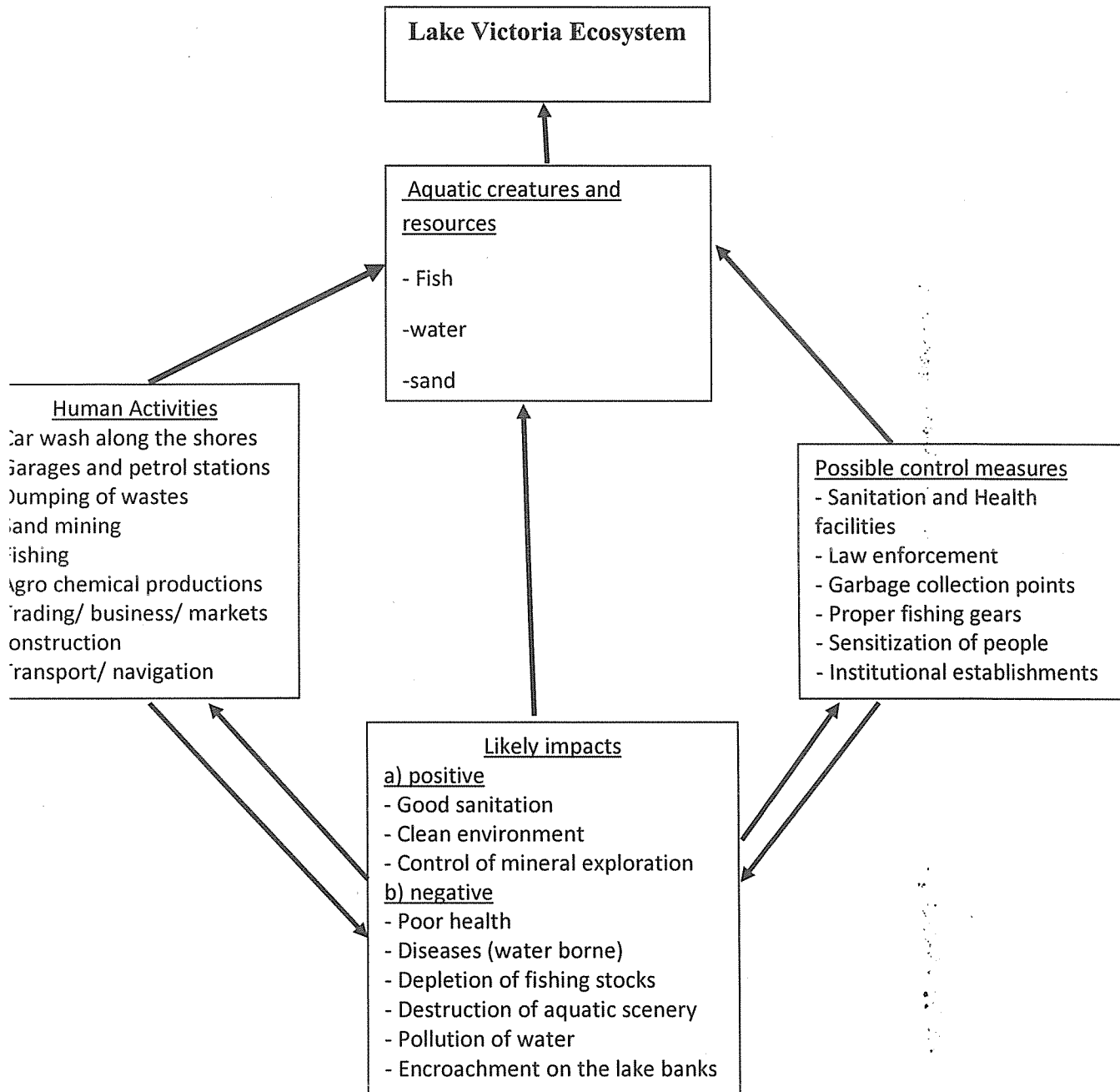
The findings will assist the researcher to know more about the effects of human activities on Lake Victoria shores.

Increase awareness of parents and the society the need to have a drug free community where teenagers and youths can live in peace without having severe effects from abuse of drugs.

Lastly, it's expected to form basis for future research on related studies in and around the same area which is currently exhausted.

1.7 Conceptual framework

Fig.1

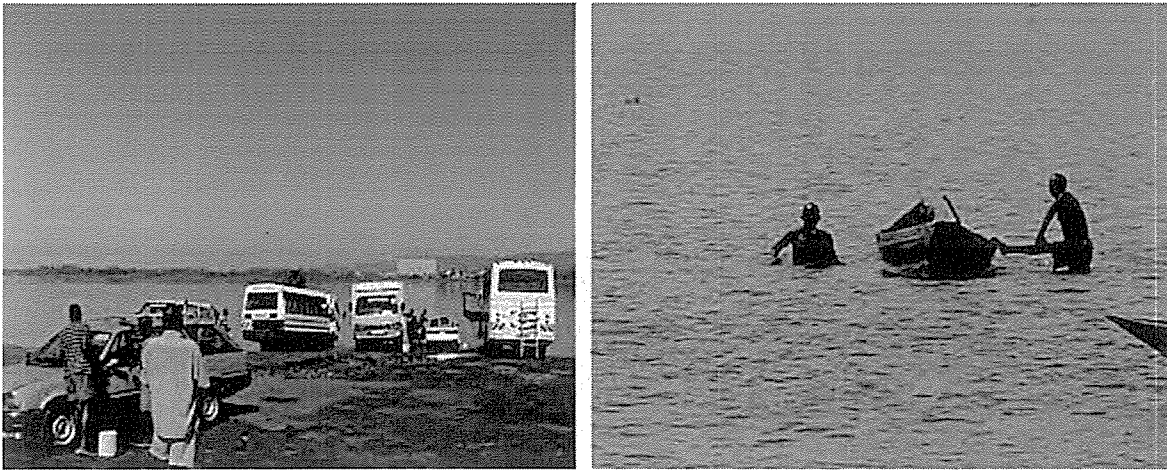


CHAPTER TWO

LITERATURE REVIEW

2.1 Human activities carried out around Lake Victoria shores

Water Pollution and Water Quality. Freshwater is vital for good health and basic survival. It is not only important for food and energy production, but is essential to meet the basic needs of hygiene. Generally, unsanitary conditions are closely associated with scarcity of clean and potable water. It is estimated that only about 20% of Kenyan rural population has access to safe water, but for both Nyanza and Western provinces it is only 8% (LBDA 2004). The lake is the final destination of factory effluent, oil and grease and raw sewage from the urban centres, and oil spillage from transportation is considered quite significant. Important pollution components of the lake include eutrophication, microbiological pollutants, chemical pollutants, and suspended solids, which result from direct activities on the lake, untreated municipal sewage, agricultural waste brought in by inflowing rivers, maritime transport waste, and runoff and storm waters inflow. The main waterborne diseases in the Lake Victoria region, which are influenced by scarcity of clean water, include cholera, typhoid, dysentery, and certain intestinal parasites. Faecal contamination of water also leads to bilharzia, the main water-contact disease in the Lake Victoria region. Increased human contact and exposure to the lake water in the cities and the fishing villages occurs through fish landing, trading, transport, recreational swimming, bathing, collecting water and washing household effects in the lake (see plate 1 A and B). Conditions at beach landing sites are unsanitary, and there is widespread faecal bacteria contamination and pesticide residues in fish, water and sediments. Economic and cultural values have in the past dictated poor faecal waste disposal mechanisms, with inadequate toilet facilities. In Kenya, intense water-contact activities such as car washing and sand harvesting have also increased around populated lakeshore towns, such as Kisumu town.



Source: UNDP – 2009 Rport on lake basins

Plates 1: A

B

The lake has also been subjected to increase microbiological and heavy metal pollution, reduction in diversity of fish species, reduced levels of oxygen, increased salt loading, and emergence of water hyacinth, all of which eventually impact on the increased incidence of diseases and general health of the people. Majority of factories in Kenya operate a treatment plant but wastewater treatment facilities are generally absent in Tanzania and Uganda. However, even in Kenya where treatment facilities exist, their efficiency should probably be subject to rigorous scrutiny. Increasing human population has created the need for greater quantities of agricultural products. This has led to the changing methods of farming from small-scale labour intensive, to mechanized farming that requires a high input of agricultural herbicides and pesticides. There is thus an increase in inflow of agricultural chemical residues, and heavy metal pollution from mining activities. Since the 1960s, phosphorus and nitrogen nutrient inflow has given rise to a five-fold increase in algae growth, being dominated by the potentially toxic blue-green variety, and causing de-oxygenation and threatening the survival of deep water fish species. Preliminary findings of the Water Quality and Ecosystem Management Component of the Lake Victoria Environmental Management Project (LVEMP) –

Tanzania indicate that near-shore areas along Mwanza and Bukoba and Musona towns show high BOD concentrations and faecal coliform counts, with poor sanitary conditions along the shoreline settlements presenting a local public health issue (Ministry of Water and Livestock Development/LVEMP 2004).

Minerals and Mining:- Lake Victoria shores is well endowed with rich mineral deposits of gold and diamonds. Both large and small-scale mining activities are carried out. Mining is more common in Geita, Kahama, Biharamulo, Karagwe, Musoma; Tarime, Bunda and Misungwi districts. Deforestation and wanton land degradation is rampant in the mining areas. Small-scale mining of gold requires the use of a huge amount of logs, which are used to strengthen the ditches to avoid collapsing. Some of the ditches are as deep as 50m or more. In addition to the logs, the concentrated, large population in the mining sites increases the demand for wood for domestic use. Fire wood collection and charcoal making are supplementary activities that are conducted in the mining area in districts like Geita, Kahama, Tarime and Biharamulo. Charcoal making and tree felling for building purposes are very evident along the major routes linking mining sites to nearby major towns. Mining activities are not only associated with deforestation but also with destruction of the soil surface, by leaving open pits in the ground and covering the top soil with gravel and sub soils. In some areas the land is abandoned after the mining activities without any attempted rehabilitation of the land.

Mining is also associated with population changes due to influx of migrants from various parts of the country, and health hazards threaten especially in the mining camps (Yanda et al., 2001). Land degradation is experienced around mining sites, and the mining activities have led to water pollution in the lake basin. In areas such as Geita and Musoma in Lake Victoria shores, where small scale gold mining is taking place, there are risks of ground water and

surface water contamination with mercury which is extensively used in the recovery of gold.

Fishing:- Fish Lake Victoria is rich in biodiversity of which fisheries is a major resource for the riparian communities and for export (Okeyo-Owuor, 1999). Lake Victoria is among the African Great lakes that are considered to be dynamically fragile ecosystems. During the last two decades the lake has encountered numerous problems and extensive resource exploitation, which has constrained its productivity resulting in the drastic decline of biodiversity in general and fisheries in particular. Among the factors that have led to the destruction of the native and endemic components of the lake include the following: intensive nonselective fishing, extreme change in the drainage basin vegetation, pollution due to industrialization and agricultural development and the introduction and invasion of exotic species. Despite the utilisation and pollution pressures experienced, Lake Victoria basin is still well endowed with fish resources; hence, it remains a major economic asset to both large and small-scale fishers and the regional economy in general. Processing of fish for the market has environmental implications especially with respect to the use of wood fuel for fish smoking as a way of preservation. This process requires a lot of wood. The implication of this high wood demand for fish preservation/processing is deforestation along the lakeshores and beyond (Yanda et al., 2001).

Wildlife:- Wildlife Resource is abundant in the Lake Victoria shores. The southern side of the basin has several national parks and game reserves, namely; Rumanyika Game Reserve in Kagera region, Biharamulo (1,300 km²) and Burigi Game Reserves (2,200 km²) in Kagera, Rubondo National Park (460 km²) in Mwanza, Serengeti National Park in Tanzania and Maasai Mara on the Kenyan side, Maswa Game Reserve (220 km²) in Shinyanga, Saanane Island Game Reserve (50 km²) in Mwanza region and Ibanda Game Reserve in

Rwanda. These resources are widely used for tourism and as a source of livelihood particularly for game meat which makes up a significant proportion of nutritional requirements for those living around wildlife areas.

Exploitation of the Lake's resources:- There is a heavy reliance upon the lake for food and water supply in Kenya, Uganda and Tanzania. Changes in population distribution, density and growth rate has had a direct relationship with overexploitation of the lake's natural resources, with unsustainable utilization of the wetlands. The fisheries industry is a major economic driving force in the areas immediately bordering the lake, and is becoming increasingly commercialized. A drawback of the development of commercial fishing industry in the Lake Victoria basin has been the growth of large commercial operations of fish for export market. This has taken over the primary economic and nutritional resource of fish, originally controlled by small-scale fishers who processed the fish for local consumption. With the development of commercial fishing, local fishermen sell almost all their fish catch for export and this leaves the local populations with a high demand for fish, and only able to buy the carcasses from fish processing plants after filleting.

Local villagers also traditionally met their dietary requirements by depending on the small fish in the lake. With their depletion, malnutrition consequences such as Kwashiorkor are often evident in children in lake communities. The introduction of the Nile Perch and the Nile Tilapia, and the use of unsustainable fishing practices such as the introduction of gill nets have altered the species composition of the fauna and flora of the lake. This has led to the loss of locally favoured fish species, known for their medicinal and cultural values. Many of the small fish originally found in plenty were specially adapted to eat algae and decaying plant material in the lake (Beadle 1974). Some species had also evolved to feed on the vector snails of schistosomiasis (Kaufman 1992). There are other major economic activities that exploit the

lakes natural resources along the beaches in the fishing villages in Kenya besides fishery. Harvesting of sand and papyrus for building and basketry, and catfish fingerlings (locally known as Nyapus in Kenya) for use as bait in long line fishing, especially Nile Perch fishing are common activities. Harvesting of catfish fingerlings has its downside as the harvesters wade into the water to get the fingerlings, directly exposing them to schistosomiasis and snake bites (WIFIP 2004).

Exploitation of mining resources is another area of health concern in the Lake Victoria basin. The region is endowed with a variety of minerals, metallic and non-metallic ore deposits such as gold, limestone, copper, iron, silver, rare earths, soapstone, quartz sand, chromium and lead. Uncoordinated and haphazard prospecting for these minerals occurs, and frequently leads to uneconomical and dangerous exploitation practices and accidents. Small-scale gold mining is increasing, especially in Tanzania, leading to some contamination with mercury. There have been a number of studies measuring mercury (Hg) concentrations in the lake water, fish, sediments, soil, and humans (Campbell and others 2003). These studies have reported total Hg concentrations in fish to be below those permissible by WHO standards and international marketing limits. However, concentrations in Nile perch between 3-10 kg, and especially over 10 kg were above WHO threshold concentrations for at-risk groups. Sediments and soil total mercury concentrations were within international guidelines. The concentrations in urine and hair from human volunteers indicated that while gold miners and frequent skin-bleaching cream users were at risk of inorganic mercury poisoning, the rest of the population, including fishermen, was not. Some traces of heavy metals such as chromium and lead have been found in the lake, but the problem is not major. In Mwanza gulf, Tanzania, Cu, Hg, Pb, Cd, Cr and Zn were found in sediments, but not in dangerous concentrations (Kishe and Machiwa 2001). So far also, agrochemical residues have not been detected in concentrations that would cause health

concerns. The presence of unacceptable concentrations of Hg in large fish, however, underline the need for regular monitoring and risk assessments to be carried out in the Lake Victoria catchment, since the same studies showed that fish consumption and soil geophagy constitute major sources of Hg for humans.

2.2 Effects of human activities on Lake Victoria

2.2.1 Water Hyacinth and Algal Blooms

Water Hyacinth (*Eichornia crassipes*) was first reported in Lake Victoria in Ugandan waters in 1988 and later spread to the other two East African countries (LVEMP 2004). The infestation extends to its uppermost point within the Kagera River system to the headwaters of Mukingwa River tributary. Unchecked growth of water hyacinth is associated with a myriad of problems including the destruction of wetlands and waterways, degradation of water quality, preventing of fishing and recreational activities, and from a health point of view, is a haven for snakes, and has been reported to be a suitable habitat for disease vectors such as encephalitis, filariasis, and bilharzias (LVEMP 2004; Rao 1989; Anon. 1992; Raytheon and others 2002). The statistical link between water hyacinth and malaria and bilharzias is not yet well defined, but it has been shown that a type of filariasis in South East Asia is entirely linked to the presence of the aquatic weeds. As water hyacinth blocks beach landing sites and prevents docking of boats, fishermen are forced to wade through it as they try to physically remove the weed and push the boats through the weed. Both activities increase contact with disease and snake infested water, consequently increasing the risk of snake bites and contact diseases such as schistosomiasis. Algal blooms, dominated by the potentially toxic blue green variety have developed on the Lake Victoria, resulting in cause for concern. Blooms of algae deoxygenate deep water, resulting in fish death, fish migration, and reduced yield. They also produce

toxins that cause forms of dermatitis (Ministry of Water and Livestock Development/LVEMP 2004).



Plate 2: Water hyacinth on Lake Victoria

2.3 strategies that has been put in place to control human activities on the source of Lake Victoria

The East African Community holds the key position for policy making for the management of the Lake Victoria basin resources. This is because the Lake Victoria shores are a Transboundary entity and needs a framework, which transcends national boundaries, for joint management as a shared resource. The Lake Victoria Development Programme (LVDP) has been established under the auspices of the East African Community to deal specifically with developmental and management issues of the Lake Victoria basin.

However, the programme includes only the current members of the community and excludes other members of the lake Victoria shores such as Rwanda and Burundi. So far the programme has developed a regional vision for the development of the Lake Victoria shores. The vision, which aims at, “A prosperous population living in a healthy and sustainably managed environment providing equitable opportunities and benefits”, is the result of the three national visions of Kenya, Tanzania and Uganda . During the national vision development process, five policy areas plus a wide array of strategies and change indicators were identified. The policy areas were; Ecosystems, natural

resources and environment, Production and income generation, Living conditions and quality of life, Population and demography, and, Governance, institutions and policies. Within each policy area, a number of strategies were highlighted. For the Policy Area 1, fish resources management, land use and natural resources, water and pollution control and waste management strategies are included. The Policy Area 2 “production and income generation”, includes the promotion of sustainable exploitation of resources potential, strengthening of research and development, and improvement of access to natural resources. Under these strategies, gender issues of access to fisheries and mineral resources are given consideration. Poverty issues and vulnerability of Lake Victoria shores communities are listed as being of strategic importance in the Policy Area 3. Others include water supply and sanitation, health services, education and training and infrastructure. Demographic and social cultural strategies are included in Policy Area 4. These are population growth and migration, cultural change and social behaviour and practices. The last policy area (Policy Area 5) includes strategies on good governance and human rights, harmonization of laws and policies of Lake Victoria shores partner states, institutional framework and devolution, law enforcement and security and gender issues where gender equality and positive gender relations are given prominence.

Sanitation and Health issues:- as noted in the preceding sections, water quality in Lake Victoria has been deteriorating due to increasing pollution from agricultural and industrial activities in the catchment and urban centers along the shoreline of the Lake. Only a small fraction of the population in urban and rural areas has access to treated piped water while a minute fraction has access to untreated bore hole water. A large proportion of the population uses raw water obtained from polluted sources such as rivers. The infectious agents found in raw untreated water are indicated in Table (5.8)⁴. Domestic and industrial waste management still remains a serious environmental problem in

most urban areas. This is due to inadequate financial resources, inadequate disposal vehicles, dumping sites and low participation by individual and private companies in solid waste management. Improvement of water quality around the Lake will contribute to better health for all that rely on it, i.e., the poorer groups. The perils of poor methods of disposal of domestic waste water are many. In Lake Victoria, these have been manifested in the frequent outbreaks of water borne diseases such as typhoid, cholera, dysentery and bilharzia. Others are gastro-enteritis, chemical poisoning, Giardiasis, Shigella, Hepatitis, Salmonella, Typhoid fever and toxigenic E. coli infections. The fraction of households with sewers in large towns is less than 30%. A small fraction of the population relies on pit latrines while a larger fraction does not have toilets, sewer pits or access to sewage treatment facilities. Implementation of joint activities in the lake victoria shores , however, already began before the establishment of the LVDP mainly through the two major projects of LVEMP and LVFO. The LVEMP was established through a Tripartite Agreement signed ten years ago on 5th August 1994 in Dar es Salaam . The LVFO convention's signing followed in 1996. The LVFO also has a vision, which is essentially specific for fisheries matters. The issue of existence of multiple visions in the same basin by various actors was recognised by the LVDP and was accordingly accommodated so as to eliminate any inconsistencies, duplications and overlaps. Furthermore the full participation by all stakeholders in the vision and policy development process was given priority.

This approach provides the opportunity for ownership, success and to a large extent ensures sustainability of the socio-economic and environmental development of the Lake Victoria basin. We evaluated the relative likelihood of success of the policy options using the following criteria: effectiveness, efficiency, equity, political feasibility and implementation capacity. The policy options in the Lake Victoria shores were additionally evaluated within the context of the policies that guide the recently re-established East African

Community (EAC) (45, 46). The Lake Victoria Development Programme (LVDP) has already established and operationalized National Focal Points in the Partner States' ministries responsible for Lake Victoria development. These ministries include the Ministry of Environment and Natural Resources in Kenya, the Ministry of Water and Livestock Development in Tanzania and the Ministry of Foreign Affairs in Uganda. The other achievements are in terms of studies conducted for facilitating the basis for objective decisions on environmental and natural resources management in implementation of the Treaty. The East African Community therefore offers a good prospect for the success of the policies that have been proposed here in that it provides a conducive environment for Kenya, Uganda, and Tanzania to work together towards common goals.

Overexploitation of Fisheries. Quota for fishing. This has a high probability of success in the medium-term (5 years). There should be involvement of stakeholders (fishers in co-management), with change of attitude from government-driven to community-driven management and ownership of the process. The process should be initiated in areas where the environment favors self-regulation and sustainability. A conducive environment for the success of the instruments that need to be put in place (revision of by-laws; scientific basis for decision-making; education and training; financial and technological assistance; etc.) should be created. This measure should be able to control the number of entrants and efforts to a sustainable level at minimum cost.

Quota for processing. This should go along the same lines as the quotas for 20
© Royal Swedish Academy of Sciences 2004. It holds the highest possibility of controlling the amount of fish landed due to restricting the main market. Resistance is expected from both sellers and buyers of fish, but with the dwindling stock of fish and reduced supply, in terms of both quantity and quality, it is expected that awareness creation properly publicized will avoid

this obstacle. Review of the rules and regulations and existing policies. In order for co-management to succeed, an environment that is conducive should be provided. This will include recognition of property rights and entitlements. The review of policies, rules and regulations are already being worked out under EAC. This, however, should be carried out in conjunction with effective enforcement. The policy option will have a high probability of success if well implemented in a participatory manner with stakeholders in the fishing communities along the lake shores, as has already begun under co-management through Beach Management Units (BMUs).

Strengthening monitoring and enforcement of restrictions and rule of law. Monitoring and enforcement of regulations and restrictions puts the risk factor for contraventions high so as to encourage compliance. The effectiveness of this policy is high, especially considering the EAC initiative's political will and intention towards strengthening capacity for the management of Lake Victoria. The move towards co-management should be supported because it involves communities in effective management at a lower cost hence making it possible to achieve the monitoring and enforcement goal.

Providing civic education and awareness, empower and involve more communities in management. The general lack of awareness of both the status of the fishery and the adverse impacts of destructive fishing practices on the fishery may be a contributing factor to the irresponsible behavior. The people's lack of awareness and ignorance of their rights and obligations in bringing about a conducive environment for a sustainable fishery may also undermine their effective participation in the management of their natural resources and fisheries in particular. Empowering the community in both these and other forms of awareness would go a long way towards effective management and consequently sustainable utilization of fisheries resources.

Imposition of size restrictions on fish-processing factories. Fish-processing factories place the highest demand on Nile perch, and prefer small-size fish, which they export to foreign markets. Therefore, by discouraging the purchase of small-size fish, the effect will be to facilitate growth of fish to full size where reproduction will take place to replenish stocks. This policy option is now achievable since most of the owners of the processing plants have realized that the availability of small-size fish for their factories is becoming a problem.

Provision of credit to artisan fishers. Lack of capital to buy the recommended fishing gear hampers compliance by small-scale fishers. Having being dispossessed of their illegal gear, they cannot afford to buy new legal fishing gear. Provision of credit to these fisherfolk will facilitate compliance of restrictions and regulations by enabling them to purchase the required gear, which does not endanger the sustainability of the fishery. With the experience gained by numerous NGOs in credit provision to small-scale entrepreneurs, this policy option has a high probability of success. It has the double advantage of alleviating poverty among the fishing communities while at the same time facilitating sustainable utilization of fisheries resources.

2.4 People's attitudes towards the strategies that has been put in place to conserve Lake Victoria shores

Neely (1989) reported that there are many areas which native people, following their traditional cultures on their environment, protected large areas of essential natural ecosystems and harvested their environment on a sustainable basis which can be acquired by the need for mutual understanding between local people and protected area managers and the authorities. Therefore collaborative Lake Victoria shores management may be appropriate

CHAPTER THREE

METHODOLOGY

3.1 Research Design

According to C.R. Kothari (1990:38) a research design is the arrangement of conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure. The researcher used both qualitative and quantitative research designs. The designs were preferred because it enabled the researcher to collect original data from the population at a limited time and resources. Simple random sampling was used to choose the respondents.

3.2 Location of the study Area

The research was carried out in Nyando Division, Kisumu District, Nyanza province, Kenya. The division is located 347 km from Nairobi city, between latitudes -01° East of Greenwich and longitudes 34.75° of the equator, with a total population of 254,000 where persons are found in Nyando division.

3.3 Climate of the Area

The temperature of Nyando Division like most areas in Nyanza Kenya is considerably with an annual average of range is 29 °C. This location near the lake has determined the nature of economic activities in the division. Its beautiful scenery means the Division was mainly residential with a lot of recreational and hotel activities.

3.4 Study population

The study population included adult's community in Nyando Division and all its 11 parishes and households, fishermen and farmers living in Nyando area.

3.5 Sample size and sampling procedures

The study used a sample size of 100 respondents from Nyando division. The study sample size was calculated using the formulae of (Kish and Leslie, 1965; Morganin, 1997) for single proportions.

$$n = \frac{t^2 \times p \times q}{d^2}$$

Where n = Sample size

d = Precision of the study (a precision of 10% will be used)

t = Standard normal deviation corresponding to 95% confidence interval which is 1.00

P = Prevalence, which is established as 49% (Oketch et al, 2002)

q = 1 - p which is 1 - 49% (i.e. 1 - 0.49 = 0.51)

$$\text{Thus } n = \frac{(1.00)^2 \times 0.49 \times 0.51}{(0.1)^2}$$

$$n = 100.002 = 100$$

The study involved 20 wards/zones of Nyando Division. The respondents of parish proportions were assigned by sampling proportions of the population size.

$$n = \frac{P \times 100}{N}$$

N

Where n = Number of respondents from parish.

P = Parish population

N = Total population of Nyando Division

Respondents in each parish were selected by use of simple random sampling to obtain a total of 100 respondents who involved the key informants such as government officials, NGOs, CBOs and individuals.

3.7 Research Instruments

3.7.1 Use of structured questionnaires

Structured questionnaires were used to interview respondents who were heads of households, business persons and key informants operating in the Division such as in public offices, NGOs, and CBOs. Thus 100 questionnaires will be distributed and filled by respondents.

3.7.2 Use of Structured Interview Guides

The researcher used Structured Interview Guide while dealing with key informants. A number of 10 respondents in this category were selected from the public offices, NGOs and CBOs operating within Nyando Division.

3.7.3 Observation Checklists and Photographing

The researcher made careful observations using her keen eyes about the prevailing situation of polyethylene bags use and disposal in Nyando Division. Thus observation checklists were also used to take records about obvious conditions or situation. Photographs were taken using a digital camera in some instances to complement on this and serve as evidence to the study.

3.8 Data Analysis

This was done after the fieldwork/data collection. When all the questionnaires, interview Guides and observation checklists are collected, quantitative data was be edited, coded and entered in the computer. The data was analysed using Microsoft excel program. Analyses were performed by use of frequencies, tables, charts, percentages of respondents among others. Quantitative and qualitative data was included in the presentation of the results to complement each other and increase the validity as well as increase in data quality control.

3.9 Ethical considerations

Permission to conduct the research study has been sought from the administration of Kampala international University, College of Applied Science and Technology. And endorsed/ accepted by the Nyando Division Urban Council. Respondents were to answer the questionnaires after explanations and consent. Also were assured of confidentiality of their information given.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.0 Introduction

In this chapter an attempt is made to present the findings and discussion.

4.1 Demographics of respondents

4.1.1 Age of respondents

Table 1: Age of respondents

Respondents' Age	Frequency	Percentage (%)
26 yrs and below	15	15
27-35yrs	55	55
36 and above	30	30
Total	100	100

Source: Field study

Then 15% of the respondents were between the age of 26 years and below while 55% were between the age of 27-35 years and 30% of the respondents were of the age bracket of 36 years and above. This shows that very many people within Nyando division are of the age bracket of 27-35 years old.

4.1.2 Sex of respondents

Table 2: Sex of respondents

Sex	Frequency	Percentage (%)
Female	45	45
Male	55	55
Total	100	100

Source: Field study

According to the above table 45% respondents were female, while 50% of the respondents were male and 5% of the respondents did not indicate whether they were male or female and others the responses were not clear. This proves that both male and female were given equal opportunities to participate in the research.

4.1.3 Educational background

Table 3: Educational background

Educational background	Frequency	Percentage (%)
Literate	64	64
Illiterate	36	36
Total	100	100

Source: Field study

In the selected respondents, 64% were literate (educated) and 36% of them were illiterate (not educated). This is an indication that education has got its roots in Nyando division.

4.1.4 Occupation of respondents

Table 4: Occupation of respondents

Occupation	Frequency	Percentage
Farming	62	62
Environmental officers	5	5
Teacher	15	15
Business men	12	12
Total	100	100

Source: Field study

According to the responses given above 62% of the respondents were farmers, 5% environmental officer, 15% teachers and 12% business men. The reason why farmers have a higher percentage is because most of Nyando division resident have land which is very fertile.

4.1.5 Number of people in a house hold

Table 5: Number of people in a house hold

people in per household	Frequency	Percentage
< 5	32	32
5 – 10	46	46
11 >	22	22
Total	100	100

Source: Field study

©

The above table shows that a big number of household s in Nyando division have 5-10 people with 46%, the followed by those with less than 5 people with 32% and lastly those households with more than 11 people with 22%. This is because there people of Nyando division still believe in a having many children.

4.2 The impact of human activities along Lake Victoria shores

Table 6: Types of human activities along Lake Victoria shores

Human activities along Lake Victoria shores practiced along the lake shore	Frequency	Percentage
Fishing	35	35
Farming/agriculture	15	15
Trade and markets/hotels	46	46
manufacturing/industrial productions	4	4
Total	100	100

Source: field study

From the above table it is very evident that trade, markets and hotel are the leading human activities by 46%, followed by fishing which is 35% of the respondents said that the dominant human activity is fishing, 15% said that it is farming and 4% said that it is industrial production. From the above it is evident that lake shore is made of dirt from the market or trade that place along the lake shore of lake Victoria.

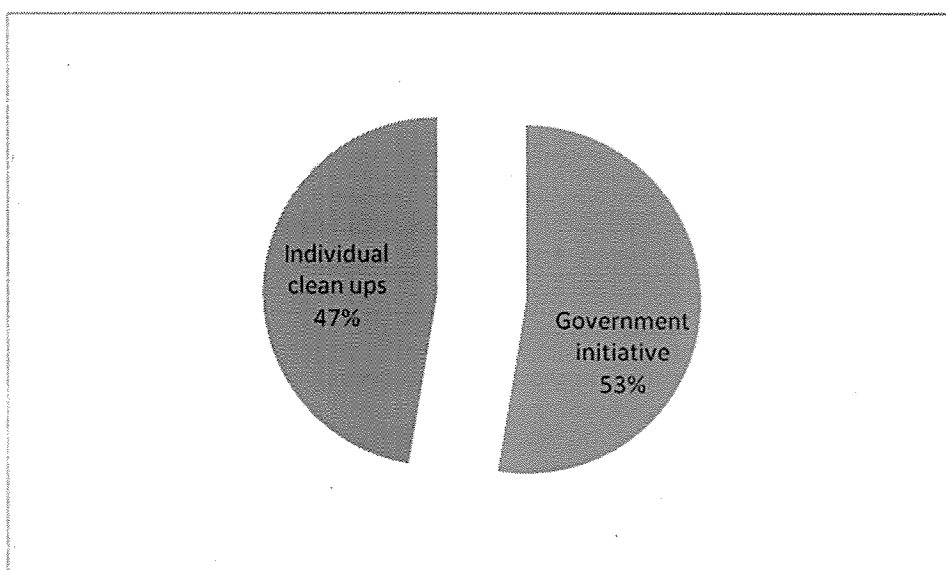
Table 7: Effects of Human activities along Lake Victoria shores

Effects	Frequency	Percentage
Pollution of water and the environment	77	77
Destruction of water as a resource	3	3
No difference	20	20
Total	100	100

Source: field study

According to the table 7 above, the 77% of the respondents believe that there was Pollution of water and the environment on lake Victoria shores, 3% say that the effect of human activities is destruction of water as a resource and 20% seen no difference of human activities on lake Victoria shores.

Fig. 2: Efforts put in place to reduce pollution along Lake Victoria shores



4.3 Effects of human activities on the people and the aquatic environment

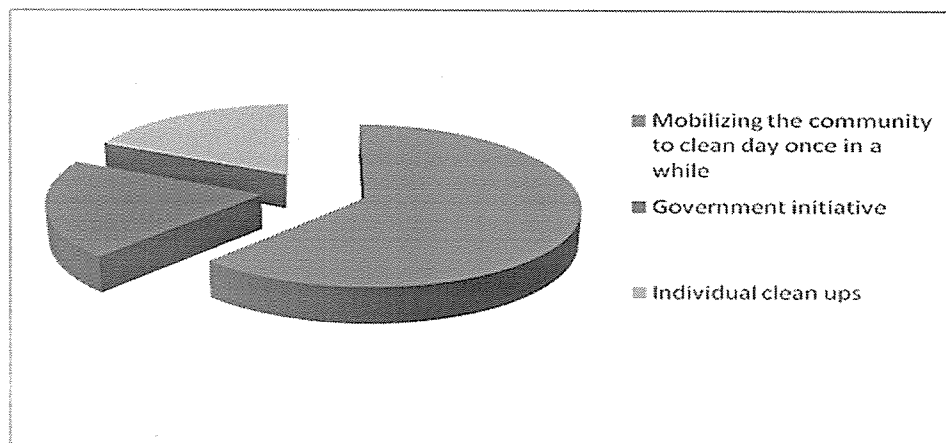
Table 8: Response on the effects of human activities on the people and the aquatic environment

Response	Frequency	Percentage
Spread of water borne diseases	65	65
Poor sanitation along the lake	30	30
Others	5	5
Total	100	100

Source: field study

According to the above table 65% of respondents say that human activities contribute to the spread of water borne diseases , 30% of the respondents say poor sanitation along the lake and others 5% gave their views like poor health, garbage at the lake etc.

Fig.3: The effect human activities on people and the aquatic environment



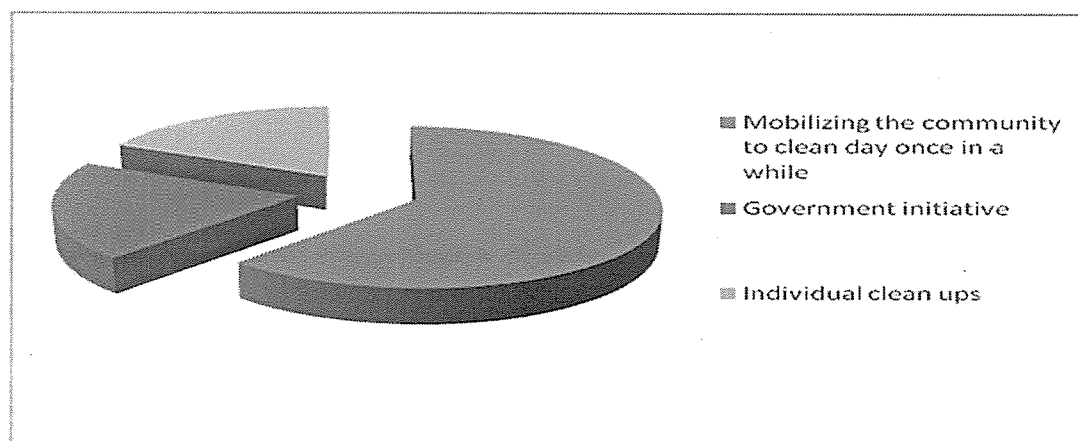
4.4 Strategies that has been put in place to control the effects human activities carried out on the of Lake Victoria

Table 9: Strategy against challenges of human activities carried out on the of Lake Victoria

Strategy against challenges of human activities carried out on the of Lake Victoria	Response	Frequency
Mobilizing the community to clean day once in a while	62	62
Government initiative	20	20
Individual clean ups	18	18
Total	100	100

Source: field study

Fig.4: Measures of challenges of soil and water conservation



According to table 10 and the above chart, 62% of the of the respondents agree that they use mobilization of the community to clean day once in a while, while 20% wait for government initiative to help them come against the challenges of human activities on lake Victoria shores, 18% of the respondents say that they do individual clean ups.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Sanitation on Lake Victoria shores in Kenya is hampered by human activities; human activities in turn are threatening the overall sustainability of the shore and its environment. Poor waste disposal is a major effect of degrading Lake Victoria shore in Kenya. Based on the result of this study, personal factors, socio-economic factors and poverty have contributed greatly in the degradation of Lake Victoria shores.

According to the findings has clearly demonstrated that the Lake Victoria water quality has deteriorated to a point that it is no longer able to support aquatic life in the same quantity and quality of the past 40 years. The major driving force behind water quality deterioration is population increase. Reorganization of the rural villages into self-supporting, well-serviced utilities urban centres will free land for cultivation that can be properly planned and managed. Review of the land tenure system in the catchments is an essential first step to the restoration activities of the lake.

Deforestation, poor agricultural practices, over-stocking and grazing have all contributed to massive soil erosion. Enforcement of laws governing agriculture, forest, land and water conservation will lead to sediment and nutrient load reduction. There is a need to apply a mixture of command and control laws and regulations as well as market forces to effect change. Some market price adjustment for fertilizers and pesticides will introduce their conservative use. The planning of urban and rural centres will lead to the provision of waste treatment plants, potable water, electricity, roads and other utilities. Once utilities are provided there should be sufficient financial resources to ensure

that systems of installed infrastructures are maintained and operational at all times.

5.2 Recommendations

5.2.1 Minimizing human activities degrading the lake shore resources along Nyando

The government must therefore continue to invest heavily in providing logistical support in order to provide residents of Nyando with the much needed funds and training on how to conserve Lake Victoria shores and other lakes in Kenyan irrespective of their region of origin, income status, gender, religion and nay other disparities. It must invest in people by expanding access to funds, the neediest and providing for working poor, those unable to work and special vulnerable and targeting marginalized groups. This would help improve the standards of food generation among the community and the country thus bettering means of livelihood and standards of living.

5.2.2 Land use changes and impacts on the lake ecosystem

Underlying all planning efforts towards improving on the Land use changes and impacts on the lake ecosystem is obvious that such programs must meet locally perceived priorities rather than externally imposed perceptions this means that adequate background data on local needs, preference and other relevant factors must be considered before any detailed lake shore management plan is undertaken in this region. Important decision is to involve individuals in question where solutions would provide a forward way; this is a means of risk aversion in project implementation.

5.2.3 Strategies to combat the lake shore resources degradation in Nyando division

In community-based programmes, the can be used for agenda-setting to stimulate discussions on Strategies to combat the lake shore resources degradation related issues among the community members. The messages should present information in an honest and factual manner, emphasizing short-term negative consequences such as poor health, environmental degradation and erosion, rather than long-term effects.

5.3 Areas for Further Research

The researcher recommends that further research should be done on the topic “Land reclamation and its effect on Lake Shore”.

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APPENDICES

APPENDIX A: QUESTIONNAIRE FOR COMMUNITY RESIDENTS

Dear respondent,

I am **Natukunda A. Munialo**, a student at Kampala International University (Bachelor of Science in Environmental management). This research is on the “effect of human activities on Lake Victoria shores, Nyando division, Kisumu – Kenya”. I humbly request you to cooperate with me by filling this questionnaire. The information that you will give is only to be used for academic purposes and will be treated with maximum confidentiality. Thanks in advance.

INSTRUCTIONS: (Tick in the box or write in the spaces)

Date of interview.....

Site/zone/ward.....

Respondent's number.....

PART 1: DEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS

1. Sex of respondent

Male ☐ female ☐

2. Age of respondent in years

15-25 ☐ 26-35 ☐ 36-45 ☐

46 and above

3. Education of respondent

Primary ☐ Secondary ☐ Tertiary ☐

University ☐

Others,
specify.....

4. Occupation of respondent

Peasant farmer ☐ Commercial farmer ☐ Business person ☐

Others,
specify.....

None ☐

5. Length of habitation in the place (months or years of living in the same place)

.....
.....

6. Marital status of respondent

Single ☐ Married ☐ Divorced ☐

Others, specify.....

7. The tribe of the respondent.....

8. How many people do you live or stay with as relatives or dependants?

Below 5 persons ☐ 5-10 persons ☐

More than 10 persons ☐

9. What is your religious affiliation?

Protestant ☐ Catholic ☐ Islamic ☐

Others, specify.....

PART 2: Activities on lake shores in Nyando division, Kisumu

11. Name the types of activities carried out by the people living around this area under the following categories:-

i) Most common human activities

.....
.....
.....

ii) Moderately practiced activities

.....
.....
.....

iii) Least practiced activities

.....
.....

12. Mention any production/manufacturing industries located in this area

.....
.....
.....

13. In your own view, suggest any advantages and disadvantages that the fishing activities could have on the following:-

i) Advantages on water ecosystem

.....
.....
.....

ii) Disadvantages on water ecosystem

.....
.....
.....

iii) Advantages on the people

.....
.....
.....

iv) disadvantages on the people

.....
.....
.....
.....

14. Beside the dangers imposed on ecosystem, what other effects does industrial production have in the area?

.....
.....
.....

PART 3: Wastes generated from human activities into the environment

15. What is the nature of products and wastes from industries/human activities reach the lake or surrounding areas?

.....

.....

16. What types of wastes are being released by humans into the lake/Nyando wetland or the surrounding places?

.....

.....

17. What impact do these wastes have on lake/wetland ecosystem around Nyando shores?

.....

.....

18. What effects are these industrial wastes on the Namanve wetland ecosystem?

.....

.....

19. How has the settlement of people changed the natural settings/aquatic life around Nyando shore/ wetland Ecosystems?

.....

.....

.....

25. What other environmental effects have human productions caused on the lake Victoria ecosystem along Nyando shores

.....

.....

PART 4: Proposed measures to overcome degradation along Nyando shores on Lake Victoria

20. What are the possible solutions you would suggest to protected any existing lake ecosystem disturbances by human activities?

.....
.....

21. Who do you think is best suited to handle the problems caused by human production/settlement along Nyando shores??

.....
.....

22. Given the state of the lake/wetland ecosystem around Nyando division; do you think the lost value/species/space can still be regained?

.....
.....

THANK YOU

APPENDIX B: INTERVIEW INFORMANT GUIDE (FOR LOCAL LEADERS, CIVIL WORKERS, NGOS, CBOS)

Dear respondent,

I am **Natukunda A. Munialo**, a student at Kampala International University (Bachelor of Science in Environmental management). This research is on the “effect of human activities on Lake Victoria shores, Nyando division, Kisumu – Kenya”. I humbly request you to cooperate with me by filling this questionnaire. The information that you will give is only to be used for academic purposes and will be treated with maximum confidentiality. Thanks in advance.

INSTRUCTIONS: (Tick in the box or write in the spaces)

Date of interview.....

Site/zone/ward.....

Respondent's number.....

Site/zone.....

Title/or office name.....

Responsibility held by respondent.....

QUESTIONS

1. What are the different resources existing in and around the Lake area in Nyando division that can be affected by human settlement and activities?

.....

2. In your own view, suggest any ways you think any industrial setting in this area has affected the natural lake/wetland Ecosystem within Kisumu/Nyando shore.....

3. What are any possible remediation/ mitigations the Government of Kenya has or is trying to put in place to protect the lake shores/wetland ecosystems in its reach?
4. Suggest the potential challenges you face as a worker/staff in this area relating to your health or immediate environment.....
5. Do you think the government of Kenya, NGOs or CBOs has done much to streamline the protection of natural resources such as lakes, wetlands and forests from the increasing industrial establishments by business persons? Give your ideas
6. Do you think the industries in Kisumu such as breweries; restaurants/hotels have the capacity to mitigate the impacts caused by their actions on the environment? Give reason (s) for your suggestions
.....
7. What are the most affected species/resources by the industrial processes or any other human activity in the area?.....
8. What are the possible consequences of industrial processes or human settlement on the future aquatic resources along Lake Victoria (Kisumu Shores?)
- 9 Does your office/position help to conduct environmental impact assessments/training/monitoring of activities such as mining and fishing along the lake shores in Nyando division? Suggest the ways you do it
.....

Thank you for your cooperation