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Effects of urban runoff on local agricultural systems in the coastal areas
of the Lake Victoria

Bachelor Thesis

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Declaration

I declare that I work up this Bachelor thesis by myself after tuitions with Ing.Bc.Tatiana Ivanova, Ph.D. and with using of mentioned literature sources.

I agree to store my thesis in the library of Czech University of Life Sciences Prague and to access it for study purposes.

Prague, 18th of April, 2013

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Abstract

The aim of this study is to give an analyse on the issue of waste management in the coastal areas of Kampala (Uganda) and Kisumu (Kenya), as well as the drivers which cause the environmental degradation of the Lake Victoria in Africa. The thesis demonstrates how both selected areas experience considerable and rapid urbanization which is the key contributor for the lake 's environmental degradation. Poor drainage systems for the waste disposal in these areas do not keep pace with the population growth and due to this fact the agriculture loses its potential. This reflects on the sewerage systems being clogged by the waste, fertile land being damaged, people suffering from water-related diseases and waste run off into the lake which creates an extensive water pollution. All these problems leave to a question what are the possibilities of preserving the Lake Victoria and its habitat. The thesis contains two implemented projects in solid waste management in the coastal areas. Using the SWOT analyses it is obvious that there is an increasing amount of people getting involved in some participatory activities, such as recycling of waste getting more practiced. Therefore illegal methods of the waste disposal, for instance burning, can be mitigated and do not had serious impact on the health of the people living in these polluted areas. There are also international, govermental and non-governmental aid organizations implementing several programs aiming at protecting the lake. And that is why there is a chance to mitigate the water pollution of the Lake Victoria and improve the livelihood and hygienic conditions of the populations in the coastal areas.

Key words

Urban runoff, water pollution, waste generation, sanitation, stakeholders

Abstrakt

Účelem této práce je zvýšit povědomí o environmentálním úpadku afrického jezera Viktoria a jeho příčinách, přičemž hlavní důraz je kladen na management odpadu. Odpad, jeho produkce, zpracování, odvádění je klíčovým faktorem, způsobující rozsáhlé poluce jezera Viktoria. Práce se dále zabývá situací dvou pobřežních měst, Kampala a Kisumu, v afrických státech Uganda a Keňa. Tato bakalářská práce pojednává o tom, jak masivní urbanizace způsobuje alarmující nárůst produkce odpadu, který znečišťuje tato pobřežní města do takové míry, která je nepřijatelná pro udržitelný rozvoj jak těchto měst, tak udržitelnost Viktoriina jezera. Kanalizace v těchto oblastech jsou v chatrném stavu a nadměrná produkce odpadu v pobřežních městech často způsobuje ucpání kanalizací a zaplavení pobřežních oblastí. Kvůli silně znečištěnému jezeru jsou klimatické podmínky nedostačující pro rozvoj místního zemědělství, a proto v některých oblastech lidé trpí podvýživou. Zdroj pitné vody a vody pro zavlažování, pocházející z jezera, je proto silně znečištěn a zhoršuje zdravotní stav obyvatelstva v pobřežních oblastech. Všechny tyto problémy nutí čtenáře k otázce, zda existují možnosti konzervace jezera Viktoria a jeho prostředí. Práce obsahuje dva realizované projekty, které se zabývají odpadovým managementem ve dvou, již zmíněných oblastech. Užitím metody SWOT se dochází k závěru, že situace s odpadem se zlepšuje, díky zvyšujícímu se zájmu a ochoty obyvatelstva ve snaze redukovat okolní znečištění. Za účelem zmírnění poluce měst i jezera, mezinárodní, vládní a nevládní organizace realizují jednotlivé projekty, díky kterým do budoucna existuje možnost omezit rozsáhlé znečištění jezera Viktoria i pobřežních měst.

Klíčová slova

Městský odtok, vodní znečištění, produkce odpadu, sanitace, zájmové strany

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Abbreviations

CBOs	Community – Based Organizations
CDS	City Development Strategy
EARV	East Africa Rift Valley
ISWM	Integrated Solid Waste Management
KCC	Kampala City Council
KIWASCO	Kisumu Water and Sewerage Company
LA	Local Agenda
LVBC	Lake Victoria Basin Commision
LVEMP	Lake Victoria Environmental Management Project
LVSWSB	Lake Victoria South Water Services Board
LVWATSAN	The Lake Victoria Region Water and Sanitation Initiative
MSW	Municipal Solid Waste
NGOs	Non-government Organizations
OTI	Office of Transition Initiatives
SIDA	United Nations Development Programme
SWM	Solid Waste Management
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNHABITAT	The United Nations Human Settlements Programme
US AID	United Satets Agency International Development.

1. Introduction

Lake Victoria is the world 's largest tropical lake by area and the second largest freshwater surface area in the world after Lake Superior in the Unites States of America. The Lake is shared by three countries, that of Uganda, Kenya and Tanzania. Its often referred in literature as Lake Victoria Basin which means that not only three countries mentioned above are included but other two countries do as well , such as Rwanda and Burundi. Surface area of the lake is 69 000 km² and the catchment surface area about 251 000 km² (UNEP, 2006). Average depth is 40 m (UNEP, 2006) and the lake is the White Nile river source with an outflow of 23.4 km² (Kayombo et.al., 2006). Primary inflow is Kagera River and primary outflow White Nile (World Wildlife Found and Saundry, 2012). Catchment of the main affluent river of the Kagera, runs through the countries that of the Rwanda and Burundi.

Lake Victoria is also reffered as an *African Great Lake* together with the lake *Tanganyika* and *Malawi*. Some secondary datas also shown that the lake is the part of the East African Rift Valley that is the group of old, but the biggest and the deepest lakes in the world. With flat topography and comfortable climate, Lake Victoria 's surrounding area is one of the three heaviest populated regions in Nile Basin (UNEP, 2010). In 2010 it was estimated that 35 million people were living within 100 km of the Lake Victoria (UNEP, 2010). Water environment also allows to cultivate various cash crops, such as cotton, sugar cane and paddy rice, for instance.

"Beyond the symbolic significance, the Lake is also the source of great socio-economic potential for investment in fisheries, transport, tourism water and energy; and in agriculture, trade and industry" (Makalle et.al., 2008) providing an environmental services, the lake is mostly important for food, energy, drinking water, irrigation water for agriculture activities, shelter, transport and repository for human, agricultural and industrial waste (Rabi, 1996).

However, this lake has been facing a significant decline in its water quality due to population growth and urbanization in the Lake Victoria region. A large share of the polluted water shed is already affecting people 's health, the environment and the economics of the three nations surrounding, but in this thesis just Kenya and Uganda are taken into the consideration. Technological and socio-economic solutions to control and to prevent further pollution problems through different projects focusing on sanitation, environmental protection and sustainable development have been implemented in this region. In initiation and implementation of these projects, various stakeholders participated and have been playing different roles. This Bachelor

thesis will be conducted with the close focus on the environmental problems with urban waste disposal and its impact on agriculture around Lake Victoria.

2. Literature review

2.1. Lake Victoria and problem description

Within four decades Lake Victoria Basin heavily undergone environmental pressure through various human activities . As it is stated by Lake Victoria Basin Commission (LVBC, 2008) the pressure is due to the high importance of the lake for transport, source of the food and disposal site for human, domestic, industrial and agricultural wastes. The pressure from poverty of rural areas, shortage of land and limited job opportunities are the additional reasons for the rapid urbanization and high population rate around the lake (UNEP, 2006 and LVBC, 2008). Now it is visible that the lake is experiencing a serious environmental degradation (LVBC, 2008).

The population of the lake basin is around 30 million. Lake Victoria region is interlinked with high population growth, in fact with one of the greatest in the world (6% is annual growth) (Kayombo et.al., 2006). The fact is that population growth in the region increases the waste generation per capita (UN-HABITAT, 2005) and the limited capacity in infrastructure and finance presents a difficult challenge for the municipal authorities in the Lake Victoria towns in collection of waste generated from urban towns (UN-HABITAT, 2008). Research done by UN-HABITAT in 2008 shows that the Municipal Authorities are able to collect less than 5% of household waste generated. 95% of the waste generated end up in open places, streets and ditches providing its share for the serious problems of environmental pollution and the deteriorating quality of the water in the Lake Victoria (UN-HABITAT, 2008) through urban runoff.

Urban runoff carries mixture wastes from streets, ditches and industrial storage yards when rain falls down or through wastewater. The runoff carries the polluted runoff to nearby lakes and streams, bypassing wastewater treatment systems (Johnson, 1997). Lake Victoria Environmental Management Project (LVEMP) research on pollutants load because of urban runoff contributed 87 large towns in the Lake Victoria Basin (see Fig. 1), 51 in Kenya, 30 in Tanzania and 6 in Uganda respectively (COWI, 2002) As it is stated by Lotodo.(1999) the wetlands around the lake which are serving as a filter for the water before entering the lake are under significant stress. The excessive amount of pollution received by the lake weakens the filtration efficiency of the wetlands. The pollution is directly entering into the lake without being filtered. This further contributes to the environmental degradation of the lake (Lotodo et al., 1999)

Nutrient load into the lake through urban runoff from the catchment area further exerted health and economic impact on the community in the lake basin. According to Chege (1995) the health

impacts of disposal sewage into the lake area are also significant. Release of untreated sewage into the lake has been one of the causes for water-borne disease. If human excretes are not properly managed to be disposed in environmentally friendly manner, disease causing pathogens which can be transmitted through water, soil, insects and animals to human beings (Schelbeek, 2007). The water hyacinth growing in the lake can be the indirect cause of bilharzias by hosting snails (Lotodo et.al., 1999)

The runoff from urban areas also contributes to the enormous amount of nutrient supplement to the lake where it increases the eutrophication (Lotodo et al., 1999) Increment in eutrophication will increase algal pollution which results in low oxygen in the deep water (Lotodo, et.al., 1999) This will create a very good condition for the growth of weeds on the lake such as water hyacinth. The problem related to the infestation of water hyacinth is disruption of transportation, fishing, water supply by clogging the municipal water pipes, used as a host for mosquitos and other pests (UNEP, 2006).

It is entirely visible that Lake Victoria now experiencing a serious environmental degradation (LVBC, 2008). There are organizations and institution bodies helping in foundation of researchers teams focusing on projects implementations and any other forms of the rescue of lake ecosystem but it is yet insufficient (SIDA, 2006). Most of this projects include water and sanitation issues as a major components of their projects (SIDA, 2006) for the realization of this projects, "involvement and the full participation of all stakeholders is found to be crucial" (Karanja, 2006). Stakeholders in the region are regional governments, local communities, private waste collection service providers and development partners (Karanja, 2006). These various stakeholders have different levels of role in improving of sustainability of environmental development of the Lake Victoria. (Kulindwa, 2006).



Figure 1 : Map of the Lake Victoria bordering Uganda, Kenya and Tanzania

Source: <http://www.lake-victoria.net/Lake-victoria-map.html>

2.2. The main drivers of the problem

2.2.1. Rapid population growth and the urbanization

The lake basin supports one of the densest and poorest rural populations in the world, with human population density up to 1200 per km². It is thus the most heavily populated basin within the EARV lakes subregion. The population has increased from an estimated 4.6 million in 1932 and stood with 27.7 million by 1995 (UNEP, 2006). Nowadays Lake Victoria has a potential to support close to 30 million. It is multi-ethnic, comprising communities from Kenya, Uganda, Tanzania, Burundi, and Rwanda. For this study two cities are selected, that is Kampala and Kisumu.

However the population rate around the Lake Victoria still remains among the highest in the world (mentioned before annual growth is 6%), due to the HIV/AIDS and other diseases pandemics, there is nowadays a decline of the population. Although for the future predictions, the population of the region is expected nearly to double within the next 25-35 years and is estimated to reach about 54 million (United Nations, 1995).

2.2.2. Improper urban waste disposal

The situation in the coastal areas of the Lake Victoria Basin that of the Kampala and Kisumu is threatened by improper urban waste disposal due to high population rate. The fundamental parts of the waste are pathogens as they are transmitted through land, water or insects into human beings and have the effect on various water borne diseases such as cholera, typhoid, dysentery and the main water – contact disease bilharzia, therefore hazardous for the health (Schelbeek, 2007). Urban waste is fluctuating into water bodies and has great impact on the ecological structure that is considered as irrecoverable (Chege, 2004). Urban waste consists of waste from streets, ditches, processing plants and of waste from living quarters and yards. When the rain falls down, waste is proceeding into down stream and surface water causing water pollution. Urban runoff as the essential element of water pollution has a great impact on the nutrient content in water bodies.

2.2.3. Introduction of Nile Perch

One of the most dramatic human activity involved in the ecosystem of the lake is unplanned discover of new exotic species of fishes, represented by species of Nile perch (*Lates niloticus*) and *tilapiines spp.*, introduced to the Kyoga Lake in neighbouring Uganda by British biologists in 1955. The content of biomass, characterized by 80% of indigenous *cichlids spp.*, stayed uniform until 1970, following by rapid changes in explorations of water bodies in 1980. Surveys has showed completely different biomass content presented by 1% of cichlids and 80% of Nile perch (Chege, 2004). From an ecological perspective the introduction has appeared as an ecological catastrophe. Due to suitable water environment provided for introduced fish, the Nile perch was allowed to reach remarkable proportions, reproduction and devastate existing fish population of the cichlids as the main provider of nourishment for the local communities (Chege, 2004). Large amount of the Nile perch (200,000 tons annually) is exported, especially to Nairobi to expensive restaurants, Middle East and Europe. How ironic is it while fishermen are not so able to catch Nile Perch because of the size of the fish although due to business it 's large

amount of fish exported while local communities suffer by malnutrition. For successful businessmen the introduction of Nile Perch was fluorescence of huge promising trade (Chege, 2004).

2.2.4. Infestation of water hyacinth

The runoff from urban areas also contributes to the enormous amount of nutrient supplement to the lake where it increases the eutrophication. The findings show that non-point source pollution that is polluted runoff from agricultural practices as well as unplanned urban settlements contribute more to eutrophication of the of Lake Victoria than that from point source pollution that is source of water, air pollution, et cetera.

Increment in eutrophication will increase algal pollution which results in low oxygen in the deep water (Lotodo et.al., 1999). This will create a very good condition for the growth of invasive weeds on the lake such as water hyacinth. The problem related to the infestation of water hyacinth is disruption of transportation, fishing, water supply by clogging the municipal water pipes, used as a host for mosquitos and other pests (UNEP, 2006)

2.2.5. Lack of public awareness

Although the environmental problems occurring in Lake Victoria are challenging, "international and domestic efforts are under way to save the lake and curb its deterioration". (Chege, 1995)

Education , especially of local communities in waste separation finds to be crucial because many residents yet are not aware of the pollution they creating and its impact on the only one treasure,ensuring them livelihood,that is the lake Victoria. The promotion of environmental problems for the residents should be more strengthened to motivate people to decrease pollution they made and to start to take care of the problems of the surrounding lake at all.

2.3. Wetlands and Agriculture

2.3.1. Importance of the wetlands

The freshwater wetlands in the Lake Victoria are important natural resource upon which communities in the agricultural areas and riparian districts depend in terms of their livelihood. They constitute about 37% and 13% of the wetland surface area in Kenya and Uganda respectively. This ecosystem has its importance in terms of food production, ecological productivity and hydrological stability. The wetlands are also important as a source of goods and services for the riparian communities,being source of handicraft and fuel included. Another function is that they support agriculture and grazing, contributing to climatic stability and providing habitat for wildlife. Most of all they act as a source of water and food during the dry season.

The wetlands are naturally buffer zone between the urban area and the lake. Municipal waste and sediments are drained and filtered through, before its leaching to the water ecosystem of the lake. Due to flooded urban areas by polluted waste, the function of the wetlands are limited (Kayombo et.al, 2006).

Slums and another unplanned settlements alike, are usually constructed by poor immigrants in wetland areas (IRIN, 2010). Why wetland areas? According to available data shown from Kabumbuli and Kiwazi (2009) wetlands are easy accessible and provides opportunities for urban farming, as a strong survival strategy for newcomers, represented by rural immigrants. Further they also stated that wetland areas are relatively free from government policing.

Recent observations (Oyoo, 2009 and Scheren et al., 2000) have shown negative impact for the wetlands ecosystem of the Lake Victoria, in case of water supply for the city and source of the nourishment for the urban people. This effect has been widely studied by Kabumbuli and Kiwazi in 2009, authors of study conducted in Kampala about Nakivubo wetlands. These wetlands are important for filtration of city 's waste and water from storm before it leaching into Lake Victoria's Murchison Bay. Low-income communities are living along these wetlands. They are highly dependent on them due to crop cultivation, brick-making and harvesting wetland vegetation. Through rising population all these sources implicate decrease of wetlands productivity hence pose a serious threat for communities livelihoods. And it is not only due to excessive use of natural sources of wetlands but also government interference to evict communities in order to restore its ecology. Therefore study conducted by Kabumbuli and Kiwazi uses alternatives for better and sustainable livelihood and formulating strategies for prepare communities for smaller dependence on wetlands so that they do not suddenly fall into the worse poverty in case they are evicted.

2.3.2. Agriculture around Lake Victoria

Community around Lake Victoria cultivated the crops, mainly in wetlands. Their other occupations are livestock keeping farm produce trading. Cultivating occurs in swamps by draining wetlands or by exploiting well-irrigated rich soils from which the floods recede during the dry seasons. The crops cultivated are seasonal (horticulture, legumes) and annual maize, sorghum, cassava, sweet potatoes, cotton, millet or paddy rice (Kimaro and Fidelis, 2007)

The first three respectively, from annual crops are staple crops in the lake area. A common crop in the drier parts of the lake region is cassava, however very poor in terms of energy and protein content. Hence communities depended on this crop tend to suffer by malnutrition unless there is sufficient supplementation by protein foods. Both maize and millet have higher energy output in comparison with cassava. However communities cannot facilitate growing of maize or millet due to very small input of annual rainfall. The poor climate conditions around the lake are the major limitation for agriculture. Droughts and floods are two main climatic extremes limiting agriculture hence people grew dependency on fish practices and due to growing population, the fish industry is under pressure (FAO, 2006).

Farming practices are threatened by wide soil erosions. The main practice causing soil erosion is conventional agriculture on fragile lands and steep slopes. A promising technology to strike with

this problem is conservation agriculture ensuring minimal disturbance of the land by using no or minimum tillage, covering the soil with organic mulch and crop rotation with legumes.

There has been introduced the principles of conservation agriculture to various communities along the Lake Basin in recent years and various researches explore the advantages of conservation agriculture to crop productivity and water and soil conservation.

Pollutants of the Lake Victoria and their potential

Pollutants are untreated effluents as urine, faeces, greywater, organic waste, rainwater; ,oil, recreational activities and reduction of fish stocks due to overfishing.

There are three different waste streams as pollutants, occurring in a sanitation, yellow,brown and grey. If these waste would be separated in a sanitation, feces and urine could be reused in agriculture. However since people in other than marginal urban areas do not work in agriculture, fecal matter cannot be easily transferred into agricultural areas. Therefore in urban areas fecal matter ends up in water or on dumps.

Another pollutant is water hyacinth. Its rich in content of biomass,hence in the rural areas, water hyacinth can be used as a treatment system for wastewater,for the production of biogas and compost production (Malik, 2007).

2.3.3. Wetland use and its impact on the agriculture of the Lake Victoria

Over the past three decades intensified cultivation of marginal areas and clearing of natural habitats,such as wetlands, forests or mountainous areas has been the major concerns behind land degradation around the Lake Victoria.

Wetlands, mentioned above are natural habitat for the soil and plants development on the surface. They have strong influence on the utilization of these two natural resources because wetlands are characterized by water saturation,mentioned above, that is needed for these both natural resources.

For agriculturists and ecologists, conversion for wetlands for agriculture provoking controversy. Agronomists regards wetlands as the area for potential crop production while ecologists have more interest in conserving biodiversity of wetlands.

However rapid increase of population growth associated by increase of human activities has lead to conversion of wetlands into crop production area and resulting in disruption of its

ecosystem. Human activities such as industries or mining tend to affect quality of wetland resources such as fish and crops cultivated from agriculture. Municipal waste bringing the components from industry plants, et cetera and that is in urban run-off is likely to have a negative impact on wetlands (Kayombo et.al., 2006).

Conversion of wetlands bring negative effects on soil environment. These changes has led to salinization and acidification of soils. Drainage of wetlands for agriculture is often connected with development of irrigation schemes important in water provision for crops production. The main problem influencing the physical performance of irrigation systems around Lake Victoria is the clogging up of irrigation canals, especially when the water flow into the system is loaded with sediments hence reducing the flow. The challenge for wetland utilization is increase of agricultural land in the way that ecological aspects of wetland ecosystem are maintained.

Lack of land for agriculture around Lake Victoria

Land in general is often used for livestock grazing and agriculture, for human settlements, urban development or transport. The agriculture practices in ecosystems such as slopes or wetlands, as the main areas for urban farming are fragile and easy susceptible in degradation, hence need to be protected. Only small proportion of the land in the basin has favourable conditions for agricultural development. Soils have low fertility and poor texture. By growing crops, landslides are very often causing drainage of the soil. And when comes the rain, urban waste get into the drainage of soil and this runoff threats livelihood of urban poor living in informal settlements, as their income from agriculture and health as well.

Due to ever-increasing population and linking need for human settlement, growing amount of urban waste, exploitations of the ecosystems by people, migration from rural to urban areas, agricultural land is being destroyed and degrading. Therefore there is also limited availability of arable land. Approximately 80% of households in Kenya and Uganda have a land on which they mostly practise crop and livestock farming, hence the land distribution is not adequate for households in meeting their needs for livelihood. By 2025 available land for agriculture is likely to be enormously reduced. This is the major threat to food security for local population. The fact there is unsatisfactory proportion of land available for agriculture implies that non-farm rural economic activities should be promoted to cater sustainable use of the land. The competition for land for farming has intensified in last decades, such as disputes in land tenure and the use of natural resources resulting in social unrest.

Available information in Lake Victoria Basin shows that the amount of poor people farming marginal land that is susceptible for degradation, is increasing. Expansion to marginal

ecosystems with agriculture brings increased risks of crop failure and loss of soil, biodiversity and forests. Therefore there is an urgent need to break the cycle between poverty and land degradation by strategies developing that economically reinforce farmers and support agricultural intensification (Executive Secretary of LVBC,2012)

2.3.4. Urban agriculture in Kampala

Over 70 % of population belongs to the poverty level due to very low urban product per capita, given by US\$120 per capita. This has led some city residents of Kampala to convert to urban agriculture to support their small income. Farming is done on marginal areas such as swamps or slopes (Kayombo et.al., 2006). Unfortunately these ecosystems are fragile and prone to degradation. For instance extensive maize cultivation in slopes has led to erosion that can result in landslips. Drainage of swamps affects water table and during dry season, most of the springs dry up. By drainage process, urban pollutants get into this runoff and it lead to deforestation. Trees are cut for land for agriculture. Due to land degradation in Kampala, farming is practiced on road reserves. Due to reduced visibility of tall crops such as maize or cassava, accidents occurring, especially near of road bends.

In informal settlements of Kampala residents are growing cocoyam as the major crop. Other crops include Amaranthus, millet, cow pea, green pepper or sugarcane. The urban poor residents cannot afford fertilisers, so they resort to bio-fertilisers, such as Mexican sunflower. In urban areas, high-value crops are demanded, such as vegetables. Urban agriculture is survival strategy for many of the poor residents however their farming systems are poorly understood and poorly supported by services.

Annual crops are grown by poor people in wetlands or road reserves mentioned above or sites with waste disposal while others utilize their backyards.

Land in Kampala is administered in complex management systems that constrains access and ownership. In terms of access to land for poor, the majority are customary tenants on land privately owned in periurban areas (Kiguli, 2003)

2.3.5. Urban agriculture in Kisumu

Urban agriculture dominates in peri-urban landscape in Kisumu area. It 's estimated that 60 % of city residents are involved in urban agriculture and livestock keeping (Kisumu City

Development Strategy, 2004b). Rapid growth of informal settlements occurred in freehold land system and municipality failed in preparation of the land for informal settlements without any development control. Hence, major part of municipality lack of basic infrastructure, water, sanitation and solid waste management (Mireri et al., 2007).

Urban farming in Kisumu is undertaken by the traditional urban farmers and migrants with their families (Mireri et al., 2007). According to Lado (1994 in IDRC) urban farming is practiced in private residential land characterized by road verges, river banks and other public places. These areas are susceptible for pollution. Most of the produced food is for domestic consumption, therefore urban agriculture has an important role in food security for farmers (Freeman, 1991). Among households practice agriculture, there is a high proportion of women involved in farming (more than 50%). Urban agriculture comprises of crop production and livestock keeping. Vegetables, beans, millet, sugar cane, bananas, maize are being grown and livestock include poultry, dairy cattle, pigs, goats and fish farming for sale and domestic production (IDRC, 1994). Urban agriculture grown as urban population seek for alternative income and employment (Mireri, 2002).

2.4. Waste and water quality management in Kampala

Kampala in data

Table 1: Urban population in Kampala

City	Population	Urban population	Population density in the city	Population density in slums	Population in unplanned settlements	Annual growth of population
Kampala	1, 700, 850	40%	6,000 / km ²	40,000/km ²	60 %	5.6%

Source: Kulabako et al., 2010

Kampala, the capital city of Uganda, is situated in the northern coast of the Lake Victoria (Fig.2). Since 1970, Kampala has experienced rapid population growth, reached 1.5 million of inhabitants until 2009 (UBOS, 2009). Since 2010 Kampala accounts for 1,700,850 people. The rapid rise of population in the city is due to rising rural- urban migration. The average population density is over 6000 people per km² (UBOS, 2009). Kampala is indicated as the city with the

Research - water supply in Kampala

There are data available from surveys concerning to water supply in Kampala provided. Some of them approaching the informations about piped water. One surveys has shown that piped water as a source of drinking water concentrated in high- income zones and low income zones in high density areas is with small improvement. This has positive impact on spring in protection. Springs are the major provider of drinking water for domestic use. These springs are protected during construction due to providing of two provisions- one of them is leachy section of sand and gravel into which water enter and second is a dam that prevents water from bypassing the reservoir or catchment. Pipes are perforated and it leeds the water out of reservoir (Berg, 2010). Few studies are carried out about extensity of polution of protected springs or even more or none of them are carried out about it in low-density and high density settlements. Therefore this study mentioned above was conducted to find out the main polutant factors and causes of pollution of the protected springs. Researchers find out that higher extent of pollution was in high-density settlements and that it has a lot to do with poor management practices. For instance pit latrines construction or bad conditions for husbandry or dumpings of waste contributing to higher extensity of biological and chemical pollutants in the protected springs. There were recorded concentrations of nitrate-nitrogen and amonium -nitrogen and faecal coliforms. Higher level of pollution were recorded during rainy season due to water from storm and its runoff and its penetrating to ground water. The results of this survey has shown that water from protected springs threats health of communities. (Nsubuga et.al, 2004)

Stakeholders involved in waste management

The major stakeholders identified for the waste management are local governments, formal and informal private sector, international donors, local and international NGOs, community based organizations (CBOs) and the community (end user). Each stakeholder has an important individual and collaborative role with other stakeholders in solving the urban runoff problem through sanitation, participation and implementation of several projects around the lake. The role of each stakeholder will be discussed

The role of governments and authorities

Local urban authorities have two major roles towards the lake ´s environmental protection. The first one is that they have responsibility of providing services for the people. The second one is that they have duty to implement the environmental legislation and policy (Wacker et.al.1999).

KCC (Kampala City Council)

has a responsibility in control, storage, collection, treatment, processing and solid waste disposal. The problem is that KCC should provide benefits of waste sorting for public awareness but they do not much in real. With the involvement of private sector, the waste collection is being improved but still 60 % remains uncollected.

The role of formal private sector

Formal private sector comprises the registered companies. They aim their target market on high income consumers for profit (Otiso, 2003). That means that formal sector must be registered by local government or municipality so they can participate in provision of waste and sanitary services from authorities (Mugagga, 2006).

The role of informal private sector

Informal private sector include small scale municipal waste collection services. Unregulated activities by individuals or families fall into (Shubeler et.al., 1996). These small services rely on low cost technology, many labours earn low income (Wilson et.al., 2006). However small scale services are more likely to be involved in efforts to improve public sanitary conditions. Because the services are basically rooted from low-income communities, they have access to reach more people that lives in poor settlements.

The role of local communities

Waste pickers that collect waste from streets and dumps are women and children. The working environment for these groups is dangerous. The strong aspect of communities is that they have a power to organize themselves into CBOs (Mugagga, 2006) with the aim of improving their livelihoods. They have a role in services provisions such as maintenance and constructing of facilities.

Active community participation is vital to achieve sustainable development in the lake basin management. The participation of local communities depends on the degree of awareness of the community on the consequences of urban runoff and when outcomes of participation clearly and directly connected to the improvement of livelihood of participating communities. The role of local government and local NGOs is very crucial here in transformation of information to the local community and in formation of social organization that establishes manageable groups in the community. For instance sanitation projects from the case studies proves that participation of local communities improves the likelihood that project resources will be used and properly operated and maintained (Kayombo et.al.,2006).

The role of development organizations

Development organizations include international or state related donor organizations NGOs and CBOs. They are actively involved in various projects and activities that focus on reduction of polluted water loading into Lake Victoria by establishing a basic infrastructure for sanitation for households. In general, these organizations support and participate in these projects through funding, in case of donors, to technology introduction and in case of local NGOs and participation in case of CBOs (Awange et.al.,2006 and Kayombo et.al.2006). NGO as a non-governmental organization has an intermediate role between CBO and Local governments. They provide advices and support CBOs and waste sorters.

The role of international donors

International donors holds the main role in projects of financial and human resources provisions and providing monitoring and evaluations of progresses in projects (Dastidar et.al.,2007).

2.4.1. Sanitation facilities in Kampala

Substantial part of local communities do not have an access to sanitation facilities. The main obstacles for improving the sanitation are political instability, population growth and low priority to sanitation issues. For instance in Kampala slums like its city part, named Kivulu, toilets are scarce. Inadequate sanitation facilities has led to increased utilization of polythene bags, named „, flying toilets,, for human waste liquidation that are thrown in nearby paths and water streams, resulting in waterborne diseases (Muyodi et al., 2009). There is a study implemented by Muyodi and Hecky in 2009, in Ugandan part of the Lake Victoria basin, investigating water quality in relation of water-related diseases.

Based on surveillance they found out from water samples that in part of the lake in Ugandan area, there is great amount of cyanobacteria toxins poses a serious threat to human health. After analyses, results have shown that water is indicated by faecal contamination, hence water-related diseases spread rapidly and attack mainly health of communities living in lakesides.

Slum areas where only basic infrastructure appear are in the worst condition. These areas have poor drainage systems due to insufficient investments of the only few private and public facilities that exists into the more efficient drainage systems. In some slum areas, such as Kivulu, flying toilets tried to be replaced by Eco-san toilets that are helpful in dehydration of human waste and getting rid of odour, breaking down human waste into compost-like material and water use saving. In 1990 s they were developed in South Africa, although flying toilets yet dominated (IRIN, 2010).

About 6.2 percent of households (IRIN, 2010) in the city do not have any toilet facility at all. The few private and public facilities that exist in the city charges up in conversion US 10 cents (IRIN, 2010). For instance a survey by the Catholic Church 's Justice and Peace Centre points out that due to urban poverty, children are ordered to use toilets in school so they do not ask for money at home to use toilets. According to chief health inspector Mohammed Kirumira most toilets are in slums.



Figure 3 : Toilets in Kampala

Source: IRIN, 2010

2.4.2. Inadequate water access

Only about 65% (IRIN, 2010) of two million dwellers have access to clean water and the rest use water contaminated by pit latrines. According to Uganda's Housing and Urban Development Minister, Michael Kafabusa Werikhe, high cost of water from pipes forced city residents to use water springs or wells where water is also contaminated by micro-organisms. Said in their paper, due to inadequate sanitation facilities, Kampala residents are hospitalized every three months however only small percentage can be hospitalized because of malaria or cholera or other diseases contamination from wells or water springs.

Only 17 % (IRIN, 2010) of the population have the access to piped water. According to UN-HABITAT there is a high prevalence of diseases such as diarrhoea, malaria and worm infestations. The African Development Bank found that 92.7 percent of population use septic tanks and pit-latrines, however these services are offered by private sector hence cash-demanding, therefore they found to be inadequate. The runoff from tanks and pit-latrins is untreated and charge into environment.

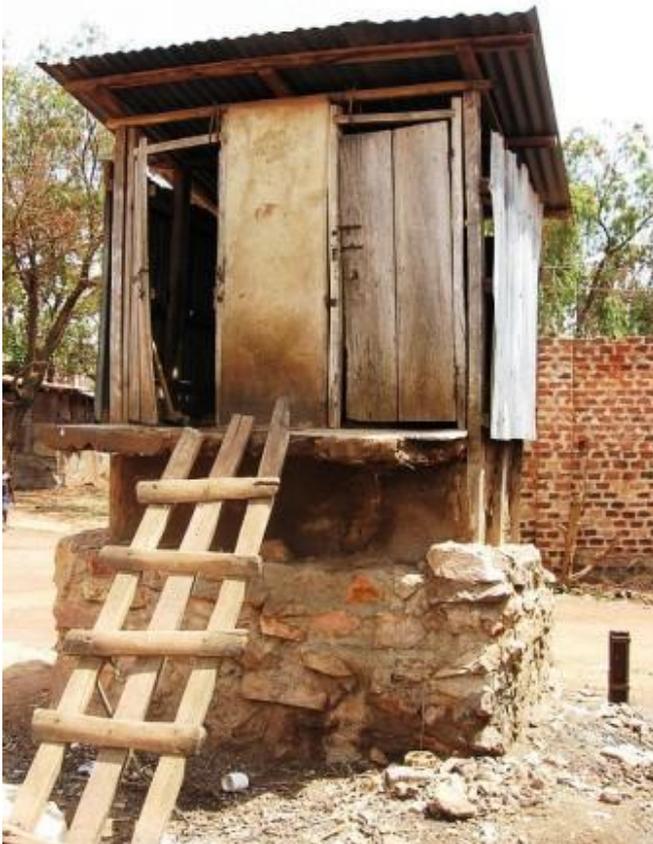


Figure 4 : simple pit latrine in Kampala

Source: Science Direct, 2010

2.5. Waste and water quality management in Kisumu

Kisumu in data

Table 2: Urban population in Kisumu

City	Population	Urban population	Population density in the city	Population density in slums	Population in unplanned settlements	Annual growth of population
Kisumu	420, 928	52.4 %	1,500-3,000 inhabitants per km ²	Over 20,000 inhabitants per km ²	60 %	2.8%

Source: UN-HABITAT, 2004-2009

Kisumu is located on the west of Kenya (see Fig. 5). Kisumu has a population estimated to be around of 565,000 living in districts that surrounding Kisumu city itself (MCI, 2007). The main economic activities in Kisumu are fishing, commerce and agriculture. City area has multi-ethnicity with predominance of Luo the tribe. Though Luo is the language locally spoken, Swahili is spoken throughout Kenya and English is taking as widely used language as well. Other cities in the region are Eldoret, Kericho, Kisii and others.

Kisumu is one of the fastest growing cities in Kenya. With an annual growth of 2.8% and population density is between 1,500 and 3,000 people, the city records one of the highest urban population in Kenya (Table 2). (UN-HABITAT, 2009). As a result of rapid population growth and uncontrolled industrial development, urban environment in Kisumu is seriously being degraded. Poverty situation is worse than national average. Just about 48 % are under the poverty level against 29 % on national level. (UN-HABITAT, 2010)



Figure 5 : Kisumu on the map

Source: <http://news.bbc.co.uk/2/hi/africa/4348289.stm>

2.5.1. Sanitation in Kisumu

The main sanitation facility in Kisumu is pit latrine. There are few public toilets, most of them concentrated in informal settlements. In the center of the city there are public toilets on the markets for instance. Sewer systems are three and divided that collects wastewater generated from northwest of Kisumu, from southeast and from west of the city. Two of the systems are conventional however they do not accommodate wastewater properly. Due to insufficient work of two sewer conventional systems, there are frequent bursts resulting in contamination of groundwater and water-borne diseases in addition.

Expanding sewers to informal settlements would be expensive and difficult. For installation of them, households with in-house water supply are required that is not very common feature of informal settlements hence it would be difficult to undertake these measurements (Maoulidi,2010).



Figure 6 : Public toilets Otonglo Market Central Kisumu

Source: <http://www.citycouncilofkisumu.or.ke/image/toilet-otonglo-market-central-kisumu>

2.5.2. Water supply and water quality in Kisumu

Water supply in Kisumu is provided by KIWASCO (Kisumu Water and Sewerage Company) established in 2003, that it 's establishment was prior to Kisumu Municipal Council. KIWASCO share a Service Provision Agreement with LVSWSB (Lake Victoria South Water Services Board) carrying responsibility in supervising activities implemented by Kiwasco (Schwartz and Sanga, 2010). There is 67 % high level of non-revenue water in 2003 shown in study of Schwartz and Sanga (WSP,2009). By 2007, only 36 % of the urban population had service coverage (Schwartz and Sanga, 2010). As the result majority of population lacks of sufficient quantity of water for cooking or cleaning (Wagah, et.al, 2010).

Several water bussinesses are in Kisumu, that of private small-scale water treatment plant operating outside of town, two water truck companies that collect water from this water treatment and delivering it to consumers. Water kiosks provide water from tap or boreholes where communities refill their containers and there are also water vendors that deliver containers to households with charge (Sima et.al., 2012).



Figure 7 : Water kiosks in Kisumu slums

Source: <http://www.cordaid.org>

Water quality

Water from Lake Victoria is of acceptable quality but requires treatment before its provided to consumers. There are car-washes installed on the Lake Victoria shore. Although these bussiness pollute the lake with oil spills and chemicals therefore it lowering the quality of water for Kisumu. Most residents of informal settlements have a poor acces to water that usually comes from shallow wells and water vendors. This water is of low quality polluted by faecals. In 2008 a collaborative team from the Kisumu Municipal Department of Publish Health and Emory University tested a quality of 72 water sources in Obunga and Nyawita informal settlements. The researchers came with results showing that 96% of wells tested had medium or high levels of contamination whereas water provided by KIWASCO had small or no contamination and water from springs had medium levels of contamination (Maoulidi, 2010).

Stakeholders involved in waste management in Kisumu

In Kisumu City there is an wide range of stakeholders such as individuals, groups or organizations colaborating. They currently facing the challenge of solid waste management. These stakeholders include Local Authorities, Central Government, informal groups, private sectors, CBOs and NGOs.

Central Government has responsibility in establishing institutional frameworks in solid waste management, Municipal Council of Kisumu, represented local authorities is responsible for provisions of solid waste collection and disposal services. Private sectors has a primary interest in earning a return of their investment by selling waste collection, transfer, treatment, recycling and disposal services. Informal sector is also taking part in waste management and include CBO 's women groups, waste salvagers. This group taking part in waste collecting, small-scale

recycling, composting and waste management programmes for public awareness, they also access the communication between CBO 's and government authorities and provide services for informal settlements for costs that are affordable . The individual households are interested in effective waste services for low prices, in low-income areas where people do not have appropriate and have poor waste management, they give a priority to water supply, sanitation facilities or drainage.(UN- HABITAT, 2010)

By-laws governing

The quantities of waste generated by the two main municipals vary, but they are comparable. Every municipal has some set of legal framework and by-laws governing its inhabitants and their activities in the provision and delivery of sanitation services. Some of these are ;

- a. Regulation of effluent or discharge of waste on land or into water. The Kampala City Council Solid Waste Management Ordinance,2000;Section 5 says "no person shall place, deposit or allow any solid waste to be placed on his or her premises or private property, on public, street,roadside,ditch,river,stream,lakes,ponds,canal or any place where it will be a public nuisance".
- b. Action plan for KCC which aims at working with NGO,CBO 's (1997 Local Government Act, Kampala declaration on sanitation)
- c. Kisumu has a similar policy that recognizes the partnership of the municipal and CBO 's in the city.

3. Research question

Are the Lake Victoria countries serious enough to mitigate increasing occurrence of solid wastes in the lake itself and surrounding habitats?

4. Objectives

The aim of this study is to give an analyse on the issue of waste management in the coastal areas of Kampala (Uganda) and Kisumu (Kenya), as well as the drivers which cause the environmental degradation of the Lake Victoria in Africa.

5. Methodology

This study was conducted by collecting and analyzing primary and secondary data sources about the environmental problems in the Lake Victoria area which included assesment of scientific / development articles and books, survey reports, thematic analyses, data from previously conducted studies , government and official statistics.

Qualitative analysis will be principal method of this study. On its basis, the implementation of brief synthesis of findings in the form of summary and conclusion will be discussed.

To get the appropriate information for this thesis, scientific databases such as Web of Science, Web of Knowledge, Scopus, SpringerLink or Scholar Google were used.

The key words used for the thesis are waste management, waste generation, sanitation, water pollution sources in Kampala and Kisumu and Lake Victoria.

Time and distance were the main limiting factor for this study, therefore its focus is only on the elaboration of the waste management in the coastal areas, projects implemented in these areas and overview of the environmental drivers causing degradation of the Lake Victoria in Africa.

Data processing for the thesis are following : at first data from scientific sources mentioned above were collected, after selection of the most appropriate data among all the collected sources and according to available informations, the overall environmental problems of the Lake Victoria were specified.

For the clear conception of projects implemented in the two coastal areas, SWOT analyse was chosen. SWOT is structured method used to evaluate Strenghts, Weaknesses, Opportunities and Threats with regards to projects with the aim to achieve specific objectives. These SWOT analysis will be further discussed in the part of the Results and Discussion. Parameters of SWOT are processed into the table.

6. Results and Discussion

6.1. Waste Management in Kampala

Waste generation in Kampala

Figure 8 provided percentage of waste generated in Kampala and its composition.

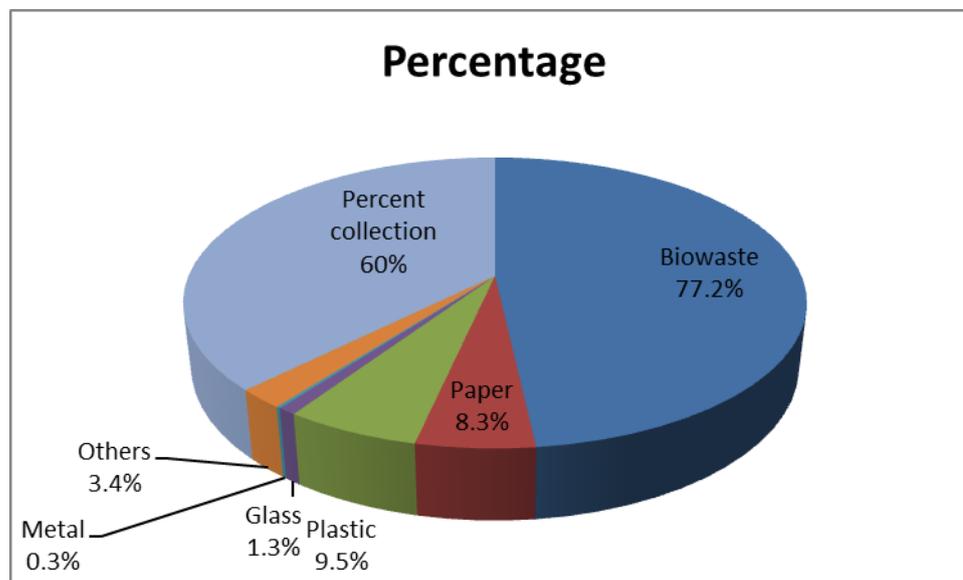


Figure 8 : The type of waste generated in Kampala can be found in the table below
Source: UN-HABITAT, 2009

The major part of generated waste is organic. The communities therefore would utilize it in the compost or use it as fertilizers. 9.5 % are plastics, 8.3 % paper, 0.3% metal and 1.3% glass (see Fig. 8).

In Kampala area, domestic waste generation ranging from 0.5-1.1 kg/capita/day. Approximately 1500 tons of solid waste is daily produced in Kampala (Kulabako, 2010).

Domestic waste generation is higher among high income earning population. On average its estimated that collection is around 55 to 60 % of this amount mentioned hence a daily collection amounts to 750 tonnes of collected waste.

Kampala is facing serious problem with managing of the waste generated by households. Yet 40 to 50% of waste remains uncollected by KCC so residents make their arrangements for waste disposal.

Lack of service coverage force people to make their arrangements for waste disposal. Some people bury it, while others burn it, or throw it nearby roadsides and public land. Burning of the waste pose threats to the health of people. Even some families established mini dumping sites in their backyard. These sites are source of pollution and smells and provide habitat for rats or mosquitos (MLHUD, 1993 ; Kanyonyore, 1998)

Waste sorters face difficulties. They are not recognized by law, unregulated and unregistered. Their activities in waste sortion are usually driven by poverty reasons, they sort the waste and afterwards resell. Furthemore, waste pickers and sorters are usually women and children working in the worst and dangerous environment.

The current strategy of government as response to this crisis is establish partnerships among business organizations, NGOs, CBOs and religious organizations. The local government is struggling with lack of enforcement of existing planning and sanitation regulation due to lack of resources.

In the case of Kampala, some studies have shown that willingness to pay for solid waste management is strongly connected with education, income or quantity of generated waste, or household size (Alta and Dehazo, 1996) while previous studies have shown that low- income consumers are willing to pay for waste services (Cairncross,1990).

Niringiye and Douglason in 2010 has been widely observe that there is a big contribution of unwillingness to pay for the solid waste collection in their conducted study. These authors claim that the age of the head of the household is strongly connected with unwillingness to pay for solid waste management and according to this kind of study there do exist only little chance for improvement if charges of solid waste collection service are introduced.

Constraints

Management of final solid waste disposal due to increased waste generation, depleted land fill capacity, growing quantity of polythene and plastics in waste

There is a lack of attention by researchers where not much is done to develop appropriate technologies for waste management



Figure 9 : Landfill in Kampala

Source: OMM Photography

UN HABITAT aims to:

- collect 80% of all the solid waste generated
- conduct public education and sanitation programmes to enhance public awareness about their role in solid waste management
- promote recycling of waste through sorting, in residential areas where home sorting of packages will be encouraged
- obtain 20 trucks from China and existing KCC trucks shall be leased to the contractors where solid waste collection will have been privatized
- introduce a “Skip less” system of waste storage in all residential areas

(UN-HABITAT,nd)

6.2. Waste Management in Kisumu

Figure 10 provided percentage of the generated waste in Kisumu and its composition.

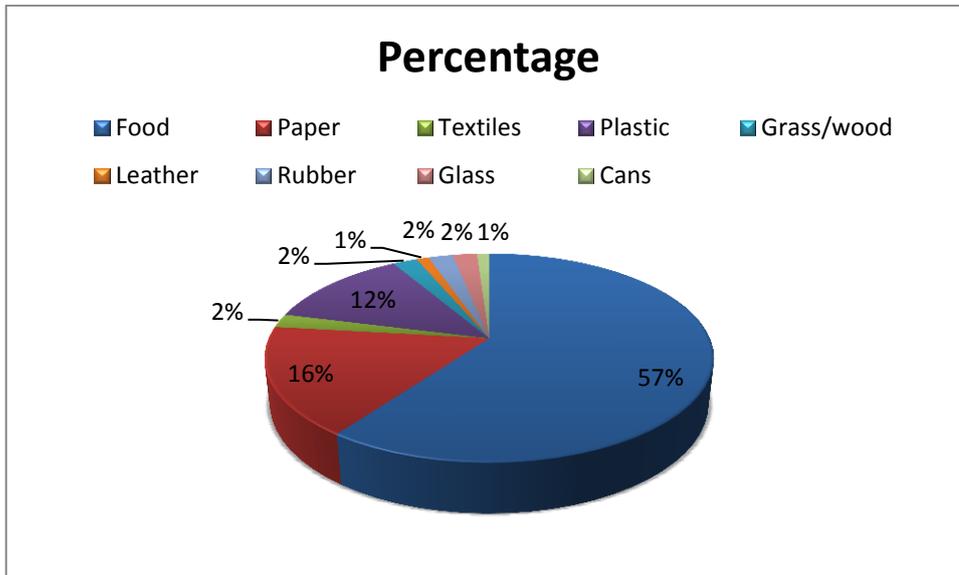


Figure 10: Composition of waste in Kisumu can be found in the table below

Source: Henry, R.K., Yongsheng, Z., 2006

Table shows that most of the produced waste are vegetable products that have the potential to be composted for agricultural use or anaerobically digested to produce energy. Also, the plastics and rubbers can be recycled and processed into packaging materials. The glass, cans and metals can as well be recycled for further use. Kisumu generated 500 tonnes of garbage daily (KCC, 1995). There are many options to proper waste collection, disposal and treatment or recycling. The first option is practicing the 3R's (reduction, recycling and reuse). When garbage's are sorted out into their various components, then recycling can be easier.

For instance in Kisumu there is a study indicating groups of women recycling polythene papers and water hyacinth plant materials in order to make products such as bags, hats, mats or baskets. Study indicates that recycling of these components contribute to environmental conservation, moreover it present the opportunities for creation of wealth among the group of women (Subbo, Moindi, 2008).

Sources of waste and problem with waste collection in the two coastal cities

In the view of Kayombo (2005) there are different sources of waste share in the nutrient load in the lake. "Domestic and industrial waste water, solid waste, sediments from soil erosion in the catchment area, agricultural waste and atmospheric deposition" are being the major nutrient sources. On the account of inadequate financial resources, dumping sites and low participation by individual and private companies in solid waste management, domestic waste still remains a serious environmental problem (Kayombo et.al, 2006). The author collection in their research paper also claim that hence poor management of urban waste represents the most serious urban environmental and public health problem around the lake (Kayombo et.al, 2006).

Problems of waste collections

The problems with waste collection varies but basically they are almost the same in municipalities. Some of the problems relate to unwillingness of officials to implement the by-laws, funding, low capacity of plants and waste not sorted before disposal. Also some waste containers are not placed within the walking distance of inhabitants but rather far and the spilling of waste from trucks as the trucks move around. Also there is a surging number of scavengers who make their living from picking some recyclable waste as plastics, rubbers or metals, to private recycling plants for a fee.

There is also lack of clarity concerning institutional mandate and responsibilities. Where they are functional, the designated coordinating bodies, the District Water and Sanitation Committees are weak and are strongly biased towards water and not sanitation/waste funding (Uganda Sanitation and Hygiene, 2005 Hygiene Assessment).



Figure 11: Landfill in Kisumu Source: www.nation.co.ek

6.3. SWOT of Waste Management project in Kampala

Project Solid Waste Management (SWM) carried out under the Local Agenda 21 (LA21) under UN-HABITAT programme – 2 years lasting – in 2007

Local Agenda facilitates participatory processes to develop environmental action plans focusing on municipal planning, it offers support for local authorities and due to action plans its believed that it will bring improvements in urban development hence supporting solid waste management

Stakeholders involved

CBOs, NGOs, Womens group, scavengers

→ **1 st purpose of project** – importance of initiation of Integrated Solid Waste Management (ISWM) for Kampala-that is crucial because all the current projects of infrastructure, service delivery, local government work in isolation

→ **2 nd purpose of project** – run a pilot project for capacity building and awareness through participatory processes leading to better municipal solid waste (MSW) management

Solid waste collection in Kampala pose a serious threat in low-income areas due to poor waste management,insufficient municipal budgets and fiscal irresponsibility. To protect the health of the poorest from local communities and to develop recycling activities in this area in order to improve livelihood of communities and mitigate degradation of the Lake Victoria, this project is implemented. Through the participatory seminars ,stakeholders interact between each other for better understanding of municipal solid waste management issue and importance of waste separation. Seminars takes place also due to make communities better informed and equipped to purchase primary storage containers as well as to use existing poor waste systems better. The project was founded by UN-HABITAT programme and most of its budgets came from governments, local authorities,charitable foundations. The project brings its strong and weak sites. Through SWOT analysis I will focus on strenghts, weaknesses, opportunities and threats of the project.

Outputs of the project:

- Environmental sustainability with waste management in Kampala city and its division Makindye
- CBO s , women groups, NGOs-better expertise and network to get involved in recycling processes
- Waste sorters-better capacity to deal with health/safety hazards in waste sorting, through seminars they will be network with ngo that will help them fight for their rights and wit recycling activities
- Use of containers for storing separated waste in Makindye,set up by KCC that will provide subsidy to households that cant afford to purchase them

- Increased awareness through campaign in schools,streets, etc. concerning health issues of MSW, importance of MSW and compulsory use of storage containers

- CBO s , women groups, NGO s will increase the number of CBOSs collecting and transporting waste in low-income areas of Makindye through seminars and networking with organization

Table 3: SWOT analysis of Solid Waste Management project (autors proposal based on Dastidar, 2004)

<p style="text-align: center;">STRENGTHS</p> <ul style="list-style-type: none"> • participatory activities in SWM and cooperation of stakeholders such as CBOs ,Women group,NGOs • Regular multistakeholder seminars - discussions for optimal solutions in waste management • Increased amount of waste recycled and decrease of health risks for waste sorters at the landfill • Large involvement of local communities, governmental institutions,private companies,non-governmental institutions supported by UN-HABITAT 	<p style="text-align: center;">WEAKNESSES</p> <ul style="list-style-type: none"> • Market availability influences material to be scavenged • Expensive recycling technology • scavengers are not organised / existing laws do not recognise scavengers as actors and stakeholders involved in SWM • expensive storage items • low motivation of communities to get involved in waste separation since other divisions do not practice these activities • mixed waste is difficult and expensive for treating
<p style="text-align: center;">OPPORTUNITIES</p> <ul style="list-style-type: none"> • World Bank has invested money • the Kiteezi landfill in Kampala already exists (its the only landfill) • private companies are already involved in garbage collection • there are established cbos, ngos, womens group involved in SWM • potential for treatment of secondary raw materials for local and energy production 	<p style="text-align: center;">THREATS</p> <ul style="list-style-type: none"> • project implemented in SWM is unsustainable due to low motivation of local communities and all stakeholders involved will continue in unauthorized activities, such as dumping/safety gear

6.4. SWOT of Waste Management project in Kisumu

Project

In 2009 Bamato Environmental and Sanitation Project in Kisumu.

The groups participated in these project are urban dwellers. They found a method in making a living through waste management strategies while cleaning up their neighborhoods.

Each collector group operated in specific collection point and they collected monthly fee from each household emerging in the specific area in the city.

With the support of USAID/Kenya through the Office of Transition Initiatives (OTI), Bamato sanitation project implemented waste recycling as an effective method to manage inorganic solid waste. The project engaged members of communities, 200 groups of men, women and youth and they were empowered by training on recycling process by using of locally available materials. The groups were collecting and sorting plastics which were delivered then to the Bamato Project site for recycling. The plastics were sorted by type and colour and then cut into small pieces by machine and smelted for molding into variable items.

USAID/Kenya supported this project by buying a molding machine and expanded rooms for molding process and improved ventilations in the working rooms.

Table 4 : SWOT analysis of Bamato Environmental and Sanitation project (autors proposal based on Kakai, 2012)

<p style="text-align: center;">STRENGTHS</p> <ul style="list-style-type: none"> • initiative of local communities to participate in the project • earn money from monthly fee from households for waste disposal • production of items recycled do not dissapoint • designing textile accessories from recycled plastic and their affordable cost 	<p style="text-align: center;">WEAKNESSES</p> <ul style="list-style-type: none"> • expensive molding machine • despite of cleaning efforts, most of the inorganic waste that dwellers collected from households ended up in dumps
<p style="text-align: center;">OPPORTUNITIES</p> <ul style="list-style-type: none"> • improve environment and health of local communities • sustainable way of managing of living conditions and environment • employment for communities 	<p style="text-align: center;">THREATS</p> <ul style="list-style-type: none"> • solid waste disposal • influx of population into the cities,along the lake which still continues and therefore risk of pollution which loses self-cleaning ability

6.5. Development Challenges in Kampala and Kisumu

Kampala

- Poor drainage system with prevailing hot rainy climatic conditions leading to deterioration of roads and spread of diseases
- Slum area increasing, due to poor water treatment and poor sanitation facilities, hence prevalence of water-borne diseases
- A growing population and its concentration in poor areas
- Due to rapid social, economic and development changes in the city and that population is mobile half a day out of the city, it makes difficult to plan projects for improving of environmental situation with waste and sanitation in Kampala
- Low service coverage of solid waste
- Existing waste trucks are insufficient in number and often break down, therefore there are high costs for maintenance
- KCC has taken a considerable step : privatization of solid waste collection and disposal, build one dumping site as a sanitary landfill allowing to private companies to collect and dispose solid waste for a fee
- Some wastes are converted into metallic containers, children toys, compost, wrapping paper or envelopes ; banana peelings and other plant leftovers are used as a supplementary feeds to dairy zero grazing systems; piggery benefits from leftovers from restaurants and vegetable / waste green from the markets
(Lwasa et.al, nd)

Kisumu

- Lack of collection facilities and low efficiencies in operation of existing facilities ; design, location and capacity of final disposal sites
 - The poor management of solid waste has resulted in generation of leachate which pollutes ground water and soil, the spread of infection diseases such as eyesores, blockage of drainage systems, spread of foul smoke from burning of waste and Lake Victoria pollution through runoff
 - Scavengers are exposed to health risks because there is no separation of hazardous waste fractions practiced
 - Waste transported to the landfill is not properly managed, often open burning to reduce the volume of waste
 - Many households do not have a privilege of any mode of collection so they often burning it or digging their own pits to burry the waste on site
 - Plastic waste is the most conspicuous nuisance, often littering in many parts of the cityand sometimes blamed for livestock death and blockage of storm water drains
 - Almost 60 % of the waste is organic in character presenting enormous potential for recycling for farm use
 - Some recycling initiatives already exists in Kisumu
 - Awareness campaigns are regularly mounted in an attempt to encourage self-responsibility among the citizens
- (KCC, Centre for development &Planning Management, 2004)

Discussion

The extent and complexity of the environmental problematics of the Lake Victoria while processing needs to be taken into account. This complex issue deals with all ecosystem around the lake, such as water hyacinths, production of Nile Perch, et cetera.

By the use of fertilizers and agrochemistry (such as Urea, Ammonium Sulphate or Calcium Ammonium by farmers) or fish exports, intervention of economical interests also have to be taken into consideration however in terms of disadvantage of the environment.

To deal with the fact that population of the Lake Victoria Basin is ever growing and that it is the major cause of environmental degradation of the lake, access and actually the overall amount of clean water has its huge importance. There is a need for more studies provided taking of water samples and consequently implement measures to eliminate this water pollution. The cost of the water from pipes is high as many residents in slums and another informal settlements do not have adequate financial resources hence they have to rely on polluted water from wells and springs and consequently suffer from water-borne diseases.

In order to improve the managing of waste disposal and sanitation in the two coastal areas and around Lake Victoria in general, governance should be more promoted in terms of transparency, accountability and responsiveness if effective urban planning as the first and major step, is to be put in place. The tools developed by UN-HABITAT or World Bank to improve the integrity of local authorities can be deployed here to improve governance. Financial budget is low and even poor governance have the negative impact on mitigation of water pollution.

7. Conclusion and Recommendations

Lake Victoria, for over three decades, has been in serious environmental problems from urban runoff as a result of high population and urbanization as well as the limited capacity of different authorities in this area. Rapid growth of the population, especially in the coastal areas has resulted in increased human activities, such as fishing, mining, et cetera and destruction of natural wealth of the Lake Victoria. As population rapidly growth, they produce more waste which causing damage of fertile land. When the rain falls down, the waste and chemicals from lands run off into the lake and change his structure. The runoff from urban areas also contributes to the enormous amount of nutrient supplement to the lake where it increases the eutrophication (Lotodo et al., 1999). Growth of eutrophication will results in algal pollution, consequently low oxygen in the lake and then fish extinction. The problem relates to limited transporting, fishing and water supply. Therefore Lake Victoria loses his self-cleaning function caused by these problems, waste is insufficiently disposed and contributes to environmental degradation. Limited job offers results in poverty hence a lot of people cannot afford proper sanitation. By low level of awareness of local communities living in the coastal areas, the problem grading however thanks to the projects implementations, some communities try to collaborate with aid organizations because all of them share the same purpose - to save the Lake Victoria.

Are the Lake Victoria countries serious enough to mitigate increasing occurrence of solid wastes in the lake itself and surrounding habitats?

While processing the available scientific sources important informations were gathered which helped the autor to realize that there is some level of collaboration among the heads of countries sharing the Lake catchment area (Kenya, Uganda) signing of various charters and protocols in order to save the lake. Because of budgetary and institutional constraints, by-laws for waste disposal are in place in the Municipalities in the coastal areas and areas in the Lake Victoria but they have not been implemented. There are international, governmental and non-governmental aid organizations which are undertaking several programs aiming at protecting the lake. But the drivers of the problems receive limited focus in these programs.

Recommendations

Therefore the recommendations for the following actions to receive priority in the future are:

1. A deepened collaboration among the heads of the countries sharing the catchment area should be encouraged to reduce run-off (waste) into the lake.
2. A research should be conducted into effective data collection of waste collected and uncollected.
3. Donor organizations should not only concentrate on the waste and sanitation problems but also the drivers (high population and urbanization).
4. The activities of small-scale waste collectors should be well documented as they also contribute to reduction of the waste problem.
5. As many of towns surrounding the Lake Victoria, and in our case also Kampala and Kisumu, are not connected to national drainage systems-untreated waste and human waste including are discharged to the water bodies – therefore more sewerage systems and water purifiers are needed.
6. Collecting, sorting and use of solid waste.
7. Because the waste of biological character is prevailing, the extension of composting is put in the place or utilize it for biogas and electrical energy production.
8. Support of usage of secondary raw material from waste.
9. Wetlands protection from house-building and pollution.
10. Need of controls while transferring of new biological organisms(fishes) into the lake and surroundings.
11. To look for such a ways of solution that countries can afford in terms of resources itself.
12. The Faculty of Tropical Agriculture should engage in these environmental matters of the Lake Victoria since the issue is actual and not solved.

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