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Assessment of Urbanization Implications in Water Management around Lake Victoria: Case of Mwanza

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Abstract

This study assesses urbanization implications on water management around Lake Victoria in Mwanza. It was conducted in Nyamagana and Misungwi Districts; and the data were collected from April 2020 to June 2021, and two hunmderd (200) respondents participated.The main findings of the study is that; urbanization, which is associated with various socio-economic activities, caused destruction and pollution of water sources and the general ecosystem around the Lake Victoria ecosystem. It is concluded that, there is a direct relationship between urbanizations, pollution and degradation of the physical environment around Lake Victoria. From the study, it is recommended that land use planning and management must be applied to mobilize, facilitate and motivate local community-based groups for participatory waste and overall water and land resources management around the Lake Victoria Basin

Keywords: Urbanization, Water, Lake Victoria, Pollution and Management

1.0 Introduction

The water resource is an important catalyst for accelerated economic and social development (URT, 2002). The Lake Victoria Basin is a treasured natural resource in the eastern Africa region.The Lake Victoria Sub-basin is home to around 45 million inhabitants and has an average population density of 300 persons per sq.km (World Bank, 2018). Since 1930's Lake Victoria and its basin have undergone enormous ecological changes. The human population around the Basin has doubles every 22 years (World Agroforestry Centre, 2006). Population growth around Lake is significantly higher than the rest of the African Region. In each decade, the population growth within a 100km buffer zone around Lake Victoria outpaced the Continent average. This reflects growing dependency and pressure on Lake Victoria and its basin (UNEP, 2016).

Growing urbanization threatens the quality of the environmental of Lake Victoria. Although urbanization drives economic growth, it also brings serious environmental challenges to the Lake Victoria Basin. The enormous speed at which Africa's cities are growing is linked to other key development trends, most prominently accelerating economic and population growth, increase migration from rural to urbarn areas (APC, 2022). According to world Bank report by 2050 there will be 16.6-38.5 million internal climate migrants in the Lake Victoria Basin countries (World Bank, 2021). One critical issue that urbanization forces us to deal with is water management. Demand for water management has increased rapidly as a result for growing urbanization (Yanar and Choi, 2019). Urban population growth, particularly in developing countries, places immense pressure on water and land resources (Scott et al.2004). Rapid urban population growth coupled with inadequate planning and resources management can pose social and economic consequenses (Kintu et al, 2019). Urbanization places an enormous ecological burden on most secondary town in the Lake Victoria region (ICLEI, 1998). Over the last two decades, the lake basin has been experiencing increased urbanization with cities like Jinja, Entebbe, Kisumu, Homabay, Musoma, Bukoba and Mwanza as examples (LVBC, 2007). These same opportunities have created highly negative impacts on the economic and social status of the residents as well as the ecology of the basin. Pressures emerging from diverse social and economic activities, as well as from natural processes increases the vulnerability of the Lake Victoria ecology and often not adequately addressed (Karanja, 2006).

The study of the land use and land cover changes in the Yamuna basin during the period 1985-2005 at the decadal interval shows continue of build up and crop land area in Uttarakhand state as impact of urbanization (Kumar et al, 2020). Also Rashid et al (2018) have analyze the relationship between land use change and water quality and how both factors have been affected by human due to rapid urbanization. Availabe resources like water are being depleted through man-made action (UN Water, 2018). Unexpected population growth is related to water quality degradation and is causing large increase in nutrients and microbial loads (Ghosh et al., 2014). Therefore, urban areas have the potential of generating ecological and environmental impacts at multiple scales (Ghosh, et al., 2014). According to Zhou and Tong (2022) development of urbanization and ecological environment is global scientific problem. With this background in mind, the current study sought to assess urbanization implications in ecological sensitive areas in the Lake Victoria with a view to providing empirical evidence for policy makers on the value and potential of this ecology in the Lake Victoria Basin.

2.0 Material and Methods

2.1 Theoretical framework

This study is explicated by two theories, 'Urban Environmental Transition Theory' (UETT) and 'Per-Urban Turbulence'(PUT). Urban Environental Transition Theory developed in the 1990s by McGraham (2007) in order to addres environmental problems in the cities. It is established and developed from studies stating a connection between urban environmental burdens and increasing abundance in wealth (Bartone et al., 1994). Much of the discussion revolves around the effects of affluence of cities upon any transformation among environmental burdens issues because of the process of wealth accumulation.

For cities which have comparatively low earnings and revenue, the challenges on the environment are abrupt, confined to that specific area and pose a serious threat to people's health. On the contrary, for cities that are more progressive environmental challenges at large scale are intergenerational and harmful to ecosystem. Therefore, these tendencies are the consequences and not something that is determined beforehand.

In other hand, Peri-Urban turbulence explains how urban settlement can led to vulnable population and high rates of poverty through the process of rapid change due to population increase. As most of this emerging cities are found in Global South, increase pressure for high population densities can led to increase of calamities such as floods, drought, soil erosion and diseases (Hutchings et al, 2022). As the impact of heterogenous activities that can be traced every where in peri-urban Africa,in one space you can find farming, mining, squatter settlement, factories and transportation activities are going on.

The theory also commend that, world population will continue to grow and more peri-urban will emerge troughtout Global South, this will led to an increasingly urbanized planet, cities are expanding and will expand outwards to incoparate land around them (Hutchings et al, 2022). Peri-urban cities experience impacts in social, economic, and ecological angles; this led in disruption on provision of social services and social infrastructure, good example is availability of safe and clean water, also raise the question on sustainable human settlementas per sustainable development goals particularly goal number eleven.

2.2 Study area

The study was conducted in urban and peri-urban areas of Mwanza Region (Fig.1). Mwanza Region is in the Lake Zone of the Lake Victoria in northeast Tanzania extending between latitude 1^0 $30^1$and 3^0 0^1 south of Equator and longitude 31^0 $45^1$and 34^0 10^1 east of Greenwich (MRSEP, 2016). Mwanza Region has a total area of 25,233 sq. kms divided into land area (11,796 sq. kms equivalent to 46.7 percent of total area) and water (13437 sq. kms or 53.3 percent) mostly Lake Victoria. The region lies at about 1080 meters above the sea level. Mwanza has an equatorial type of climate that is characterized by bimodal rainfall pattern, the short rains falling from October to December and the long rains falling from March to May (MRSEP, 2016). The region's average annual rainfall is 1000mm; the temperature in the region is to some extent influenced by the Lake Victoria about 25^0C-28^0C between September and December, and cool dry season which lasts from June to August when the temperatures are low ranging 20^0C and 11^0C. The soils vary from sand or sandy loam to sandy-clay or loom-clay texture "mbuga" (MRSEP, 2016). Specifically, the study was conducted in three districts of Ilemela, Nyamagana and Misungwi in Mwanza Region. Urbanization and population expansion in the Region plus the Population and Housing census report (2012) as the study area locate adjacent to Lake Victoria were the major reasons for selecting the study area. Logistic support was also another reason for selecting the named districts.

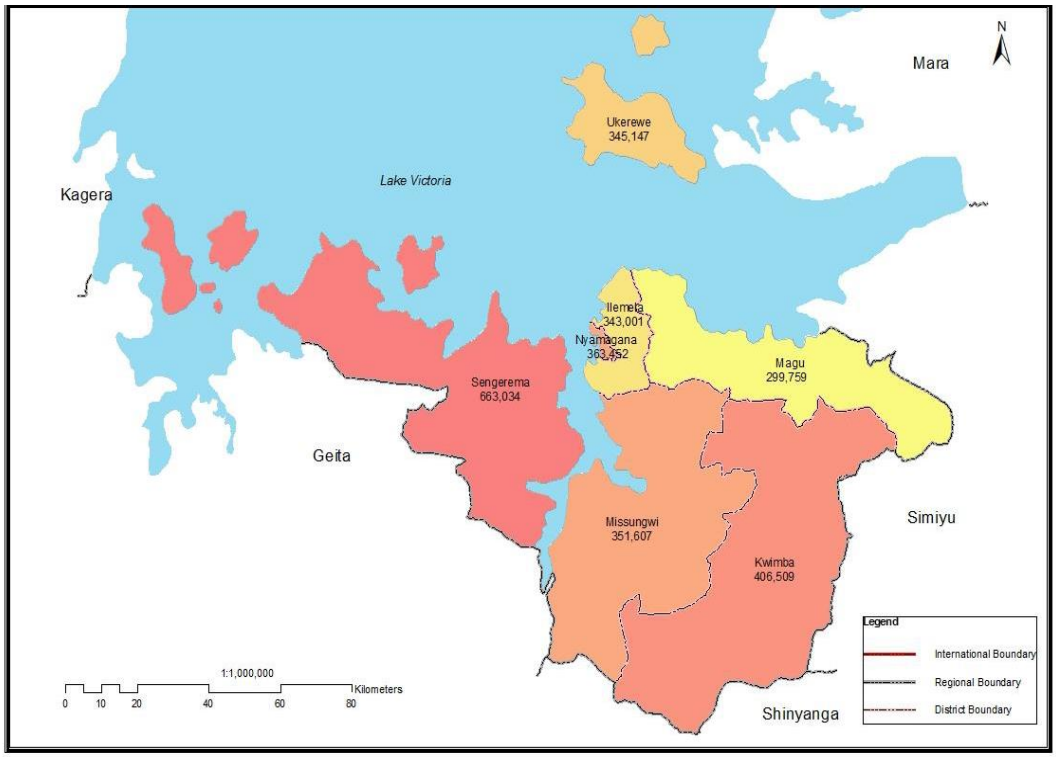


Figure 1. *Map showing the study area Source (NBS, 2001)*

2.3 Study design and data collection

This study was conducted from April 2020 to June 2021. The study used qualitative technique, and involved focus group, individual interview and observation. Other methods employed included documentary reviews. Secondary data on the population and GDP from Nyamagana, Ilemela and Misungwi Districts were obtained from NBS (2012) and MRSEP (2016). In-depth interviews of key informants were used to solicit information related to urbanization and implications on ecologicalyl sensitive areas of the Lake Victoria. Cross-sectional survey was employed in four wards as presented in Table 1.

Table 1: Wards selected for a cross-sectional survey in the study area

S/n	District	Number of Wards Selected	Name of Wards
1.	Ilemela	1	Ilemela
2.	Misungwi	1	Idetemya
3.	Nyamagana	2	Luchele and Nyamagana

Two hundred (200) respondents, including 180 households and 20 environmental experts and activists, were interviewed. Simple random sampling method was used in selecting household respondents while purposive sampling was employed to select the environmental experts and activists as informants.

2.4 Data processing and analysis

Data was collected, analyzed and presented thematically reflecting objective of the study. I n analysis of data, the researcher also considered the triangulation of data collected in form source in order to ensure the validity and reliability of the information obtained. Data generated (output) was presented in deception or text form with the support of table, figure and maps where necessary for clarification of information obtained.

3.0 Results and Discussion

The study assessed the impacts of urbanization on the sensitive ecological areas around Lake Victoria. Respondents were asked to identify various impacts caused by urbanization. The findings indicated a close relation between urbanization, population expansion, and environmental threats to sensitive ecological areas of the Lake Victoria Basin. Further, the respondents were asked to state the likely causal factors for the experienced ecological deterioration. Their responses are presented in Table 2.

Table 2: Causal factors for environmental deterioration in the study as stated by respondents

Causal factors	No. of respondent	%	Sources (%)	
			Domestic	Industrial
Pollution	28	14	7.14	6.86
Overfishing	30	15	3	12
Chemical discharge	24	12	4.68	7.32
Sewage system	33	16.5	8.08	8.41
Land degradation	38	19	11.78	7.22
Waste dumping	25	12.5	9.75	2.75
Forest products	22	11	10.1	0.9
TOTAL	**200**	**100**	**54.53**	**45.47**

3.1 Pollution

Important pollution components of the Lake include eutrophication, microbiological pollutants and suspended solids from both domestic 7.14 percent and industrial sources 6.86 percent as per Figure 1. Most of the fishing and transport industries located along Lake Victoria water like Igogo, Airport, Busisi and Kamanga direct most of the untreated wastes to the Lake water. One example is the Igogo industrial area in Mwanza, most of whose industries found adjacent to lake water discharge all the waste waterastewater in the Lake.

The ships and ferries are themselves potential sources of pollution both for waste disposal and marine accidents, like MV Bukoba, which dump pollutants into the

Lake Victoria where water movement caused widespread impact of potential pollutants. Also, the study has revealed that excess nutrients in Lake Victoria arise from a variety of anthropogenic activities, which include deforestation, intensive cultivation and run offs from agriculture, municipal and industrial affluent.

3.2 Overfishing

According to results in Table 1, fishing was a lucrative business since time immemorial, but in past decades fishing has been undertaken for both subsistence and commercial purposes as a result of urbanization. Most of the fish folks have been fishing over the years as a source of their livelihoods, but previous decades fishing became increasingly commercialized,, and most fish species, and particularly the Nile Perch was under pressure to sustain both commercial and subsistence uses, which led to overfishing of the resource.

The study revealed 15 percent of total respondents suggested that 3 percent is due to domestic uses and 12 percent is due to commercial demands; thus urbanization involves intensive business venture. Many industries were opened to meet demand and supply, hence overfishing. Also, it shows that there is a reduction in the diversity of fish species in Lake Victoria due to change in the ecology as the impact of human activities on the Lake. Additionally, the uses of pesticides to catch fish pose a great risk to human and environmental health and to the acceptability of the fish to the international market.

3.3 Chemicals discharge

This study reveals an increasing use of chemicals in the Lake Victoria in recent years. Many restricted chemicals are used by untrained persons, while adulteration of some is common. Most of the respondents mentioned the use of DDT, Endosulfan, Diedrin and Lindane. Also, it has been discovered the increases in commercial farming within wetland area of the basin, organophosphate compound is used to control weeds eventually washed away to the water or stays in the soil and cause harmful to the soil PH scale due to high concentration.

Furthermore, the study shows that the excess nutrients have led to the proliferation of macrophytes, and algae blooms whose decomposition lead to depletion of oxygen in the bottom waters, thus contributing to death of fish and loss of habitat. Increasing the cost of treatment is evident in water treatment plants that abstract water from the Lake.

3.4 Sewage system

Water is vital for treatment and disposal of cities and municipal sewage. Findings in Table 1 also indicate that wastewater was another problem to the ecology of Lake Victoria due to absence of a proper sewage system. Treatment plants are, therefore, always close to permanent water sources while municipal and industrial effluents are often disposal off aquatic ecosystem. The sustainability of water as a medium for treatment and safe disposal of municipal sewage is a challenging task to modern emerging urban in Lake Victoria as 49percent believe that domestic is the source of this sewage while 51 percent believe that it is due to industrial development the discharge of partially treated or raw sewage from urban centres together with wastes from landing beaches, has resulted in the contamination of surface water sources with pathogenic microorganism.

3.5 Land degradation

Most aspects of utilization of wetland ecosystems and resources in the Lake Victoria Basin are not based on proper planning. They often lead to serious ecosystem degradation, and are therefore, unsustainable, intensive improper planned excavation of sand and clay for construction occurs in wetland close to the urban centers. In the process, valuable wetland biodiversity is destroyed. As the result shows 19percent of respondents suggested that domestic activities highly responsible for land degradation which is 11.78 percent compare to industrial 7.22 percent as they suggest awareness is needed to reduce the disposal of domestic waste to water and land but most of the Basin area is now under threat due to sand mining activities continue to take place near lake basin as the demand went up daily with expansion of town to complex city like Mwanza.

Hard waste also continues to pile up every day from domestic sources wards like Mabatini, Buhongwa and Kirumba continue to contribute a huge share. The large earth scarification disfigure entire landscape and trap water. There has also been witnessed a steady decline in the size of per household land holding in the decades leading to 2010. This coupled with the basin's population growth rate. The continuous decline in per household land size and cultivated land per person constitutes threats to food security. Land degradation in the Lake Victoria Basin worsens the state of food security and integrity of the environment, which in turns threatens the stability of societies and the regional environmental

3.6 Waste dumping.

The study revealed an increase in waste in the study areas due to population pressure. Twelve (12) percent of the respondents identified both industrial and domestic as sources of waste in Lake Victoria as 9.75 thought that the domestic source as a cause while 2.75 believed that industries are as the source. Also, the study revealed the absence of proper places for dumping hard and liquid forms of wastes and the available one are not sufficient to sustain the population pressure within the locality.

Additionally, the study reveals negligence in laws and regulation enforcement despite the existence of those laws and by laws enacted to assist in administrative duties. Most of the offenses related to the environment went unpunished, and people continue to dump waste as usual in Lake Victoria and its basin.

3.7 Forestry produce exploitation

Forestry and woodland resources in the Lake Victoria Basin have declined considerably because of the indiscriminate harvesting of fuel wood, fishing cunning, charcoal making for domestic uses, amount of fuel wood uses, as per results 91 percent suggested that domestic demand responsible for forest produced exploitation in the Lake Basin is for domestic uses. Therefore, growing urbanization puts pressure on human beings to find cheap ways of meeting their amenities by over exploitation of existing resources within the Lake Basin. In Misungwi District, the results have shown that efforts to reforest the region still have a long way to go in order to show meaningful impact. Only percent believe that forestry produce from the Lake Basin is intended for industrial consumption. This paints a picture of how life puts pressure on low- and middle-income families in urban areas as they struggle to meet their amenities. As more modern urban puts limited choice to these classes to cope with life, fewer options leaves them with no choice other than over-exploitting resources within the Basin.

4.0 Conclusion and Recommendation.

4.1 Conclusion

This study was carried out to assess the urbanization implications on ecologically sensitive areas of Lake Victoria, Tanzania, as a case study. The study has revealled that urbanization, growing commercial activities and industrialization in

Nyamagana, Ilemela and Misungwi in the Lake Victoria Basin coupled with inadequate provision of waste management services, have led to an increase in the volume of carbon waste discharged into the Lake water and environment. This, together with poor urban planning, of dilapidated and inappropriate technologies, poor maintenance of treatment plants, lack of waste treatment and disposal mechanism, has resulted in the deterioration the Lake Victoria ecology.

4.2 Recommendations

The study recommends that, there is a need for proper management of solid and liquid wastes from both industrial and domestic sources to improve the quality of natural water resources like rivers and lakes, also strengthen, monitor and control anthropogenic activities in the Lake Basin that are roots cause of ecosystem degradation. Furthermore, proper land use and management through public awareness programs geared towards sensitizing the public on the ongoing environmental destruction and how it can be mitigated. We also recommend to expand regional and international cooperation on Lake Victoria basin management and continuing various projects like the Lake Victoria Management Environment Program (LVMEP). Lastly, is to mobilize, facilitate, and motivate local community-based groups for participatory waste and over all water resources management in the locality.

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