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Implications of Rapid Urban Sprawl towards Water Resources Management: The case of lake Babati, Tanzania

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Abstract:- Population and economic development are key drivers of water resource pollution. The population of Babati town increased from 44,000 in 2002 to93,108 inhabitants in 2012. It was projected the population would have reached 105,610 inhabitants by 2022.This study is an attempt to assess the implications of rapid population and spatial growth of Babati Town on Lake Babati and water resources. The study involved random sampling in the four villages of Hangoni, Himiti, BagaraZiwani, and GendiKuu. The data were collected through direct observations, questionnaires, and interviews with individual households around the Lake. TheGIS technology was applied in analysing the collected data including trends of the implication of population and spatial growth on Lake.

The study revealed that there is rapid population growth inBabati Town including around Lake Babati whereas, Bagara ward which is located around the lake found with the highest populationconcentration;Migration (58%),andNatural increase(37%) are the major causes of population growth; Spatially the Town to grow around the lake Babati shore and along Babati-Arusha Road, Babati-Singida Road, and Babati-Dodoma-Road;Economic factors and migration (61.3% respondents) and increase of the value of the land at the Town center (28.7% respondents)have indicated are the main causes ofthe rapid urban sprawl around the lake basin;Deforestation and soil erosion, flooding, pollution, encroachment of lake areas, eutrophication and shrinking of the lake size are the major impacts of rapid urban sprawl towards Lake Babati and water resources.The Government led initiatives in addressing the challenges include Land management programs;the development of Natural resources Legal Frameworks;the Development of urban spatial growth guidance frameworks; and the establishment of Natural resources management policy frameworks.

To this end, the study recommends physical boundary demarcation ofthe core area of the lake;public awareness creation campaign on existing bylaws, people's responsibility in protecting the lake and the grave consequences of environmental neglect; and a review of policy and regulations to favorthe necessary needs of the communities around Lake Babati.

I. INTRODUCTION

Urbanization over the last three decades resulted inthe overuse ofthe available water resources which reduced the area of water bodies such asponds, lakes, and canals (Ningrui et al, (2010). Experience shows water resources are useful in many social and economic activities which includeagricultural, industrial, household, recreational and environmental activities. They can also be used to prevent heat island effects and to improve the microclimate in cities (Nindi, 2010). This makes the availability of freshwater not only vital for the survival of the human race, but also for the ecosystems upon which humans depend (Anderson, and et al., 2013).

Urban spatial growth is a major cause of the distraction of the water resources and also exerts significant influences on the structure and function of water resources, mainly through modifying the hydrological and sedimentation regimes, and the dynamics of nutrients and chemical pollutants. (O'Driscoll, et al., 2010).Babati has shown an increasing population growth trend.The population has increased from 44,000 in 2002 to93,108 inhabitants in 2012. It was projected the population would have reached 105,610 inhabitants by 2022. (URT, 2003). The rapid population growth of Babati Town which accompanied by spatial growth may results to several environmental impacts. This may include excessive landscape changes as a result of agriculture practices, brick making, livestock keeping, deforestation, waste disposals and over fishing. Other impacts may include flooding incidences as highlighted by Sandstom(1995);habitat loss, degradation and fragmentation; spread of invasive species; and pollution of tributaries.

Therefore, it is the interest of this study to assess the implications of urban spatial growth prevailing around Lake Babati including the status of water resources and their sustainability in the pace of high human population growth and other anthropogenic activities.

II. LITERATURE REVIEW

The global population exceeded 7 billion people for the first time, representing a doubling of the global population in less than 50 years (United States Census Bureau, 2012). It is anticipated that 83% of the developed world and 53% of the developing world will live in urban areas by 2030 (Cohen 2004). However, the expansion of

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urban areas continues to pose a significant threat to natural dynamics, resource availability, and environmental quality (Niemczynowicz 1999, Vörösmarty et al. 2000). For example, in West and Central Africa which is endowed with numerous surface water resources (rivers, estuaries, lakes, reservoirs), including major rivers such as the Niger, Senegal, Gambia, and Lake Chad the urban spatial growth has resulted in substantial loss and degradation of natural ecosystems over the last 80 years (Cohen, 2004). Lake Chad, for example, fluctuates in size from 2.5 million Ha in 1960 to 600 000 Ha in 2012, being severely impacted by aquatic weeds(Denny,1985). In North Africa, Tunisia has experienced an overall loss of 15% of wetland area, and an 84% loss of wetlands in the Medjerdah catchment alone (Moser, 2006).

In East Africa, Lake Victoria is the second-largest fresh water lake in theworld and the largest tropical lake with a surface area of68,000 km^2 (Wang et al. 2012). The lake also provides alarge quantity of fish for East African countries as well as forexport markets in USA, Australia, European Union countries,and Israel (Muli 1996). The catchmenthas a high human population density due to urbanization and industrialization whose activitiesinfluence the lake intensively (Lung'ayia et al. 2001) including degradationof its waters (Wang et al. 2012).

In Tanzania, there is an abundant water resource which includes African Great Lakes such as Lake Victoria, Lake Tanganyika, and Lake Nyasa; inland lakes include Lake Rukwa, Lake Eyasi, lake Babati, and Lake Manyara. Also,as indicated inURT (2022), Tanzania has several wetlands resources in the lake systems, river floodplains, delta, and mangrove systems. The major wetlands include the Kilombero valley flood plain, Usangu plain (Ihefu) wetland, Malagarasi-Muyovozi Wetlands, Kilombero floodplain wetland, Lake Natron wetland, Usangu floodplain, Rufiji delta, Lake victoria wetlands, Wembere-Kitangiri_LakeEyasi system of wetlands, Katavi floodplain wetlands, Mara River wetland, Sao Hill wetlands, Lake Jipe wetlands, Bahi Swamp, Singidani and Kindai wetlands and Burigi Lake.

However, most of the water resources in Tanzania including wetlands are under intense pressure from encroachment and human activities (URT, 2022). For example, the size of the wetlands of Ihefu, Kilombero, and Malagarasi have decreased as indicated in Figure 1.0 (ibid).

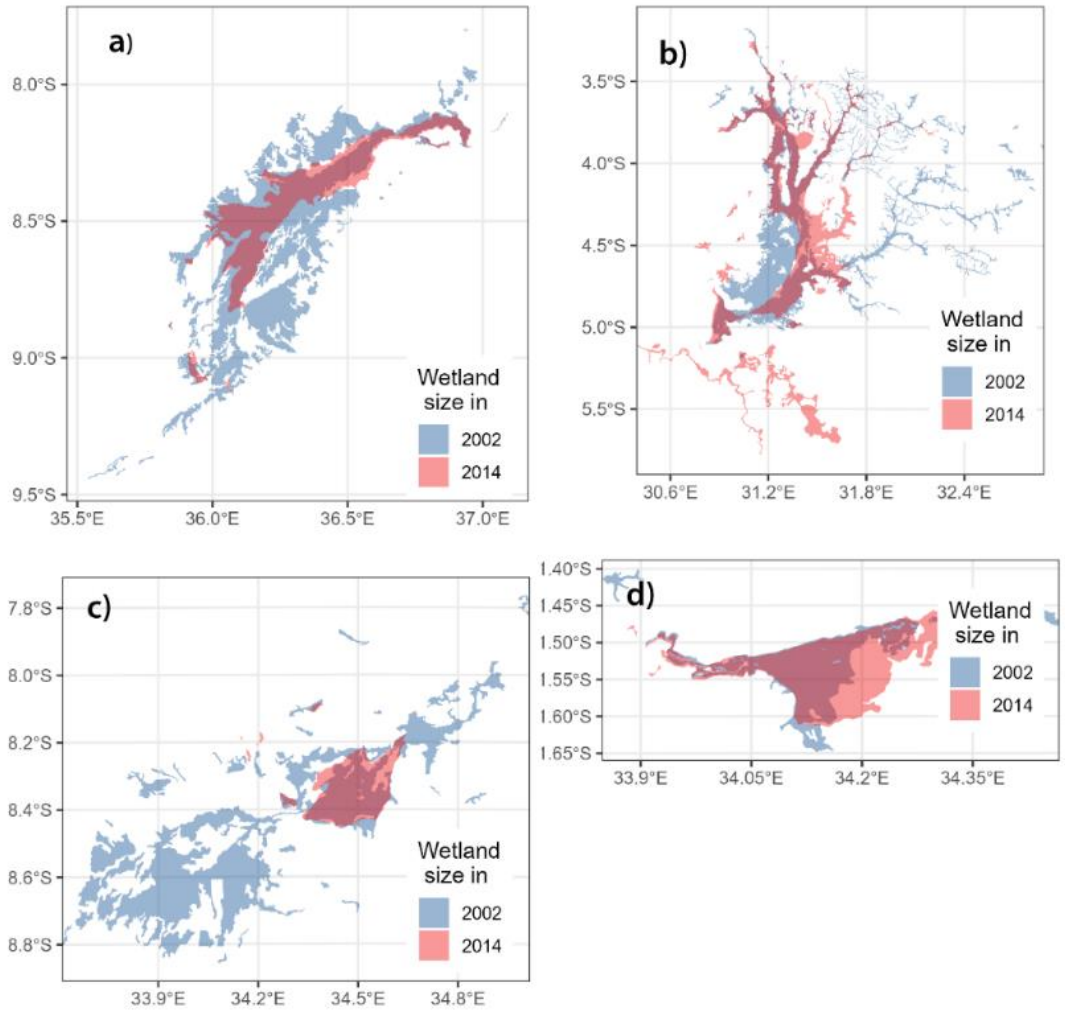

Fig. 1: Change of wetland are between 2002 to 2014 in Kilombero (a) Malagarasi (b) Ihefu (c) and Mara (d) wetland.

Source: URT(2022)

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According to URT(2022) the causes of deterioration of water sources including Wetland are unsustainable agriculture especially, uncontrolled irrigation, overgrazing, uncontrolled construction of fishponds, illegal fishing, and overexploitation of other wetland resources. Projections indicate that by 2025 Tanzania will experience water stress due to population growth and the resulting increase in consumption (Kihwele, 2012). An increase in human activity and urban spatial growth is posing a threat to natural aquatic ecosystems in Tanzania and contributing to environmental damage and ecological changes (Nonga, 2012).

Different researchers have documented on how water resources can be utilized to combat widespread poverty without impairing their sustainability. However, only a few have a focus on the sustainability of aquatic resources (IUCN, 2012). The implications of urban spatial growth prevailing around Lake Babati are needed in order to assess the status of water resources and their sustainability at the pace of high human population growth and other anthropogenic activities. Moreover, trends of urban spatial growth in relation to water resource coverage have not been fully explored. Also, initiative measures to be taken in order to eradicate or minimize this implication have not been clearly explained and implemented. Thus, this study is proposed and undertaken so as to fill in this knowledge gap.

A. *Main Objectives*

To assess the implications of urban spatial growth prevailing around Lake Babati

B. *Specific Objectives*

- To describe the trends of population growth in Babati town;
- To assess the factors affecting population growth in Babati Town;
- To assess the spatial growth structure of Babati Town;
- To analyse factors influencing rapid urban sprawl along LakeBabati;
- To analyse the implication of the growth of BabatiTown onLake Babati; and
- To explore the Government initiatives on the conservation of Lake Babati

III. DATA AND METHODS

The data for this study was collected through questionnaires and interviews with individual households around lake Babati. Primary and secondary data were used in order to obtain an output that contributed towards the achievement of the research objectives.

Mapping of the location of Lake Babati and the trend of its coverage were done in collaboration with different Actors such as Town planners, Forest officers, and natural resources managers because they were the ones who know the boundaries of lake Babati. Tools such as GPS, Remote sensing Images were used toanalyse the trends of degradation. demarcate the boundaries of the lake.

IV. DESCRIPTION OF THE STUDY AREA

This study was conducted at Lake Babati which is among the water resources located in the urban area and it's surrounded by villages/Streets such as Hangoni and Majengo streets in Babati ward, Bagaraziwani and Ngarenaro streets as well as Nakwa villages in Bagara ward, Gendikuu and Managhat villages in Singe ward and Himiti village in Bonga ward which are all within Babati town in Manyara Region as seen in Figure 1.1. The lake is located in the northern part of Tanzania and is one out of a chain of freshwater lakes extending across the East African rift valley (Machiwa, 2003). It has an elongated shape and curving eastwards of Babati town. Lake Babati with string shape lie to the south of Babati town covers about 100 Km^2 with Lake Basin of an approximate 18Km^2. It lies along latitude 4^0 15'S and longitude $35^0$45'E. The town is situated at the northern end of Lake Babati catchment areawhich covers anarea of 460.84 square kilometres which is about 7% of the total area of BabatiDistrict. The flora and fauna of the lake Babati ecosystem includes hippo, fish, water, and bird populations.

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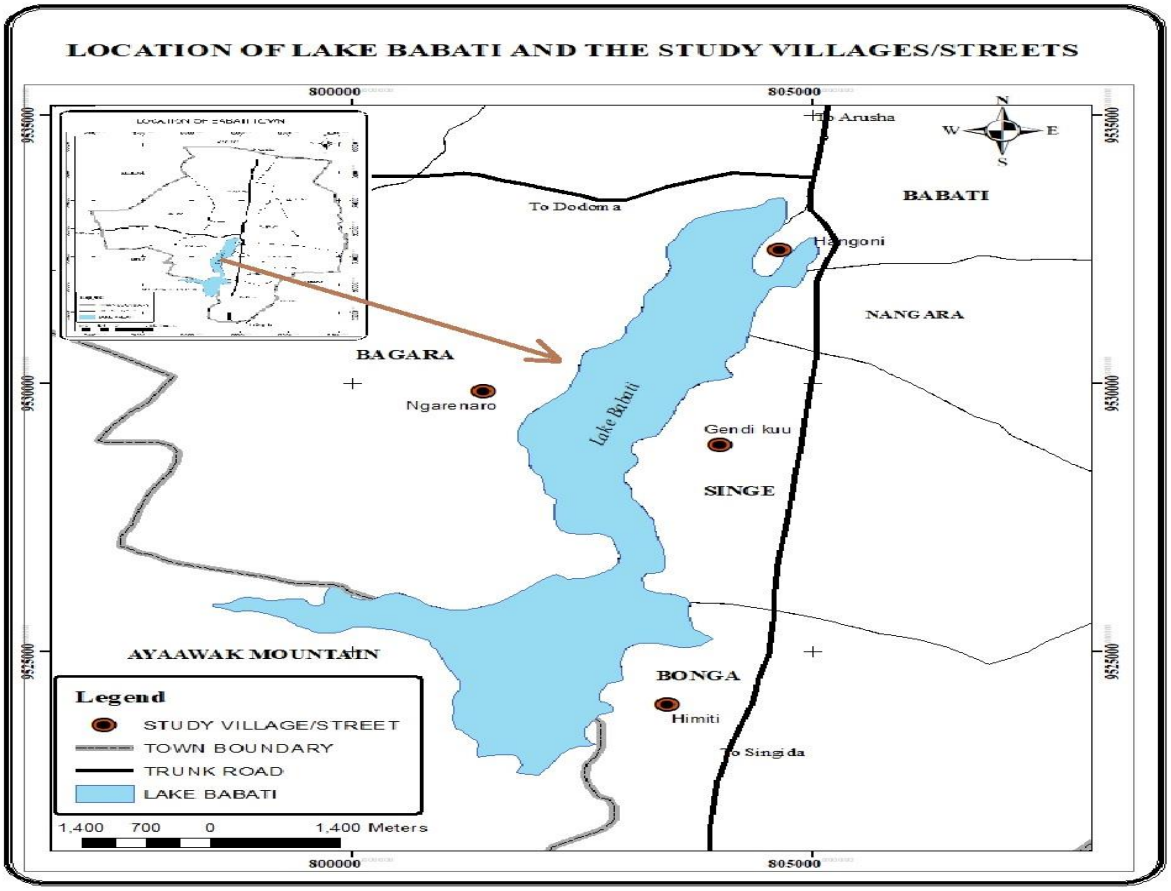

Fig. 2: Location of the study Area

Source: Authors Construct (2022)

V. FINDINGS AND DISCUSSIONS

A. Population Growth Trends

This study is focusing on the implications of rapid urban sprawl towards managing water resources around lake Babati. It covers four villages/Streets which are Hangoni street in Babati ward, Ngarenaro street in Bagara ward, Gendikuu village in Singe ward and Himiti village which is situated in Bonga ward. According to the data obtained from National Bureau of Statistics during the field work, Population growth trend of Babati Town is increasing. In 2002 census the population was recorded to be 44,000 people. In 2012, the town's population stood at 93,108 inhabitants. In the 2002 national population census, Babati town had a growth rate of 4.8. In 2012, Babati town had a growth rate of 3.2 per annum, and the current surveys have shown that Babati town has a growth rate of 5 percent.Findings show that the projected population is currently estimated at 146,216people. The highest population size was observed inthe Bagara ward (28,920 people) while the Mutuka ward had the least population (4,910 people).In 2020, according to the projected population data, Bagara ward with 34,803 inhabitants accommodates the largest urban population inBabati Town. Mutuka remains a ward with less population (of 5,669 people). The concentration of the population in Bagara ward is influenced by the presence of fertile land and a conducive environment due to its location around the lake while less population in Mutuka ward largely contributed by the poor infrastructure, inadequate supply of clean water, and poor community services.

Therefore, the resulting population increase has stimulated the expansion of settlements, agricultural practices, and fishing in order for the population to be able to attain their own needs. Consequently,this results in the unsustainable utilization of the water resource which leads to the poor management of lake Babati.

B. Influencing factors for Urban Population Growth in Babati town

The study shows that migration contributes 58 percent of the urban growth of Babati town when compared to 37 percent of natural increase which includesa birth rate increase as well as a death rate decrease (See Figure 3). Also, other factors which were mentioned by the respondent such as those affected by boundary change contributed 5 percent in the growth of Babati town. The results show that there is rapid urbanization of Babati town due to migration, natural increase and other minor factors.

Babati town is the centre for administration and commerce in Manyara region, after acquiring this status, the town became very popular and attracted migrantswithin Manyara region and other regions as well.

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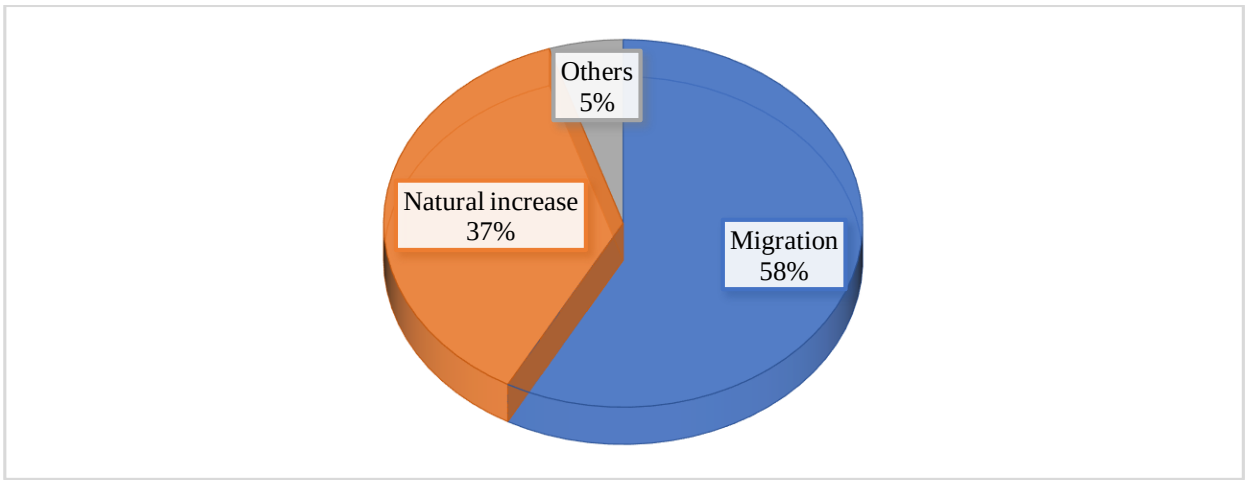

Fig. 3: Factors which stimulates Urban Population Growth.

Source: Authors Construct (2022)

C. The Urban spatial structure of Babati Town

Through observation during the field work, it was noted that, the urban form of Babati has been influenced by a number of factors notably, topography, storm water drainage system, infrastructure development and rural settlements (villages). Development is concentrated along the less physically difficult areas and main roads which radiate from the central area of the town. The overall urban form of Babati town is a mix of a compact and radial development. The oldest parts of the town comprise Babati and Bagara wards which have compact development form and it engulf the central part of the town. The two wards are also the highly urbanized areas than any other part of the town.

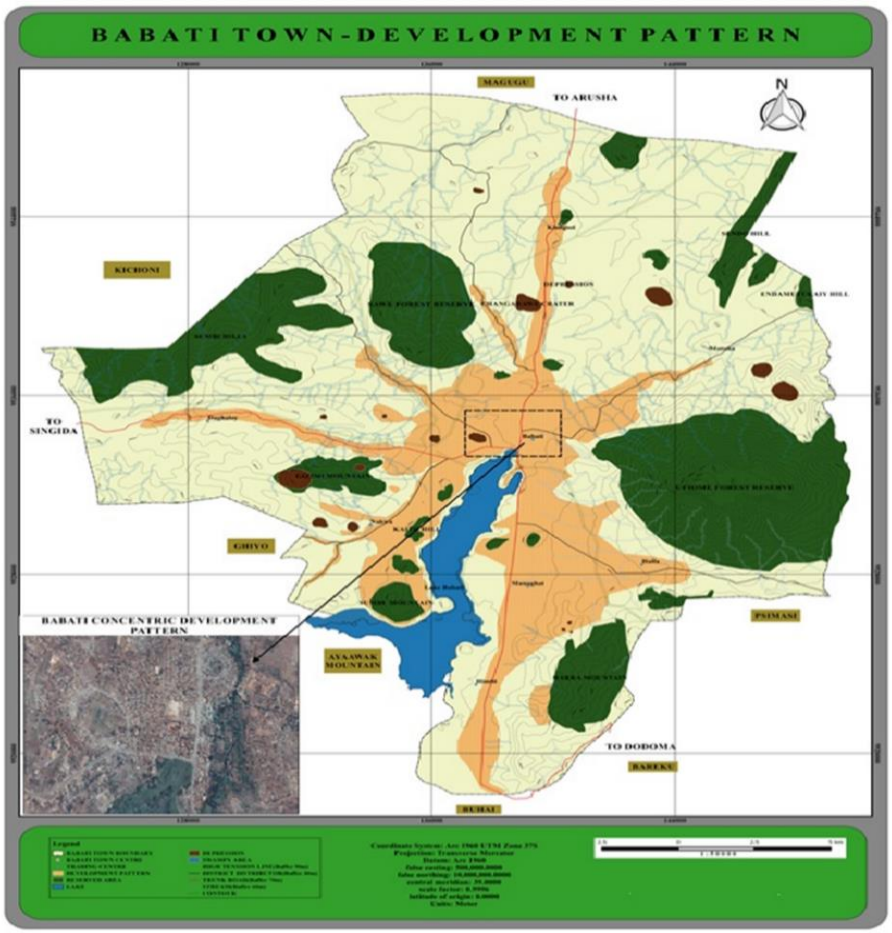

Fig. 4: Development pattern of Babati town

Source: Authors Construct (2022)

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Generally, the development radiates from the inner-city following the main transport corridors. The spatial development pattern is largely dictated by three trunk roads namely Babati-Arusha Road, Babati-Singida Road and Babati-Dodoma-Road. Rapid settlement growth is also taking place around the lake Babati shore (Refer Figure 4).

Although larger part of Babati is planned, there is rapid proliferation of informal settlements in peri-urban areas, around water resources including Lake Babati, on existing hills and mountains largely due to rapid population increase, ineffective implementation of the laws and regulation and inadequate fund for land acquisition, compensation, planning, surveying and allocate plots to urban developers.

A. Spatial expansion and land use coverage in Babati tow

Babati Town council is the centre for business and socio-economic activities and the headquarter of Manyara Regional. Spatially, the town has been physically expanding outwards. This is evidenced by its spatial coverage from the colonial era to date. The Built-up land has been expanded due to the increase of population.

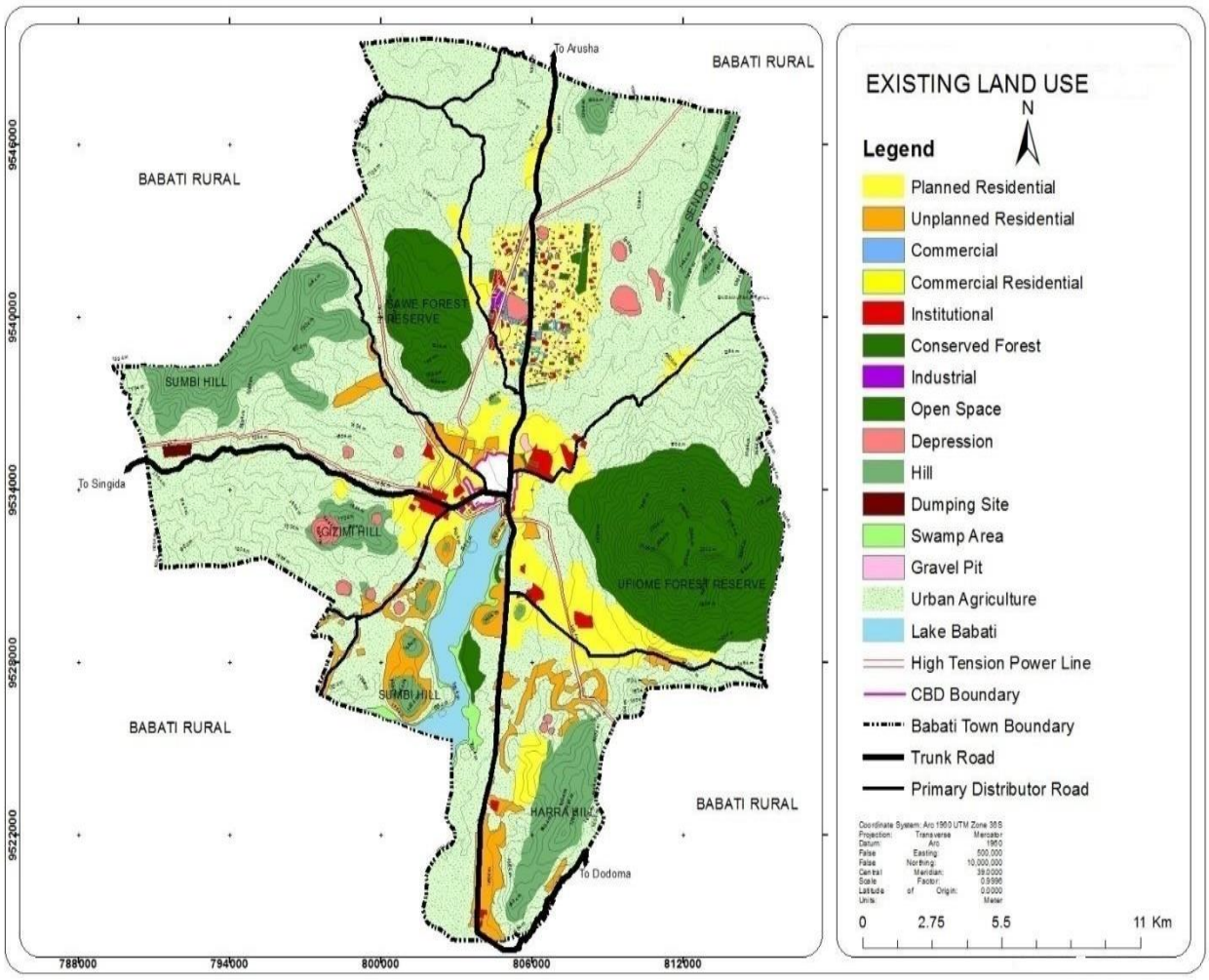

Fig. 5: Babati Existing Land Use by 2021

Source: Adopted from Babati master plan (2016 – 2036) and modified to suit the study

According to the Babati town Master Plan of 2016-2036, the increase in population and urban spatial growth, led to the changes in land uses. This is due to the fact thatland allows development activities to take place as it provides space for settlements, social and technical infrastructure and recreation. Through observation, the land uses around Lake Babati that impact water resources include agriculture, forestry, urbanization, recreation and industrialization. These land use/cover changes affect water resources mainly through vegetation interception, evapotranspiration, runoff surface infiltration, soil moisture status which affects the process of watershed hydrology and water resources cycles of Lake Babati.

D. The driving factors influencing rapid urban sprawl along Lake Babati

Respondents in the study area had different view on factors that have driven changes in land use. According to the majority of respondents (88.6%), urban spatial growth in the area is attributed by Population increase which ultimately results on pressure of land.

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Wards	Factors influencing Urban spatial Growth									
	Demographic factor %		Land Price %		Economic activities %		Migration %		Height of Land %	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Hangoni	81	19	43	67	78	22	21	79	33	67
Ngarenaro	92	08	71	29	67	33	73	27	41	59
Gendikuu	93	07	54	46	56	44	78	22	26	74
Himiti	67	33	64	36	81	19	84	16	51	49

Table 1: The influencing factors of urban growth in the study area
Sources: Field data, August, 2022

a) Migration
Table 1 presents a clear indication that, most (61.3%) of the interviewed respondents in the study area mentioned economic factors as well as Migrationas the main concern for the increase of the rapid urban sprawl around the lake basin. Based on the official interview with the Town Economist urged that, economic benefits and educational achievements are factors which stimulates the migrant decision to move out of rural areas and settle in urbanareas. The need to survive forces these in-migrants to engage in various economicactivities along the lake such as fishing, farming and others.

b) Land price
About 28.7% of the respondents in the study area pointed on the issue of the increase of the value of land at the town Centre pushes them to the place with low-cost land price especially along the lake basin where it influences rapid urban sprawl. However, height of the land was another driving factor whereby through household interview, participants mentioned as the influencing factor for rapid urban sprawl.

c) Economic activities
According to Babati investment profile (2010:52) Agricultural sector is the leading economic base in Babati district which engage about 79% of its residents. Agriculture, crop farming and livestock keeping are carried out for both cash and food crops. This is due to the availability of high fertile soil and fall within the rain zone.

Other economic activities which influence urban spatial growth which were mentioned by the respondents includes the presence of Industrial activities, Fishing activities, Trade and lastly the presence of employment opportunities which are offered by public and private sectors as well as self-employment (See Figure 6).

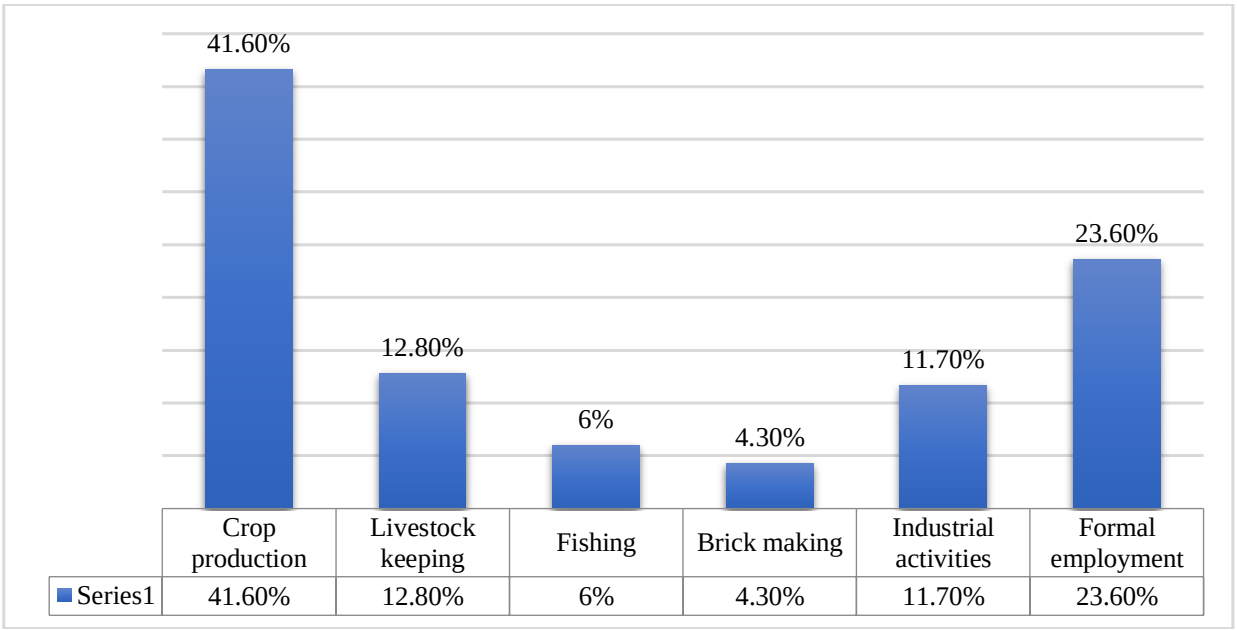

Fig. 6: The main economic activities that influence rapid urban sprawl

Sources: Field data, August, 2022

E. The implication of spatial growth of Babati Town on Lake Babati and Water resources

The rapid urban sprawl around the lake Babati due to population increase has resulted into the different impacts around and within the lake Babati. According to the respondents during the fieldwork, the obvious implication includes Soil erosion, Deforestation, Flooding, Environmental pollution, Encroachment, and Eutrophication (See Figure 7).

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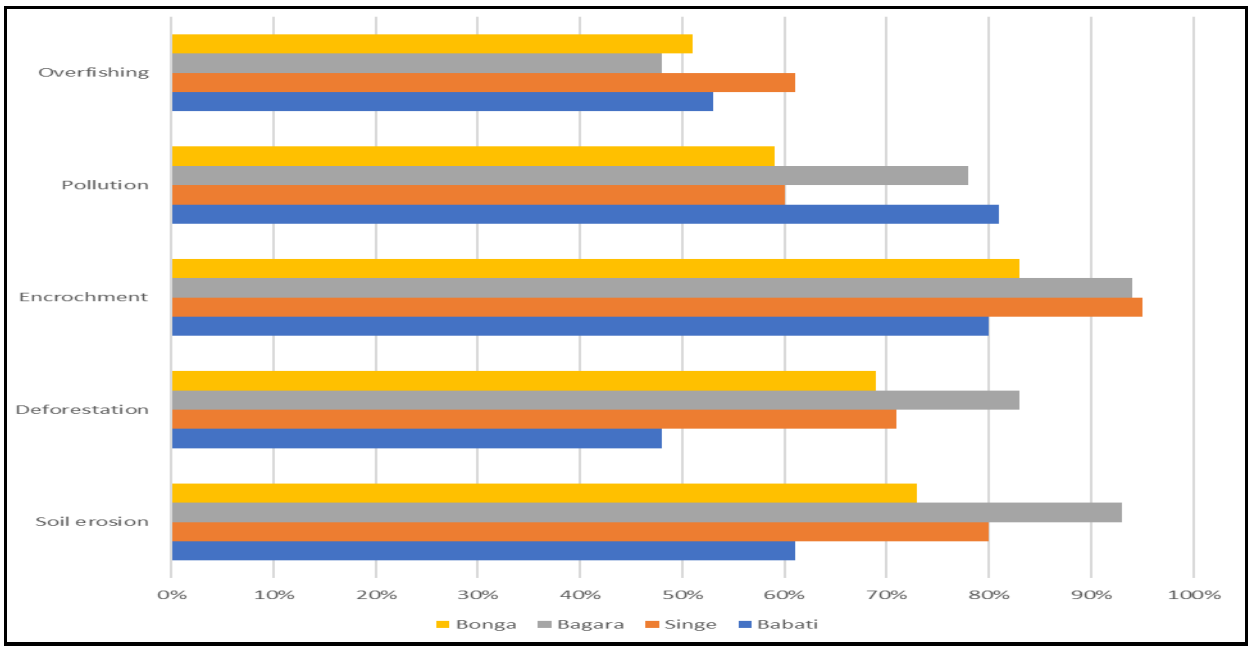

Fig. 7: The implication of urban growth on water resources

Sources: Field data, August 2022.

- **Deforestation and soil erosion**, this is due to the excessive use of or extraction of building materials such ascutting of tree for obtaining forest products like timber and poles for house building aggravates deforestation which in turn destabilises the ecosystems in the lake (See Figure 8). Therefore, almost all the Acacia xanthophloea forest which surrounded the lake was cleared for settlement and cultivation between 1990 and 2021.

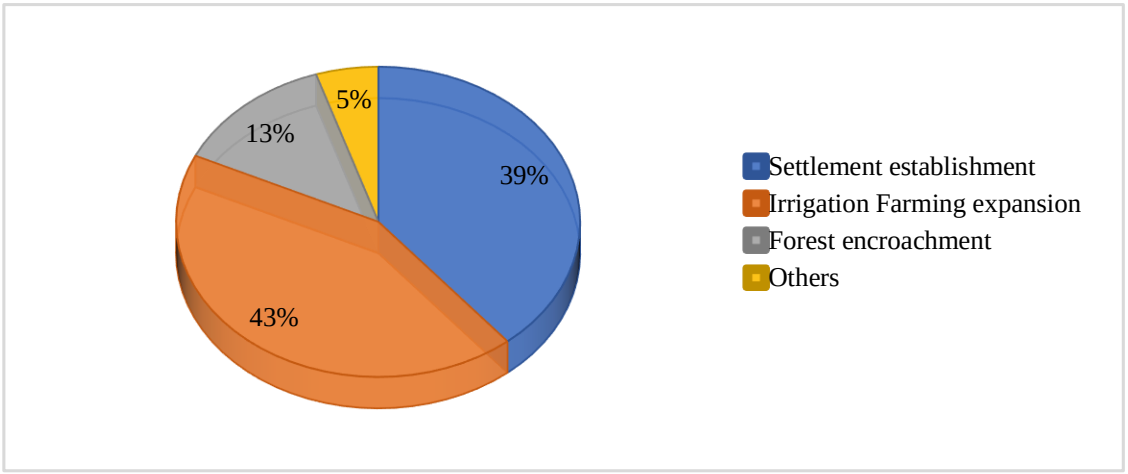

Fig. 8: The main issues influencing Deforestation around lake Babati.

Source: Field data, August 2022

The study has also revealed that, the mushrooming of informal settlementcaused by rapid urban sprawl has influenced soil erosion due to uncontrolled tree felling trees and vegetations clearance on farms and hazard lands, also lead ground water danger of pollution from cesspits pit latrine. Demand and encroachment of building materials lead to extensive gully erosion along the banks of rivers and on hills and mountains. There are many large gaping gullies on the hills and steep slopes around the lake. Hence there is no doubt that erosion is a major cause of the siltation of the lake.

- **Flooding**of Lake Babati also affects the town because ithas almost the same altitude levels with the Lake (See Figure 4.7).Also,reduction of the lake volume due to siltation, solid waste deposition, eutrophication, climatic change and the human encroachment to the discharge line of the lake was observed during the study. This factor makes the lake Babati to discharge its content through the town towards the Faheli stream. Therefore, based on the mentioned factorBabati town had flooding problems in 1990, 1997/98 and in 2006/7.

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Fig. 9: Lake Babati flooding through the main street of Babati town in 1990 and 2006/7

Source: Field data, August 2022

The only seasonal outlet of Lake Babati is in the Kiongozi/Farahani River. Informal settlement has been developed within the areas which the Lake was discharging its content.This has led to the reduction of surface area and depth of the lake and in some parts the levels have completely driven the water away leading to vegetation growth.

- **Pollution:** was noted during thebecause of the disposal of untreated local sewage and solid waste and other pollutants into the lake Babati since it has been ultimatelyturned into landfillswhich impacts the water resources. Also, the study revealed that, industrialization has been identified as the major threat to the environment as it releases various toxic chemicals, gases, solid wastes as well as microbes of various kinds into our immediate environment particularly interest in water pollution.Releasing inadequately treated wastewater into lake Babati lead to the degradation of the aquatic ecosystem. This has caused death and diseases (water borne disease) to most of the aquatic organism found within and around lake Babati.
- **Encroachment:** is a major threatto lake Babati and its associate water resources particularly in Bagara and Singe wards. Due to the increase in population and urban spatial growth, the availability of land isgetting scarce, the basic reason is theincrease of the value of the piece of land inurban areas. Hence, water resources around and within lake Babati are no more acknowledged for theirecosystem services.
- **Eutrophication:** Lake Babatiobserved to receive Industrial effluents, run-off fromagricultural fields, refuse and sewage, domestic wasteslike food remnants, soaps, detergents, and sewage through dumping practices. The breakdownof these waste and chemicals releasesnutrients in the lake. Microscopic organisms ingest these nutrients and survive on them. Followingingestion of carbonic elements, carbon dioxide isreleased, while some of the elements are converted intonitrates and phosphates.
- **Decrease in Lake volume:** Experience shows that, the lake volume is shrinking due to siltation. Siltation has been reported to be very high in recent years. Hango (2014), argues that, the lake depth has decreased from 6 – 8m on in 1970's up to 3 – 4m deep in recent years. The area of the lake has also fluctuated during the last couple of years, from 5 km² to18 km² in 1990. Environmental challenges are threatening Lake Babati and its fauna. Water level in the lake has decreased in recent years and the number of hippopotamuses has dwindled. The number of hippopotamuses has dropped from 400 to 150 in 1990s. Local people and environmentalists link the cause to the human induced activities and climate change. Lake Babati is now being covered by weeds, twigs, and shrubs, which are threatening to overlay the entire water body (See Figure 9).

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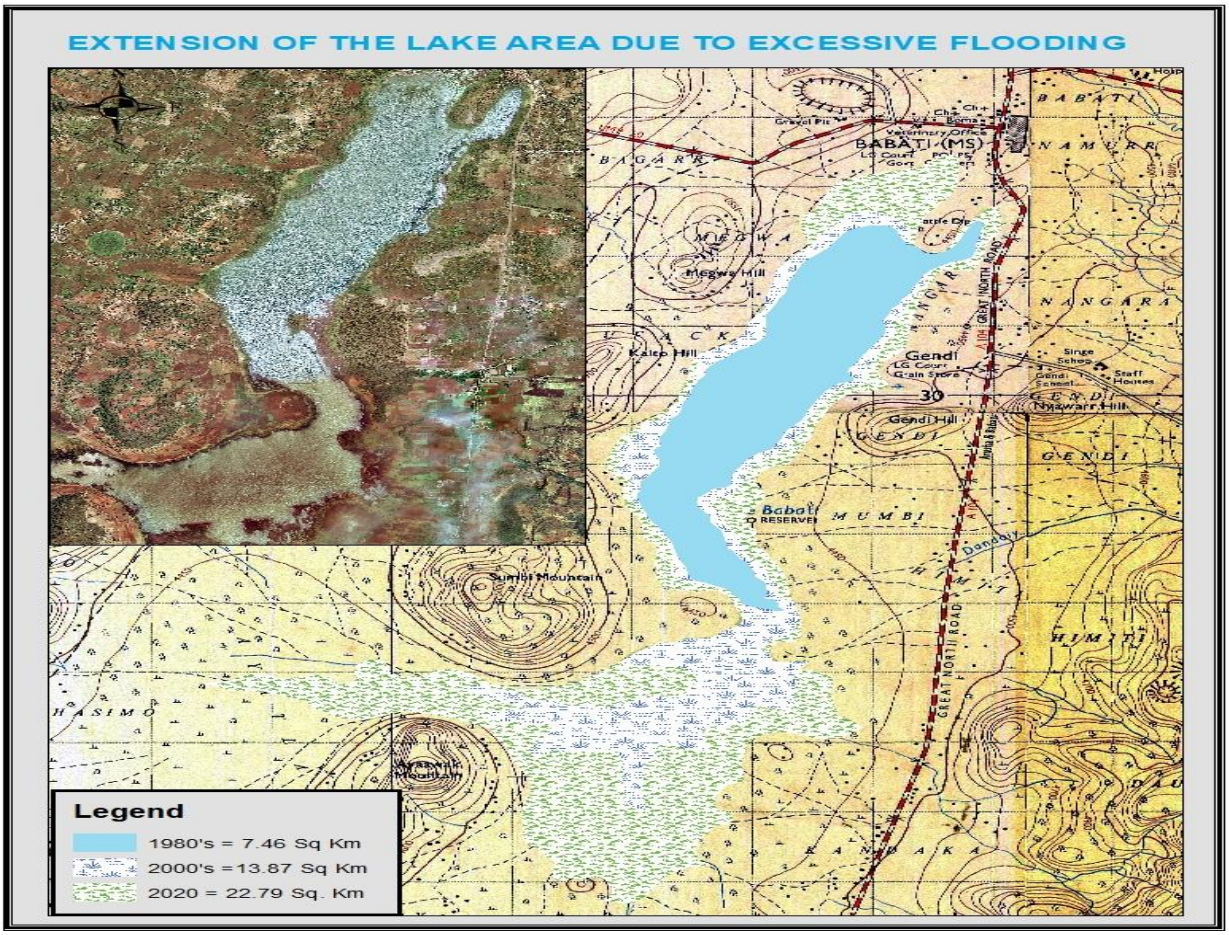

Fig. 10: Changes of the lake surface area as the impact of rapid urban sprawl.

Source: Authors own construct (August 2022)

Figure 10 above shows the size of the lake between 1990, 2010 and 2020. In1990's the lake depth was between 6 – 8 m deep in the middle, due to siltation in 2010 the lake was only 5 m deep in the middle with its depth decreasing to 3 m at the northern end and 1-1.5 m at the southern end (Babati environmental profile, 2010). Currently the lake depth has decreased from 6 – 8 m in 1990's up to 3 – 4 m deep in recent years. Due to decrease in the lake depth an artificial outlet was created in 1990 to empty the flooded lake into Faharan River.

F. Government initiatives on conservation of water resources at Lake Babati

The rapidly shifting of the population distribution pattern and economic activity in Babatitown created the high demand for water resources. These demands have prompted policymakers to experiment with spatial considerations in their national economic policy schemes. Policy initiatives are transformed into legislative initiatives which then formulates different regulatory, administrative, organizational, and procedural changes. Despite various acts, policies, and organizations of thestatus of lake Babati are not clear. This meansthere are some gaps in the system whichmust be addressed for an effective management of the lake and its resources.

a) Land Management Programme in Babati

Formulation of the performance guidelines for the Environmental Management Committees, the community is sensitized, trained, and mandated to control or guide any practices centrally to the Environmental Management Policy of 1997.The council under Land Management Programme (LAMP) in cooperation between the Tanzaniangovernment and Swedish SIDA (Swedish International Development Agency), WILD AID and RAFIKI wildlife, sensitized the community living in the Lake catchment area on the potentials of Land management by facilitating afforestation program in order to control soil erosion and Lake Siltation problem. The community representatives from 39 Sub-wards and Sub villages were trained on contour leveling in the farms to facilitate land conservation practices. Effort is also put into mobilization of fishers' community to form their Economic groups under which fishers, fish venders and other stakeholders will be trained on participatory fisheries management and other income generating and environmentally friendly activities.

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Fig. 11: Management signposts restricting unfriendly activities around lake Babati.

Source: Field work, August 2022

b) Natural resources Legal Frameworks
Babati authorities have Laws, by-laws, regulations, and institutions which are very essential in the control andmanagement of natural resources particularly in the areas experiencing rapid humanpopulation growth. In respect to this expression, the Council has enacted the By-Law with number 249 of 2007. This By-Law clearly provides and prohibits the causation of any kind of nuisance within the Council. It also provides the protection of our environment by prohibiting deforestation and carrying out any human activities at the water sources.

Plate 1: Sensitization program on LakeBabati Management Plan

Source: Field work, August 2022.

c) Urban Spatial growth guidance framework
The Master Plan for Babati Town (2016 – 2036) has been prepared as a dynamic framework that aims at guiding and managing urban growth anddevelopment whilst focusing on environmental conservation and thus achieving sustainable development of the town. It is, however, expected that during itsoperational period, the Master plan will form the basis for the long-term planning perception ofthe Town.The Master plan for Babati Town has maintained the Lake Babati Management Planprepared by LAMP. In addition, more land around the Lake has been earmarked toenhance conservation measures. The Lake and its environment should be protectedfrom unfriendly human activities to minimize flooding risks to the town.

Moreover, most of the communities residing along the Lakeunder the Lake participatory conservation approaches, have been sensitized on the adverse effects of socio-economic activities to the Lake and its ecosystem.

d) Natural resources management policy frameworks.
The Government of United republic of Tanzania has formulated different policies, which have influencedthe conservation of water resources. Furthermore, the government enacted laws toenforce policies These guide different activity sectors for the management of the Lakes. Under these Policies, the communities are sensitized to form economic groups under which they can plan and implement their projects and plans. Under this approach, projects are being monitored and assessed for Environmental Conservation Integrities.

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VI. CONCLUSION

A comprehensive analysis was carried out to investigate the implication of rapid urban sprawl towards water resources management, also the trends of population growth, economic development, and unplanned catchment management on the water quality of Lake Babati. The study discovered that rapid population growth, growing economic activities around the lake such as irrigation farming, Brick making, Deforestation, and proliferation of informal settlements have resulted in the destruction of the water resources due to their unsustainable utilization. These practices, together with poor urban planning, have resulted in the deterioration of the water quality of the Lake. To reduce the influencing factor for rapid urban sprawl caused by mostly population growth, along the lake, policies need to be put in place, which encourages the inclusion of the environmental sustainability component on economic development projects to avert externalities.

Also, there is still a need to strengthen, monitor, and control anthropogenic activities in the basin that are the root cause of ecosystem degradation and encourage proper management of land use through public awareness programs geared towards sensitizing the public on the ongoing environmental destruction and how it can be minimized or stopped. Encouragement of regional interventions and incorporation of harmonized principles, policies, strategies, laws, and other agreements into national legislation to enhance enforcement should also be emphasized.

VII. RECOMMENDATIONS TO MITIGATE THE IMPACT OF URBAN SPRAWL ON LAKE BABATI

Respondents in the study area suggested several mitigation measures to enhance the sustainable management of the Lake and its resources. These included Clear boundary Demarcation, reforestation through tree planting, improvement of beekeeping, provision of environmental education, review the existing land use plan and enforcement of regulations. Regarding reforestation, local communities asserted high demand of fuel wood both for brick making and domestic consumption. Table 2 below show suggestions given by respondents to ensure sustainable management of the lake and its resources.

Local people	Local leaders	Town officials
Wildlife (Hippos) management	Clear boundary Demarcation	Campaign to inform the public
Provision of environmental education	Review the existing Land Use Plan	Review the existing land use plan
Natural Forest conservation	Draft amendment of the by- laws	Improving Beekeeping projects
Farm owners closer to Lake should be compensated	Provision of environmental education	Central government should locate funds for conservation
Closing the Lake during breeding season	Enforcement of the fishery regulations	Strong law enforcement
Planting of trees	Monitoring and evaluation strategies	Contour ploughing
Seedling provision and grass production	Soil and water conservation	Upgrading the protected area to game reserve

Table 2: Suggested mitigations on enhanced conservation of Lake Babati and its Resources

Source: Field data, 2022.

- **Policy and Legal enforcement recommendation**
  It is hereby recommended that all the provisions regarding water resources management proposed in the various urban sectoral policies should encourage proper environmental planning and management to ensure that settlement is fit for human habitation and sustainable development.

A. Spatial recommendations

It is recommended that the Ministry of Lands, Housing, and Human Settlement review the design concepts to address the issue of outdated urban design concepts and planning standards regulations. Spatial planners need to design neighborhoods' that accommodate environmental issues as well as water resource management and many others while taking care of the compatibility of land uses to avoid disturbing land use conflicts.

It is recommended the council should effectively Implement the approved general planning schemes (Babati Master plan 2016 - 2036). The study has revealed the mismatch between the proposed design concepts and the urban reality in informal settlements. This study supports the development control measures to be introduced to the areas around the lake in order to control further urban sprawl

It is recommended that there should be a boundary demarcation of the core area of the lake which includes the open water, the surrounding swamps, and forest patches. Also, compensation should be paid within theboundary of the protected area in such a way that tree crops are left out as much as possible.

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B. Recommendation for plan implementations

Establishment of a steering committee for effective implementation of plans & coordination. Its role will be to provide advice and ensure the delivery of the project outputs and the achievement of the project outcome.

It is recommended that the projects which are adjacent to the lake must undergo Environmental ImpactAssessment prior to their implementation. This is in order to identify the problem which may exist and its mitigations.

It is recommended that the provision of environmental education to local communities bordering the Lake. Local community must made aware on the negativeimpacts associated with their anthropogenic activities on the Lake. .

C. Environmental management recommendations

It is recommended that there should be an intensive soil and water conservation area around the lake such as the existence of a buffer zone in which planting of trees and grass, terracing, and other forms of agroforestry are promoted to reduce soil erosion and siltation of the lake.

*It is recommended to introduce Pollution control and utility enhancement of water bodies.*Cleaning of water bodies can be done by desilting,de-weeding, aeration, reduction of nutrients, and removal of floating and otherinvasive aquatic plant species.

*It is recommended to have Wildlife and fishery management focus*more attention on the hippo and bird populations. Systematic routine observations need to be instituted to obtain accurate estimates of population size, home range, reproduction rates, seasonal migration, and feeding habitat. Also, it should be declared a closed season for fishing to allow breeding and proper growth of the fish.

REFERENCES

[1.] Anderson TA, and et al, (2013). Effects of land use and precipitation on pesticides and water quality in playa lakes of the southern high plains. Chemosphere. 2013 Jun;92(1):84-90. doi: 10.1016/j.chemosphere.2013.02.054.

[2.] Cohen, B, 2004. Urban growth in developing countries: a review of current trends and a caution regarding existing forecasts. World Development, 32 (1), 23–51.

[3.] IUCN (2012). Ecosystem functioning in African tropical freshwater wetlands:Nyanza Gulf, Lake Victoria

[4.] Kiwhele, S. J. (2012). Livelihoods and the environment along Lake Nyasa, Tanzania SCSRD/JICA Newsletter No 13, July 2005.

[5.] Lung'ayia H, Sitoki L, Kenyanya M (2001) The nutrient enrichment of Lake Victoria (Kenyan waters)-Hydrobiology

[6.] Machiwa PK (2003) Water quality management and sustainability: the experience of Lake Victoria Environmental Management Project (LVEMP)—Tanzania.

[7.] Moser, P. (2006). Physical Geography. Vol. 74, No. 2/3. Blackwell Publishing. http://www.jstor.org/stable/521286

[8.] Nindi, S. J. (2010). Changing land-use in the fragile Lake Nyasa catchments of Tanzania: A lowland-highland nexus. Vol. 52(73-82). April 2010.

[9.] Ningrui Du, Henk Ottens, Richard Sliuzas, (2010), Spatial impact of urban expansion on surface water bodies- A case study of Wuhan, China, 175–185, Elsevier

[10.] Nonga, J. (2012). Upland-Lowland Initiatives towards Sustainable Land Resources Management. Amabilis Centre, Morogoro, Tanzania.

[11.] Taylor & Francis (2012). Lake and Reservoir Management. An International Journal of the North American Lake Management Society. Volume 2. Issue No. 3. New York.

[12.] United Republic of Tanzania (2022): National Master Plan for Strategic Intervention (2022-2032). MkukinaNyota. Dar es Salaam.

[13.] Wang HT, Wang T, Brahima T, Li FT (2012a) Protect Lake Victoria through green economy, public participation, and good governance. Environ Sci Technol 46(19):10483–10484