THE IMPACT OF POPULATION INCREASE AROUD LAKE BABATI

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CERTIFICATION

I have critically read the dissertation report and satisfied that it is in acceptable standard for a higher degree award.

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Date: --------------------------

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DECLARATION

I, Hongoa Pius Simon, do hereby declare that this dissertation is my original work under the supervision and guidance of Dr. Makundi A.E and has not been submitted for a degree award at any other university.

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Hongoa, Pius Simon

DEDICATION

To my beloved mother (the late) Doradine Emanuel Hongoa and My beloved father Col (Rtd) Simon Lali Hongoa, who laid down the foundation of my education and their tireless support.

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I extend my sincere gratitude to God for the blessings and good health. This dissertation would never have been in this shape, without the countless hours of discussion and unwavering commitment of my supervisor Dr. Makundi A.E of the Department of Life Science of Open University of Tanzania. His contribution and guidance throughout the study enriched and created the foundation of this dissertation, the support, assistance and professional inputs provided before and during the writing of this dissertation remain a permanent asset for reporting other scientific works in future.

My father Col (Rtd) S.L Hongoa as well as brothers and Sisters – special thanks. My Mother "May her soul rest in eternal peace".

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ABSTRACT

Lakes are amongst the most productive ecosystems of the Earth. Despite its potential in supporting people's livelihood in Babati, Lake Babati is being converted into other land uses due to ever increasing population in town. This work evaluates the impacts of population increase around Lake Babati in Babati Town Council. Primary data were gathered by administering the questionnaire to a sample of 100 households. Participatory rural appraisal techniques, participant observation and checklist were employed in data collection. The land use types and land use changes was examined through analysis of satellite imageries. This was attained by making use of ArcGIS10. The results from the present study showed that there was a strong relationship ($p \leq 0.05$) between education level, occupation and awareness status of respondent on environmental issues. Also there was a strong association between the anthropogenic activities in particular agriculture/brick making and lake degradation. Lack of awareness under the role of environmental sustainability on lake resources was found to hinder the involvement of local people to Lake Babati conservation. Thus, this study recommends that, natural resources management (including lakes) should be incorporated in the program of study of all education levels to foster awareness raising campaign on role of lake benefits to local people's livelihoods. Also proper land use practices should be promoted so as to reduce the impacts that has been caused on the lake Babati due to poor land use practices in the study area.

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LIST OF ABBREVIATIONS AND ACRONYMS

MSW: Municipal Solid Waste

UNCED: United Nations Conference on Environment and Development

URT: United Republic of Tanzania

Anon: Anonymous

CHAPTER ONE

1.0   INTRODUCTION

1.1   Background Information

Environmental issues are firmly entrenched at the centre of the world stage in all spheres of development activities (Child, 2004 and Wang et al., 2008). Increasing urbanization and rapid population growth around water bodies like lake areas puts extra stress on the need for finding and implementing sustainable solutions to prevent environment contamination (Roxendal, 2012). The pressure of this rapidly increasing population on the available resources will be too great to sustain desirable livelihood in the area (Pardo, 2009 and Maltby, 2000). For example, Lake Victoria basin is used as a source of food, energy, drinking and irrigation water, shelter, transport, and as a repository for human, agricultural and industrial waste (Strandberg 2004, Robert 2009 and Sandstorm 1995). With the populations of the riparian communities growing at rates among the highest in the world, the multiple activities in the lake basin have increasingly come into conflict. This has contributed to exposé the lake environmentally unstable (Strandberg, 2004 and Lyding, 2009). Massive blooms of algae have developed, and come increasingly to be dominated by the potentially toxic blue-green variety (Jonas and Annete, 2010). Over fishing and oxygen depletion due to eutrophication at lower depths of the lake threaten the artisan fisheries and biodiversity (Over 200 indigenous species in lake Babati are said to be facing possible extinction) (Strandberg, 2004). Lake Babati is a fresh water lake located in the eastern part of the East Rift Valley, 168 km from Arusha at an elevation of 1,346 m on longitude 35° 45° E and latitude 4° 15° S, The lake is rich in

fish like Nile tilapi (Oreochromis niloticus), African catfish (Clarias gariepinus), fresh water shrimp (Palaemonetes paludosus) and other species like Hippopotamus amphibius, otter (Aonyx capeusia) ducks and flamingo (Camilla, 2011). It provides water with polar pH between 7.4 and 8.0 suitable for both domestic and economic uses but the major town's water sources are surface rivers, streams and springs originating mainly from Mrara Hills. Mrara stream and Nangara stream are among the town's water sources. The permanent water table ranges between 3 − 18 meters below ground level.

As for Lake Babati, fishing may not exactly have much hope of ever becoming a sustainable activity, being practiced seasonally. Still, the lake has great potential of being another tourist attraction site for Babati due to its beautiful surroundings and breathtaking scenery (URT, 2006). Lake Babati is covered by sub-merged plant (Eichhornia crassipes, Callitriche, Potamogeton illinoensis e.t.c), emerged plants (Bacopa caroliniana, Blurish etc) and floating plant (Azolla caroliniana, Utricularia, Nymphaea odorata). Around the lake there is grass, shrubs and trees and the catchment/landscape is covered by farming and forest (Sandstom, 1995).

Given the current rate of population increase, water resource utilization in and around most of Rift Valley Lakes is not sustainable (Gunya, 2009 and Ramachangra, 2000). The intensification of agriculture around the lake coupled with application of fertilizers and pesticides will lead to the silting and eutrophication, that is already happening in Mang'ola at Lake Eyasi and Mto wa Mbu at Lake Manyara where irrigated farming is practiced (Yanda and Madulu, 2005, and Sandstom, 1995).

Siltation in the lake is quite high and during the last couple of years the depth in the lake has decreased from 6 – 8m on in 1970's up to 3 – 4m deep in recent years (Anon, 2013). The area of the lake has also fluctuated during the last couple of years, from 5 km² to18 km² in 1990. The only seasonal outlet of Lake Babati is in the Kiongozi/Farahani River (Gerdén, et al., 1992).

Lake Babati is one of dozens of water bodies known as the Rift Valley Lakes that span the eastern side of the African Continent from Mozambique to the Red Sea. The lake is the lifeblood of the town of Babati in Manyara-Tanzania (Jake, 2009) and is used by people as a source of income through primarily fishing activities and fish mongering. Other activities culminated by the lake water are such as horticulture, beekeeping, brick making and construction of infrastructure but also for watering animals (Lyding, 2009).

The purpose of this study was to determine the impact of population change on environmental degradation of Lake Babati and to suggest improvement strategies that may lead to sustainable utilization of available scarce resources to improve the economy and livelihood of the nearby communities.

1.2   Statement of the Problem

Previous research has found that lakes provide a wide range of environmental services from which people benefit, and upon which all life depends (McCartney et al. 2004; URT 2007). The importance of wetlands is not only accounted by being highly productive, biologically rich and providing many ecological services, but also

their support to both biodiversity and the economy. They are natural assets which make significant contributions to the Tanzania's national economy (Munishi et al. 2003; URT 2007).

According to the 2002 population census, Babati town has a population of 31,077 people of which 28,000 equivalent to 90% of the total population live in the town proper, covering the areas of Babati, Maisaka, and Bagara. 3,077 people, equivalent to 10% live in the peri - urban area of Nangara village. The town's population Growth Rate is estimated at 3.8% annually (URT, 2003).

Since 2002 Babati was promoted and become headquarter of Manyara Regional, many people from other regions immigrate into the town for business, work and looking for other opportunities. By 2009, population in Babati Town was estimated to be 74,000 of which 40,000 live in town proper and 34,000 in peri-urban (URT, 2003).

The increase of population might be caused by many factors including the decision of allocating the headquarters of Manyara Region and Babati District, development of infrastructure ie construction of tarmac roads, development of water facilities (BAWASA), presence of enough food supply and fertile soil which support productivity of agricultural products (URT, 2003; URT, 2013 and Nyoke 2012).

The recently increase in population and rapid urbanization of Babati town while in the catchment area there has been excessive landscape changes as a result of

agriculture practices, brick making, livestock keeping, deforestation, waste disposals and over fishing which lead to flooding in 1964, 1979 and 1990 (Sandstom, 1995) and most recently 2002.

Lake Babati biodiversity is under stress from a number of factors. For example, in the Lake Babati watershed, invasive species, habitat loss, degradation and fragmentation, rapid residential growth and infrastructure development, unsustainable agriculture practices, pollution of tributaries and open waters, altered hydrology, mining and harvest of fish and forests (Anon, 2006).

Little has been done on the effect of population increase on changes of lake physical features due to human social economic activities but the extent of the impact of the population increase on Lake Babati environmental is not clear. It is the concern of this study to determine the current status on the effect of rapid population increase in Babati town to Lake Babati environmental management, its socio-economic consequences and implication towards environment sustainability.

1.3   Significance of the study

The study would help the government, planners, policy makers, agricultural officials, experts and development agents to design strategies to improve policies to cub the problem of Lake environmental degradation and enhance investment programs and projects that may bring positive synergies to restore fish, timber, soil productivity, enhance food security, and avert the vicious cycle of poverty and natural resource degradation.

Furthermore, the analysis contributes to the general literature on land and soil degradation. This is essential to long-term progress because of the scarcity of primary data at the farm and household level to address lake degradation toward smooth environmental sustainability strategies in Babati District, and in other places with similar characteristics.

1.4   Objectives of the Research

The general objective of this study was to determine the impact of rapid population increase around Lake Babati.

1.4.1   Specific objectives were

i.   To determine awareness status of local community on environmental management of Lake Babati

ii.   To identify, various human activities that have been responsible for degradation of Lake Babati.

iii. To explore the changes on biodiversity and physical features of the lake over a considerable period of time as a result of human activities.

1.5   Research question were

i.   What is the awareness level of local community on environmental management of Lake Babati based on indicators such as number of seminars and awareness creation campaign, number of house hold with environmental management projects, governance and by laws?

ii.   What are various human activities which has been responsible for degradation of Lake Babati based on indicators such as agriculture and livestock keeping, fishing, hunting and tourism, settlement and urbanization and disposal of domestic waste?

iii.   What are the changes in the physical features of the lake over 50 years based on indicator such as Lake Depth, Lake Size and out let, and Landscape (catchment area)?

CHAPTER TWO

2.0   LITERATURE REVIEW

2.1   Water Resource, Human Settlement and Development.

People tend to settle and clusters in places that have the resources they need to survive and thrive (Clark, 2010). Water resources like springs, river and lake are among the factors that influence most of human to settle on an area like Babati Town. Large groups of people often migrate (move) to a place that has the resources they need or want and migrate away from a place that lacks the resources they need. Economic activities in a region relate to the resources in that region (Baldus, 2001). Economic activities that are directly related to Lake Babati resources include farming, fishing, ranching, timber processing, brick making, mining, and tourism (Anon, 2013).

Natural resource conflicts have been an inherent phenomenon of human history (Redfern, et al., 2005), 'development' in contemporary societies intensifies it because of the qualitative shift in the scale, intensity and modes of resource transformation and use (Redfern, et al., 2008 and Glover, et al., 2012). Hence it generates higher stakes and interests as opposed to other modes of resources use and which have the potential of generating more intense conflict (Glover, et al., 2010) Natural water resource and wetlands areas have been under many uses since immemorial time for socio-cultural and economic benefits to society (Nielsen, et al., 2010 and Glover, et al., 2010). This started as early as human being started his social economic activities such as agricultural practices without conserving the natural

resources water being inclusive (Tolunay, et al., 2007 and Baur et al., 2000). Some measure were used by our ancestors to conserve the natural resources; measures like terracing methods which helped people to stop facilitating environmental degradation and avoid them to conduct social economic activities in water sources (Salafsky and Wollenberg, 2000).

It is important to understand that while resources are very important, it is not the presence of or lack of natural resources within a country that makes a country prosperous. In fact some of the wealthier countries lack natural resources, while many poorer countries have abundant natural resources (Giliba et al., 2011 and Isango 2007).

The threat of multidimensional global crisis has therefore been a key theme within debates about sustainability (DeGeorges et al., 2009). A crisis of development, environmental quality and of threats to the materials benefits supported by natural biogeochemical processes and sink (Adams 2001 and Chid 2004). It has also been recognized that tight and complex links exist between development, environment and poverty (Vosti, 1995 and Blaikie 1995). The poor often endure degraded environments, and in some instances contribute to their further degradation (Adams, 2001). Urban air and water pollution are both rising rapidly, even in those countries in which economic growth is taking place and the degradation of agricultural, forest and wetland resources is extending the depth and wideness of deficiency in many rural areas (Baldus, 2007). Access to and controls over cultivable land, fuel wood or other usable attributes of nature is uneven. Blaikie and Brooffield (1987), argue that

'land degradation can undermine and frustrate economic development, while low levels of economic development can in turn have a strong causal impact on the incidence of land degradation.

Environment provides the natural resources for the process of Development on the other hand; the development process modifies the natural resources and environmental quality to meet human needs (Lundi and Trene, 2008). The goal of both environmental and development is the same, to improve human well being. Poverty has been termed the worst enemy of environment because it gives rise to poor life styles in terms of production, consumption and living conditions. Poor life styles cause environmental degradation in terms of depletion of resources which eventually reduce production and perpetuate poverty (Muthoka, 1998).

2.2   Human land use and Land degradation

Today's landscapes result from many causes, including variability in abiotic conditions such as climate, topography and soils; biotic interactions that generate spatial patterning even under homogeneous environmental conditions; past and present patterns of human settlement and land use; and the dynamic of natural disturbance and succession (Turner, et al., 2011). Patterns of land use can alter both the rate and direction of natural processes and land use patterns interact with the abiotic template to create the environment in which organisms must live, reproduce and disperse. Land use refers to the way in which and the purpose for which humans employ the land and its resources (Kansiime et al 2007 and Gunya, 2009). For example, humans may use land for housing, industry, recreation and food production.

Land use change is used to encompass all the ways in which human uses of the land have varied through time, the ways in which humans use land are important contributors to landscape pattern and process (Turner, et al., 2011).

Land degradation leads to a significant reduction of the productive capacity of land. Human activities contributing to land degradation include unsustainable agricultural land use, poor soil and water management practices, deforestation, removal of natural vegetation, frequent use of heavy machinery, overgrazing, improper crop rotation and poor irrigation practices. Natural disasters, including drought, floods and landslides also contribute (Turner, et al., 2011).

Land and soil degradation, reoccurring drought, small farm plots, high population density and input shortage including draught animal and improved seed are the major agricultural problems of the Africa (Pu et al., 2012). These agricultural production problems are enhanced with poor delivery of research technology and extension support. Cash income for household financial requirements is mainly generated from sale of livestock and crop products (Blata, 2010).

There are dramatic land use changes in Babati Town especially in the catchment area of Lake Babati in the period 1990 –2010 and these changes have negative impacts in terms of loss of natural habitats for both flora and fauna, causing negative impacts to both aquatic species and people (Lyding, 2009; Hariohay, 2013). Conservation educations, land use planning, family planning to reduce rate of natural population

growth and income generating projects should be emphasized in the conservation of the lake Babati environment (Hariohay, 2013).

2.3   Urbanization and Solid Waste Disposal

One of the major impacts of urbanization in Africa is the increased generation of solid waste, threatening ecosystems and undermining economic activities such as fisheries and tourism. The dumping of solid wastes in rivers, lake beaches and in the sea has become common practice, as reported in the Comoros and Madagascar (Sandstom, 1995).

The contemporary urbanization process in many low and middle income countries are affected by globalization and imply a concentration of infrastructural and service investments. The result has been improved availability and access to infrastructure and a variety services and goods. Through migration and infrastructural investments the per - urban population and the rural population are gradually integrated to urban areas, often in slums (Hurtig, 2009) .

The amount of waste is increasing in the world due to changed consumption patterns and increasing populations (Hariohay, 2013). This is a problem especially in poor countries where the ability to handle the waste is limited due to financial and management problems. The authorities of Babati at present have an opportunity to adjust the waste disposal system before population density and mountain of waste gets out of control (Hariohay, 2013).

2.3.1 Types of solid wastes

The major types of Municipal Solid Waste (MSW) are food wastes paper plastic, rags metal and glass, with some hazardous wastes, households waste such as electronic light bulbs, discarded medicines and automotive parts.

Table 1: Highlighting the main source of MSW; the waste generators and types of solid waste generated

Sources	Types of wastes generators	Types of solid wastes
Residential	Single and multi family dwelling	Food wastes, paper, cardboard, plastics, glass, metals, ashes, textiles, special wastes, bulky items, consumers electronic, oil, tires and household hazardous wastes
Commercial	Stores, Hotels Restaurants, markets, office buildings	Paper, cardboard, plastic, Wood, Food wastes, glass, metal, special wastes, hazardous wastes.
Municipal services	Street cleaning, land scalping, parks, beaches, recreational areas.	Tree trimming, general wastes from Park, beaches and recreational areas.

Source: UNCED Report, 1992

Municipal solid wastes (MSW)-consists of Household waste, construction and demolition debris's, sanitation residue, and waste from streets (Table 1). This garbage is generated mainly from residential and commercial complexes. With rising of urbanization and change of lifestyle and food habitats MSW has been increasing

rapidly and its composition changing. In 1947 cities and town of India generated an estimated 6 million tones solid wastes, In 1997 it was about 48 million tones, more than 25 % of the Municipal solid waste is not collected at all,70% of the Indian cities lack adequate capacity to transport and no sanitary land fill of wastes. The existing landfills are neither well equipped nor well managed and not lived properly protect against contamination of soil and ground water (Carl, 1999).

In Singapore; domestic as well as non-domestic, i.e. commercial and industry, activities generate solid waste. In most Asian countries, there is generally no system to identify the classify MSW into domestic, commercial and or industries wastes. All types of solid waste are mixed together and not sorted at home or at other sources. Thus there is no differentiation during collection by public or private contractors. In some countries waste collected is taken to a common processing center for separation, treatment and disposal (UN chronicle 2001).

2.4   Population Expansion around Lake Babati

Babati is a fast growing town. Since it became Town Council and Head Quarter for Manyara Region in 2002, more people have moved to the town looking for work and a lot of bureaucrats have also been transferred there. There are many challenges to a growing town. Housing, transport and working opportunities are the main concerns. But the waste management is also a challenge (URT, 2003).

Babati District was established by dividing the then Hanang District into two districts - Babati and Hanang. The decision produced Babati District, which was officially

documented in the Government Official Gazette No. 403 on 1 October 1985. Babati District became autonomous in July 1986 as a District Council (URT, 2003).

Babati is a small town in Babati District of Manyara Region of Tanzania. It is the administrative capital of the district and also the administrative capital of Manyara Region. The new status boosted the town into rapid growth. Since Babati town received the role as district and regional capital, the urbanization process and economical activities increased. Babati town is accessible from the main road between the larger cities Arusha and Dodoma, which enable the food supply, marketing and retailing of processed and readymade foods from outside to Babati town (Lyding, 2009).

Migration of population in search of better source of water, land and other economic opportunities is a widespread phenomenon in Africa with a long standing history. Migration has led to intensive water conflict causal by the convergence of pastoralist and farmers, traditional irrigation system and large scale irrigation system and other uses including hydropower generation (Mbonile, 2007).

According to the 2002 Tanzania National Census, the population of the Babati District was 303,013 people in 2010 the population of Babati Town council was 34,291 people according to the GeoNames geographical database, and according to 2012 Tanzania National Census, the population of the Babati Town council was 93,108 people and population of Babati District council is 312,392 people (URT, 2013).

2.5   Resources and Environmental Management

The activities carried out within and outside the area surrounding the lake include uncontrolled grazing, cultivation, extraction of building minerals (sand and stone), tree clearing, use of fishing gears and other human activities. This means that, any degrading factor due to outside activities has great influence inside the Lake on water purity, ecosystem performance and reduce water level (Anon, 2006).

The National Environmental Management Policy of 1997, National Fisheries Sector Policy of 1997, National Human Settlement Policy of 2000 and all other relevant policies guiding agriculture and socio-economic activity are used for the management of the Lake Babati environment (URT, 1997). 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. However, Street, village and wards Environmental Management committees have formed, trained and empowered to monitor all development activities around the lake.

Major environmental hazards are deforestation, Lake siltation and flooding, earthquakes, soil erosion and over fishing (Hariohay, 2013). There is basically land conservation practices insisted in the Lake catchment area in order to reduce land sliding and gully erosion which ultimately results into siltation processes to the Lake. Under the Lake participatory conservation approaches, communities residing along the Lake have been sensitized on the adverse effects of socio-economic activities to the Lake and its ecosystem. For example, Community participation in fisheries

management (Co- management) is being tried in Lake Victoria, through co-management, which is the sharing of responsibility between the government, researchers and the resource users (Nyeko, 2012).

According to Mitchell (2002), that when conflict arises over resources allocation or different interest regarding the environment, at least four approaches can be used to deal with them. Political, Administrative, Judicial and Alternative dispute Resolution. Some of approaches can be used together, political approaches involves values and interest and the making decision. Decision makers are not specialist; they receive advice from technical experts in resources and environmental management. Administration approaches are best suited to what might be called routine as opposed to strategies type of decision. Judicial approaches involves litigation and the canons, this approaches are suited in dispute are so entrenched in their positions, the approaches has the power to impose and enforce sanction (finer, prison sentences) the judicial approaches is based on procedures and guidelines but it is time consuming and very expensive (Gunya, 2009).

Mitchell (2002) explained that environmental change and violent conflict or resource scarcity is the increasing likelihood of conflict among the people. Also human activity can contribute to environmental change and decreases in the quality and quantity of resources if they are used or harvested at rate faster than they can be harvested and An access to resources or the environment it causes change. This is a result of laws or property rights which leads to encourage concentration if supply to few people leaving other subject to scarce.

2.6 Knowledge gap

Overpopulation and land use interactions have negative impact on the water resources sustainability, but the extent and implication of these problems on Lake Degradation, is still unclear because several studies have been conducted to analyze the impacts of this problems over water resources (Gunya, 2009). Thus, most of the wetlands have been vanished completely. At the same time the ability of the remaining ones to provide valuable benefits has reduced significantly. This paper examines the population increase, socio-economic activities, and land use changes and their consequences on the Lake Babati in Babati Town Council in order to provide enriched information for decision making with regard to lake resources uses and proper land use plan.

Moreover, many of the problems associated with resource allocation and use have been proven to have a political ecology scenario, with the major groups of actors being residents, policy makers, council staff and local leaders.

CHAPTER THREE

3.0   MATERIALS AND METHODS

3.1   The study area

The study carried out at Babati District which is located below the Equator between latitude 3° and 4° South and longitude 35° and 36° E, around Lake Babati in urban and rural areas. The district covers an area of 6,069 km^2 (2,343 sq m), a large proportion (640 sq km) of which is covered by the water bodies of Lake Babati, Lake Burunge and Lake Manyara. The head quarter of the district is in Babati town which is located on the northern part of Lake Babati. The head quarter for Manyara region is located at Babati town.

The Council is divided into two climatic zones namely highland and low-land zones. The mean annual temperature is 23 ^{0}C, the coldest month being July with an average temperature of 15 ^{0}C and warmest month is December with an average temperature of 34 ^{0}C. The town receives two rainy seasons; short rains from October to December and long rains from March to May with an average of annual rainfall of 1200 millimeters.

According to the National census of 2012, the 8 wards of Babati town council have a total population of 93,108 people, out of which 47,313 are male and 45,795 are female. Primary economic activities of people living around the study area include fishing, livestock keeping and small holder agriculture production such crop as maize, pigeon peas, lablab beans, beans and horticulture activities. These crops are

grown for subsistence and cash generation. Other economic activities include business activities and brick making.

The reason for selecting the area is due to the fact that Babati town is one of the urban centre with rapid population increase which accelerate high rate of urbanization and is the area which lies along the shores of Lake Babati. Either the area is potentially vulnerable to environmental pollution, management conflicts due to increasing urbanization and social economic activities around the lake.
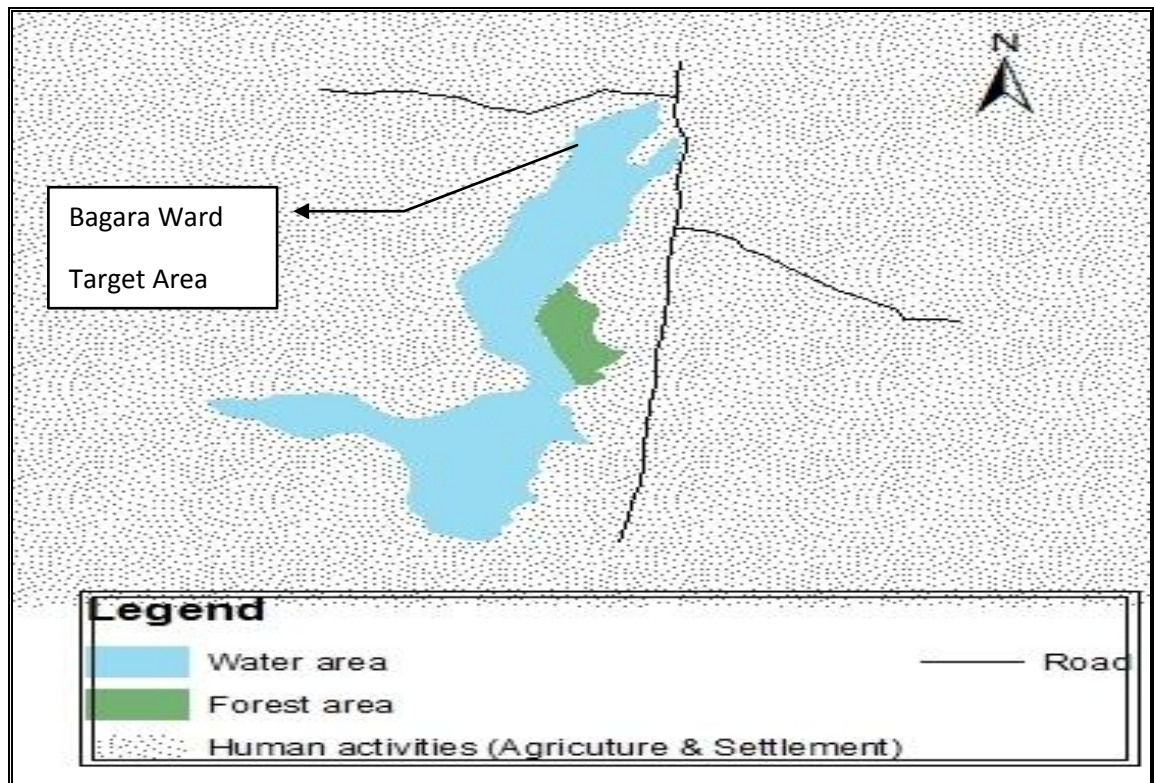
Figure 1. A map of Babati Town showing study area.

Source. Field Data arcview GIS 9.1 (2014)

3.2   Methods

3.2.1   Data Collection

Both secondary and primary data were collected to capture information needed for analysis. The secondary data was collected from different sources such as government offices (like Street Executive Office, Ward Executive Office and District), and some published and unpublished hard and soft information sources. The information collected from secondary data includes fluctuation of the size of the lake, depth of the lake and Lake Biodiversity. The primary data was collected through a closed and open ended questionnaire in order to obtain quantitative and qualitative data at a household level. The information collected using this method includes. the current awareness level of local community on environmental management of Lake Babati, socio-economic activities that are major basis for Lake Babati environmental degradation, sustainable environmental management strategies of the scarce resources at Lake Babati. A checklist was used to collect the data from key actor which includes NGO's, Government leaders at District and Local levels, and influential local people.

3.2.2   Household Survey

Primary data was obtained through structured and semi-structured questionnaires administered to various respondents. A structured survey questionnaire was used to gather primary household data at the village level on economic activities, waste disposal, management issues and policies, demographic data and level of awareness on environmental management. Primary data also obtained by interviewing local environmental agents. In addition, direct field observations and a number of informal

discussions with village elders, farmers groups, and extension workers was conducted to cross-check and verify additional information of interest to this study. The questionnaire prepared was tested, and amended to fulfill the objectives of the present study. In the study area villages, up-to-date household list which obtained from the respective office is used as a sample frame. With the lists, systematic random sampling procedure used to select a total of 120 sample households which was interviewed using a structured questionnaire.

It is known that sample size depends on variability of a population to be sampled and taking time, cost and accessibility. Given the relative homogeneity of the subsistence household in the study villages in terms of physical environmental factors and resource endowments, this number was considered maximum which could be handled effectively within the research time and budget.

a.   **Field observations**

Another qualitative method of the study was direct observations on biodiversity of the lake (fish and forest cover), soil erosions (brick making sites and water inlet channels) and number of environmental management's project in the study area. Either observation was employed on activities and physical environment in the catchments and buffer zone to determine the existing situation and compare with what was narrated by the community either to observe various issues related to environmental degradation of Lake Babati and environmental management initiatives. A visit was made around the lake and on catchments areas. The aim of the visit is to asses if this has any direct relationship with land use activities and if there

was any relationship between what the respondents had stated and the real situation on the ground. Check list of various items was used as a tool for observation.

b.   Focus Group Discussion

Various groups of people like farmers, livestock keepers, fishermen, urban dwellers, Brick makers and key stakeholders in the study area including women, men and elders were organized to get more information about awareness to environmental degradation and its effects on biodiversity and lake physical features, if their practice are environmental friendly or environmental unfriendly. These groups consisted of 5-7 people each and were questions concerning Lake Babati environmental degradation and management in the study area.

c.   The Interviews

The data collection entailed intensive interviews (Appendix 1) with the household heads or their closest deputies, using a structured questionnaire which was designed as explained.

The questionnaire was detailed and consisted mainly of close-ended questions that served to gather information on the basic demographic characteristics of the household heads such as age, marital status, education, level of income, environmental awareness, awareness of waste management issues, experience of household as well as questions relating to basic socio- economic activities of the household. Some open-ended questions were also included to facilitate oral discussions and assessment of opinions. These conversations between interviewers

and interviewees were flexible and the responses were written down and utilized as background information for the data interpretation

3.2.2 GIS Arc view and remote sensing

The geographical information system software was used to detect the changes on the lake size, change in forest cover and changes on landscape due to human socio economic activities. Previous data was compared to current aerial and sketch maps of the study area. Some of the previous maps was obtained from Babati District- Map room and from other map sources i.e. Google map, Land Sat aerial Photographs e.t.c.

3.3 Study Design

Probability and non-probability sampling techniques was used to select respondents. Simple random sampling technique was used to select names of respondents in the selected hamlets where respondents were assigned number and processed in excel computer software to obtain sample without biases. Also with non- probability sampling i.e Purposive sampling, stratified sampling and multi-stage sampling were applied. Two or three sampling methods were applied together in some cases. For example stratified sampling was used to select households from rural and urban area while random sampling was used to select households for interview while the purposive sampling was used to select key informants from street and ward leaders etc.

The study area was stratified into two zones as urban lake area and rural lake area, further stratification in each area was carried out as Lake buffer zone and non buffer

zone (Table 2). Both in each of the four zones all Hamlets was listed down and assigned to a random number and one hamlet (from each of the four zones) where selected. In each of the four selected hamlet 25 respondents where randomly selected for questionnaire administration.

Table 2: Study area stratification

Urban Lake area		Rural Lake area	
"Mtaa"	"Mtaa"	Hamlet	Hamlet
Buffer zone	Catchment area	Buffer zone	Catchment area
25	25	25	25

The sample size was obtained from the total number of 7230 households in the study area. To minimize errors and sample biasness from each household in each village, households were equally selected using standard formula, $n = N/ (1+N (e)^2$. Where, n = sample size, N = total number of households, e = it is an acceptable error, i.e. 10% (0.1) used to obtain manageable respondents. Thus, $n = 7230/ (1 + 7230(0.1)^2) = 99$ households plus other 12 informants i.e. District land officer, ward executive, street executive officer x 3, lake resource officer, district community development officer etc, making the total of 111 respondents.

3.4   Data Analysis

The survey generated both qualitative and quantitative data; the first task was to summarize, categorize and code all qualitative responses into numeric values and then enter them in Statistical Package of Social Science (SPSS) version 17.0.

Descriptive statistic was used to generate mean, percentages which are important for comparison purposes; chi - square tests were used in determining the association of different demographic variables and awareness status. Regression analysis was carried out to determine the level of impact of main economic activities on the lake degradation in the study area. The parameters set for degradation of the Lake Babati shall give the magnitude of drop in relation to productivity, physical as well as ecological products. Predictions will be made so as make proper recommendations to save the lakes deteriorating biodiversity.

Non parametric statistics was mostly used when data were not normally distributed. Significance level was set at $p < 0.05$. Imagery analysis was done through using ArcGIS Desktop version 9.1(Lu et al, 2004).

Information obtained from unstructured interviews and informal interviews with different elderly people in the village and officers which mostly where in form of verbal/narrative information. These were written down during the survey and summarized. This information is more qualitative in nature and was used to support the coded qualitative and quantitative data analysis. Descriptive statistics; sum, mean, and percentages presented in tables to enable easy interpretation and quick visual comparisons of variables within the study area.

3.5   Data Presentation

Data output was presented in the forms of tables, graphs, figures and in text format.

3.6   Validity and reliability

Validity is the truthfulness or correctness of the measurement as planned or intended. Seale (2004.74) gives seven (7) threats to (internal) validity thus history, maturation, instability and regression, testing, instrumentation, selection and experimental mortality. The study was designed and conducted within a short time but adequate for respondents to answer the questions in which the threat of history as well as maturation would not have influence. The questionnaire was pre-tested to both professionals (specialists in the field) as well as would be respondents. This was to guards against the threat of instrumentation as well as testing. Experimental motility would have little if any effect since the study was not 'experimental' but a survey.

Reliability concerns the consistency with which research procedures deliver their results (Seale 2004.72). It also relates to the repeatability of the findings under similar conditions. Apart from statistical variations (number of respondents increasing or decreasing), it is doubtful whether a similar study would yield very different findings. Additionally, the same questions were asked to all respondents and the questionnaire can be used elsewhere hence the study is repeatable. Study also applied chi-square test of significance to determine generalize ability of findings. It would be inaccurate though, to claim hundred percent reliability and validity.

3.7   Limitations of the study

There were a number of limitations in this study but the key ones are. The broadness of the topic for it was not specific to one type of lake degradation, but perhaps this is motivation for further studies in this area; the data collection setting where some respondents were not only less conversant with English language but also apprehensive about it; on instrumentation the questionnaire has been described by many researchers to yield low response rates and this manifested in this study. The other limitation was the combination of methods itself. Brysonan (2002) has argued that research methods are ineluctably rooted in epistemological and ontological commitments, the epistemological positions in which the two methods [quantitative and qualitative] are grounded constitute irreconcilable views about how social reality should be studied (Seale, 2004.294). Philip (1998) echoes this distinction and notes, 'recognizing this destabilizes the distinction between the two approaches and therefore their apparent incompatibility'. I tried to reconcile this dichotomy by conforming to the institutional setting in which the study was carried out. That is, the language factor militated against the use of pure qualitative research (especially interviews) while the nature of the topic would not yield much using pure quantitative method.

CHAPTER FOUR

4.0   RESULTS

4.1   The influence of demographic variables on awareness status of local community on environmental management of Lake Babati

The results for the influence of demographic variables are shown in Table 3. Age, sex, marital status have been shown to be statistically insignificant ($p \geq 0.05$) on level of awareness on environmental issues. On other hand, there was difference ($p \leq 0.05$) among the respondent with different level of education and occupation status of respondent on awareness to environmental management. In term of association of respondent environmental awareness based on location of respondent the study found that there was no statistical significant difference between those located within catchment area and buffer zone.

Results shows Local Government Authority, NGO's and CBO's are the only organizations that were creating awareness and capacity building on environmental issues in the study area by 49%, 31% and 20% respectively. The result also showed that 64% of respondents did not attend environmental awareness campaigns that were carried out in the area. Further more 26% of respondent had not heard existence of such campaigns.

The study also revealed that community awareness toward environmental governance and by Laws is not high since only 65% of respondent know the roles and regulation related to fishing activities, residential development, agricultural

activities, waste disposal and wildlife management. Almost 35% of respondents lack knowledge and therefore they are not aware of roles and regulation towards environmental conservation.

Table 3. The influence of demographic variables on awareness status of respondent

Variables		Count	Percent (%)	Awareness level of respondent on environmental issues (%)			p-value
				High	Medium	Law	
Age (Years)	Less than 25	3	3	0	1	2	
	26-35	39	39	5	20	14	
	36-45	39	39	6	19	14	
	46 – 55	10	10	2	7	1	0.812
	Above 56	9	0	1	5	3	
Total		100	100	14	32	54	
Gender	Male	63	63	8	35	20	0.640
	Female	37	37	6	17	14	
Total		100	100	14	52	34	
Marital Status	Single	15	15	3	7	5	
	Married	64	64	7	36	21	0.590
	Widow	12	12	1	6	5	
	Separated	9	9	3	3	5	

Total		100	100	14	52	34	
Occupation	Farmer	51	51	3	26	22	
	Livestock keeper	10	10	2	4	4	
	Formal Employment	29	29	9	14	6	0.001
	Business man	9	9	0	7	2	
	Fisher man	1	1	0	1	0	
Total		100	100	14	52	34	
Education	Primary	56	56	1	23	32	
	Secondary	21	21	4	17	0	
	Higher	13	13	8	4	1	.000
	Tertiary	9	9	1	7	1	
	Literate without formal education	1	1	0	1	0	
Total		100	100	14	52	34	

4.2 Human activities responsible for degradation of Lake Babati

Results for various economic activities carried out in the area are shown in Figure 2 below. Results showed that majority (91%) of respondents were engaged in various economic activities such as crop production, livestock production and formal employment, fishing, brick making while only a small (9%) proportion of old age people were engaged in economic activities in the study area. There was no significant differences in economic activities carried out by respondents in the study area (X^2= 0.139; p = 0.9330) which ranged from crop production (25.3%), livestock

keepers (21%), small-scale business (18.4%), employment (15.8%), fishing (11.6%) and 7.9% of respondents were Brick Makers (Figure 2).
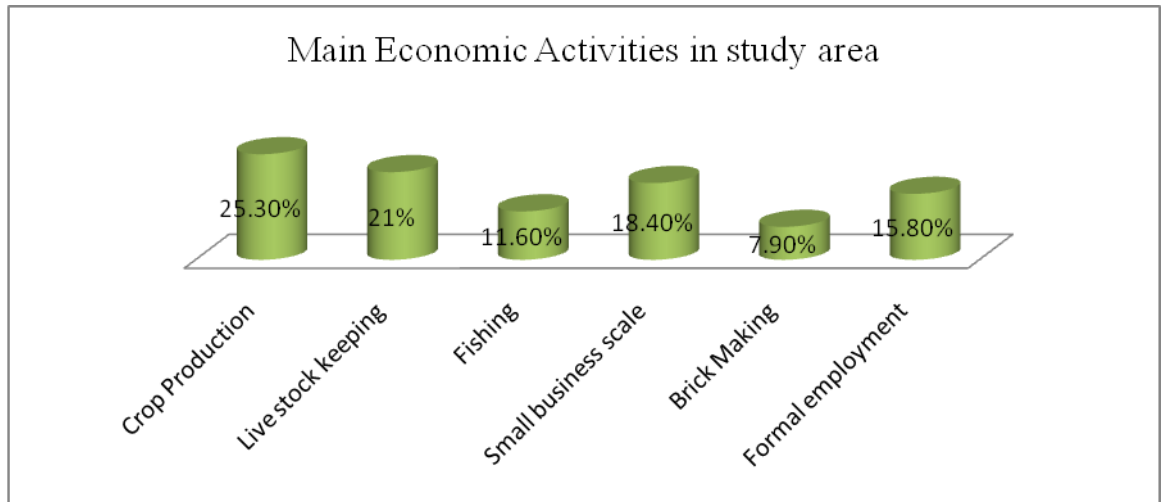
Figure 2: Main Economic Activities responsible for Lake Babati degradation

The study revealed that majority of respondent had lived in the study area for more than ten years and owned less than two Ha of land (Table 4). This indicates that the respondents are sufficiently knowledgeable in terms of time and space to provide useful information with regard to the use of wetland resource in study area. These results showed evidence that, people who live in a certain area for a longer period of time accumulate experience and knowledge, on various matters with regard to respective area of interest. Paradoxically, it may also indicate that people may have enough time to cause significant impacts (positive or negative) at the study area.

Table 4. Residence Duration, Average size of land and Distance from Lake Water

Variable	Variable information			
	Mean	Frequency	Percentage (%)	p-value
Resident Duration (years)				
<5		16	16	0.226
5- 10		36	36	
10+		48	48	
Total	2.78	100	100	
Average size of land(ha)				
<1		33	33.7	
1-2		50	51	0.140
3-4		13	13.3	
5+		2	2	
Total	1.84	98	100	
Respondent residential distance from lake water (M)				
<60		7	7.3	0.052
60 -100		17	17.7	
100+		72	75	
Total	2.68	96	100	

Crop production and livestock keeping were key economic activities carried in the area and followed by small business scale and fishing activities. Result shows

majority (96%) of respondent in the study area are engaged in small scale agriculture specifically subsistence food crops farming where by majority 54.6% of respondent cultivated cereals crops, 34% of respondent mentioned Legumes crops and only 11.4% of respondent in the study area grew horticulture crops. When asked if they practice conservation agriculture in their agricultural activities, only 48(49.5%) confirmed that they practice conservation agriculture and 50.5% of the respondent did not practice conservations agriculture where by 25.8% are from Buffer zone and 24.7% are from catchment area. In addition, for respondents who practiced conservation agriculture, it was found that 25% use uphill ridges method, 69.4% contour barriers and only 27.8% practiced agro forest agriculture in their small scale farms.

Figure 3: Onion (Alium cepa) farming as one of unsustainable agricultural activities along the buffer zone of Lake Babati.

Result also showed that only 10.1 % (6.1% from Buffer Zone and 4% from catchment area) of respondent in the study are practicing irrigation agriculture while majority 89.9% of respondent are not practicing Irrigation agriculture in the study area. When asked on the sources of water for irrigation schemes 40% of respondent who practice irrigation agriculture indicated lake water, 20% used well water and other 40% of respondent who practice irrigation agriculture mentioned piped water where 20% from Buffer zone and Other 20% from catchment area.

Soil erosion in the study area was common since 39.8% of respondent in the study area experienced soil erosion in their area where by 16.3% was from Buffer Zone and 23.5% from catchment area. When asked about the main causes of soil erosion/land degradation in the study area majority 41.2% of respondent stated deforestation, 22% of respondent indicated unsustainable agricultural practices, 16.2% of respondent said Housing Development (Residential), 13.2% of respondent mentioned Infrastructure Development and only 8.8% said live stock keeping.

The result also showed that 56% were livestock keepers and 24% were located within buffer zone while 32% were located in the catchment areas. When asked about the sources of food for their animals, majority (65.5% of responds) mentioned from the lake Buffer zone while 21.8 % of respondent raised animals in the catchment area while 12.7% are fed their stock from non catchment area. Likewise the 56.4% of respondent use lake water for watering their animal while, 36.4% used piped water and only 7.3% are watering from wells. The Study further found that only 7.1% of respondent in the study area were practicing brick making activities,

where by 4% were within buffer zone area and remaining 3.1% were from catchment area. The average mean of brick making site distance from Lake buffer zone is 2.48, result found that 14.3% of brick makers are found within 50 m from lake water, 57.1% were found between 50 − 100 m which is sensitive ecological zone (Hippos Range Reserve) and only 28.6% are conducting brick making in catchment area over 100 m away from lake water.

Figure 4: Earth brick industry found in the buffer zone around Lake Babati

Figure 4 above shows brick making activities within Lake buffer zone. In Figure 4 raw bricks stacked ashore waiting for curing a pile of Yellow fever acacia (Acacia xanthphloea) cut down for bricks curing process.

Figure 5: Acacia logs (bottom) for burning the kiln found at Lake buffer zone.

In Figure 5 the brick kilns with yellow fever acacia ready for firing bricks in the buffer zone. Both the processes have immense effects on the lakes degradation hence its biotic survival.

The study also showed that only 15% of respondent in the study area were engaged into fishing related activities where by 8% and 7% of those were fishing in Lake Babati come from urban and Per Urban areas, respectively. It was also found that there was illegal fishing in the study area as supported by 87(90.6) of respondent. Either result showed that majorities (75%) of fishermen were using acceptable and sustainable fishing gears while 25% of fishers were using unsustainable fishing gears. Illegal fishing practiced in the lake Babati included fishing during off season, use of dynamite and poisons.

Result showed that 100% of households involved in this study generated solid wastes where by 48% produced less than Five kilogram while 22% produced 6 to 10 kilograms and 30% of respondent produced over 10 kg of solid waste per week.

The results also show that, 40% of the households placed wastes into polythene bags at home premises, 10% households were collecting their solid wastes through unloading wastes into transfer station /collection site, 20% households were disposing solid waste by open dump, 18% households were used methods of enclosure/field for disposed solid waste, and 12 % households were used method of disposing by burning. The people in households do open burning their solid waste at lower rate of 12%.

The findings also showed that, 45% of households used landfill dump as their systems to managed solid wastes, 33% of households incinerate solid wastes, 19% of households reuse solid waste and only 3% of households were prefer recycle system to solid waste and on composition of solid wastes generated within the household results of research shows that 41% households were generating plastic waste, 29% households were generating compostable/domestic residual foods waste, 18% households were generating cardboard waste, 6% households were generating metal wastes, 34% households were generating glass waste and 2% households were generating paper waste.

4.3   Changes in the Physical Features of Lake Babati

Lake Babati is reported to have flooded extensively in 1964, 1979, and 1990 (Gerden et al., 1992). The lake area is about 18 square kilometers and its catchment area is

about 384 square kilometers. The dimensions of the lake in fluctuate from 16 and 19 km in length from 3 and 6 km in width reached after the 1990 floods is the largest it has been in recent times. Figure 6 and 7 below shows the size of the lake between 1970, 1990, 2010 and 2014.
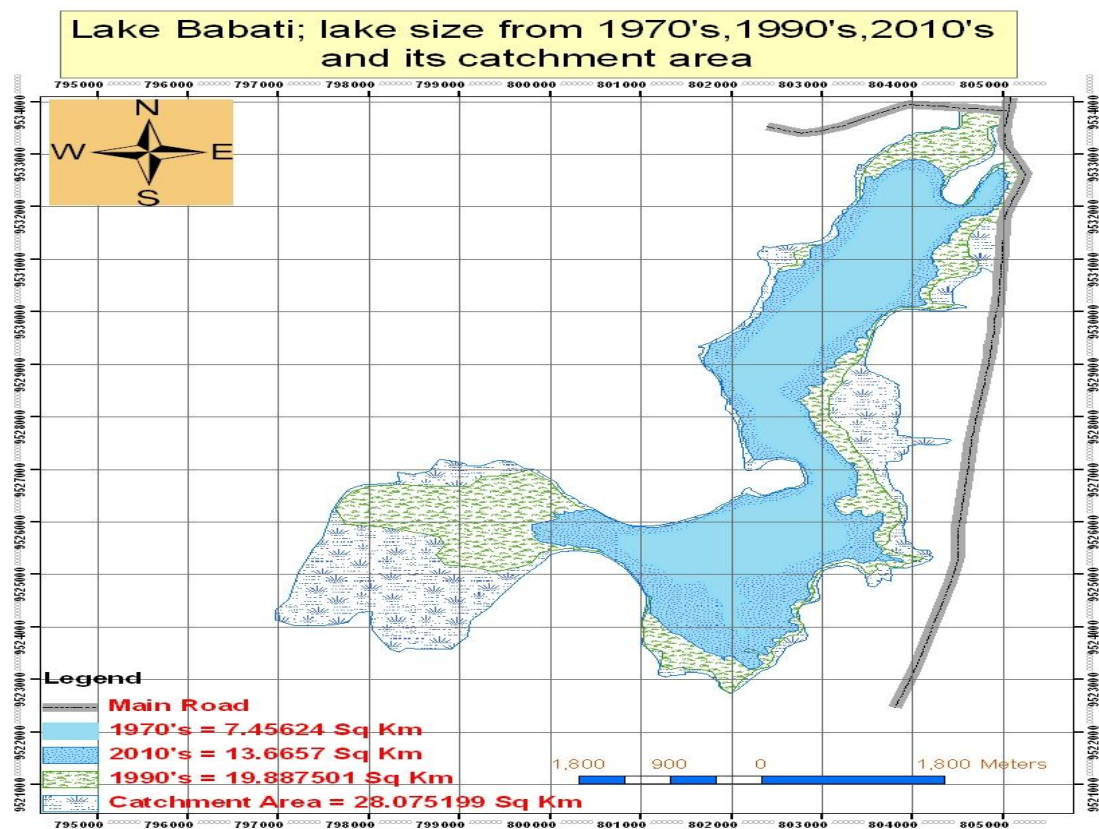
Figure 6 Changes on Lake Babati 1970, 1990 and 2010: By 1990 the digitized map show extension of lake area due to excessive floods.

Figure 7: Satellite image showing the landscape and various human activities carried out in the lake Babati catchment area (Source. Arc view GIS 9.1 (2014))

In1960's the lake depth was between 6 – 8 m deep in the middle, due to siltation in

1974 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 (Nhwani, 1974). Currently the lake depth has decreased from 6 – 8 m in 1970's up to 3 – 4 m deep in recent years. Due to decrease in the lake depth an artificial outlet was created in 1964 to empty the flooded lake into Faharan River
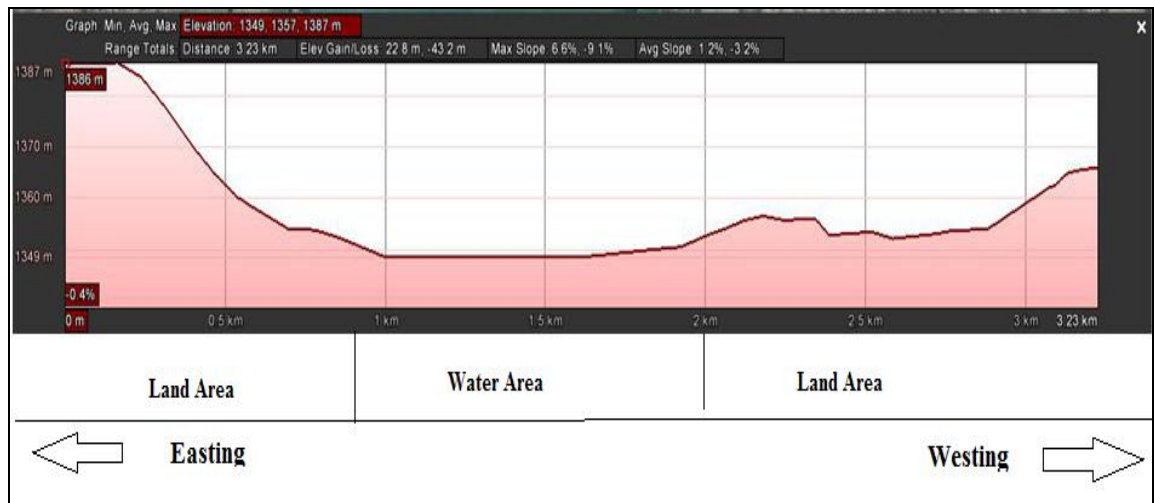
Figure 8: The elevation cross-section of Lake Babati showing the depth of the Lake Babati
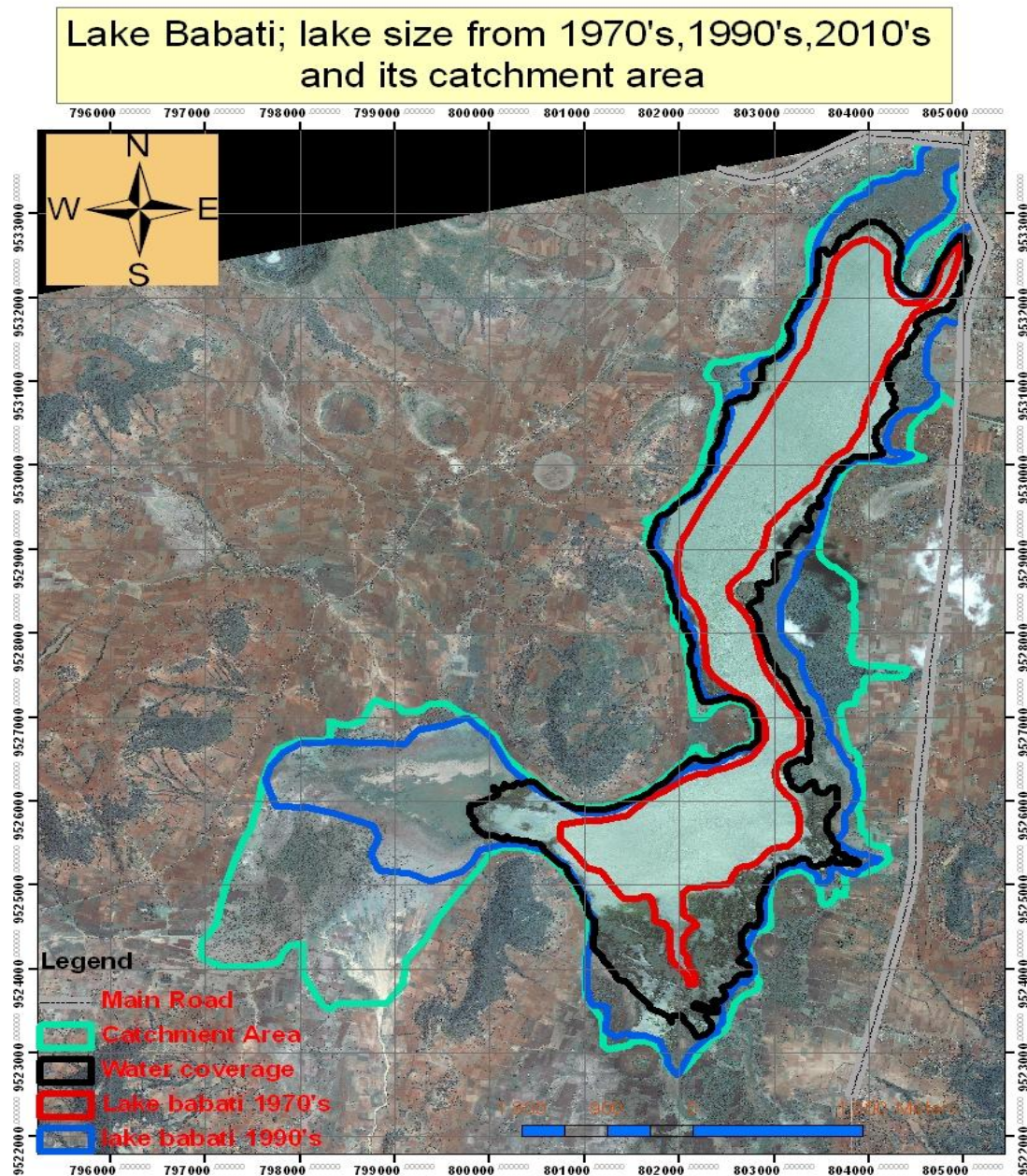
Source. Arc view GIS 9.1 (2014)

The topography around the lake is slop and the catchment area of the lake Babati is slowly being degraded of which lead to the total land cover change and change of land scape due to deforstation and caupled with bad agricultural practices has degraded the soil, leading to siltation in the lake being localized in urban area around the lake while deforestation, soil erosion, infrastructure development and increasing human and livestoct population have contributed to increased nutrient loading to the lake from inlet channels. In aditional to that the atmospheric deposition of nutrient from poor land use management within and outside the lake catchment.

CHAPTER FIVE

5.0   DISCUSSION

The finding from the present study support the research hypotheses that younger

people, women, and people of higher education levels have influence on awareness

status of local community on environmental management of Lake Babati.

In the present study only education and occupation was found to have an influence

on respondent level of awareness on environmental management. Equally those with

formal education were more aware of environmental management issues than those

engaged in fishing and brick making, primarily due to their high level of education.

Generally, respondents in Urban Lake area had more exposure about environment

issues and as a result, take more initiative to control the environmental problem

compared to respondents in rural lake area.

Such literacy rate indicates that, most respondents know how to read and write an

important input which may enable community to be aware, understand and adopt

new technologies more easily hence creating necessary strategies for improving

environmental management at lake Babati. Education is always regarded and valued

as a means of liberation from ignorance. It is perceived that education is among of

the factors that influence an individual's perception for intervention before making

decision to take part in any undertakings. It also imparts the desire to learn more and

seek information regarding environmental conservation activities (Luhasi, 1998).

It was revealed from the present study that the great percentage of male were

involved and benefited from Lake Babati environmental degradation. It seems clearly

that men engage more in economic and agricultural activities as compared to women. These findings concur with Otero and Downing (1989) who argued that women lack control over economic resources and other environmental resources.

The results from the present study showed that majority of the respondents were in the middle age group, which fall within the economically active and productive group. These findings are supported by Basnayake and Gunaratne (2002) who argued that the age of a person usually is a factor that can explain the level of production and efficiency. Age influences experience, wealth and decision- making all of which has an effect on the working capabilities of an individual, utilization of lake environmental resources and therefore individual's productivity age of respondent.

The level of awareness on environmental issues has increased significantly in recent years (Ellul, 2014). Environmental awareness is one of components in strengthening sustainable development in any Country (Giddings et al., 2002). The lack of continuous and comprehensive environmental education in community makes the youth overlook the importance of the environmental protection in their daily life. This is because; they do not have continuous exposure to environmental issues and awareness by exposure through formal or informal education (Hansen, 1991).

Although the local government has been conducting campaigns on awareness and capacity building to solid waste management, the residence in Babati town are yet to carry out proper disposal of solid waste disposal. The most important ingredients that form the basis of a waste minimization drives in any municipality is surely the

awareness campaign. This is so true, simply because most people do not realize the importance of waste minimization and how easily it can be accomplished sometimes (Mvuma, 2002).

The present study has shown that majority of households own land and depend on it for their livelihood, thus, any decision made by majority regarding use of their land may have major positive or negative impact on wetland values in the study area. This implies that good land management can have positive impact on wetland management. As such decision made by majority in the course of land use and other economic activities can affect water quality and other lake values. This argument is similar to observation made by Falkenmark et al. (1999) who asserted that, exploitation of land resources has undesirable effects on the ecosystems, thus it is essential to understand how humans interfere with the landscape systems (Musamba et al., 2011)

The diversity of economic activities in the study area indicated the need for more land to accommodate various land uses and the need for space to dispose wastes generated from these economic activities. This may increase the chances of lake degradation as a result of pollution from these economic activities.

This implies that the degradation of wetland (water) quality due to a certain land use type in upstream parts o a watershed can have negative effects on users in downstream parts of the watershed and the degradation affects flow through the watershed. These findings are similar to the study conducted by Baur et al. (2000)

and UN (2009) who argued that different land use systems may have different impacts on wetland values direct or indirectly as a result of land use practices of the stakeholders (upstream or down-stream). Results of this paper is similar to the studies by Musamba et al. (2011), Copeland et al. (2010), Kangalawe and Liwenga (2005) and Ramsar (2009) who assert that poor farming practices have led to land degradation along with negative impacts on wetlands.

Results indicate that, the main land use types were farms, commercial areas, infrastructures, settlements, and spiritual activities. In the present study it was also shown that there was diversity of land use types in the study area which have been changing since 1990's to date. This implies that, there was a significant change in land use with increase in population in catchment areas and decrease in some other land use types such as farmland, settlement and infrastructure. Conversely, there was a dramatic decrease in catchment area which was observed between years 1995, 2009 and 2014.

During late sixties and early seventies there was immigration of fisherman tribes from Lake Nyasa and Victoria to Babati in search of fish. In those days there was good catch, often the population of Babati was low. Decrease of fish catch led to change in occupation and people change and took other activities in particular farming in lake/buffer zone area. Other became earth brick makers to meet the over increasing number of residences that require more house. Thus, the decrease in wetland area was in line with decrease in its values such as ecological values (breeding sites for fish and birds). Besides, this may also reduce the number of fish

catch in the respective period (temporally and spatially) and increase the costs of fish catch effort which affected economic returns in fishing activities and the multiplier effect might spread to other households (Musamba et al., 2011). Results of this study can be compared with the study conducted in Vedaranniyam by Prabaharan et al. (2010) who found that coastal zones are most vulnerable for land use changes in rapid industrialization and urbanization area mainly influenced by various anthropogenic activities.

The conversion of Lake Catchment to other uses might be due to rapid population growth in the study area which increases pressure and the demand for natural resources and wetland benefits to meet people's basic needs. It can also be attributed to negative attitude of local people towards wetlands as a wasteland. Results of this study are in line with some previous studies (Kashaigili 2006; Kirsten 2005; URT 2007 and Canty 2006) which argued that wetlands have been converted to other uses such as agriculture, settlement and infrastructure. While some wetland conversions no doubt have been in the best interest of society, wetlands have too often been lost for very limited benefits and even costs to society (Munishi et al. 2003; Turner et al. 2000).

Subsistence agriculture is the major activity within the Lake's watershed. Ownership and management jurisdiction of the lake's aquatic resources has caused concern. Pollution levels from farms and industries, and reclamation of wetlands for agriculture raise concern. Poverty levels are pushing the landless to the ecologically marginal wetlands.

Findings from present study revealed that crop production was significantly (p=0.052) affecting the wetland by a high multiplicative factor. This shows that a marginal increase in crop production characterized by poor land use practices has highly affected Lake Babati . This can be attributed to the increase in household size at the surveyed area which implies that there was high demand for food and other household sustenance needs. Furthermore, the increase in household size marks the increase in demand for land along with the use of agrochemicals to produce enough food to feed the growing population.

Furthermore since cultivation is the major economic and social activity for the majority of the communities adjacent to lake is a confirmation that pressure on the natural resource base is high. Poor agricultural practices and pressure from anthropogenic activities (in situ and external actions) on Lake Babati has jeopardized its values. Either lack of capital to invest in different social economic undertakings and infrastructure development leading to land degradation and other factors have been pointed out by previous studies.

Apart from crop cultivation livestock keeping was another activity practices at the lake area. The marginal increase in livestock size has caused impact on Lake Babati. This can be attributed to large number of livestock in the study area. Livestock grazing has significant impact on wetland and can damage reproductive habitats (nests, burrow trampling, exposing spawning sites to desiccation and removal of mating perches sites which may reduce habitat diversity. Mwakubo and Obare

(2009) asserts that the ecological health of Lake Victoria has been weakened profoundly as a result of increase in land demand for material production such as raw materials and food as a consequence of rapidly growing population, clearance of natural shores for agricultural and livestock production.

Brick making activities accelerate soil erosion, deforestation and land degradation in the study area since the study found that those brick makers are obtaining their raw materials i.e Natural clay minerals, water and fire wood for brick manufacturing process within the lake buffer zone. Results portray that marginal increase in brick making activities has impacted the lake negatively by a multiplicative factor of 0.002 with p-value equal to 0.698. This impact can be attributed to increase in the area of housing in the study area driven by increased household size.

Use of good quality soil in large quantities for brick making is also a grave area of concern. In geographical regions having thin topsoil, this result in reduction in the productivity of land and in extreme cases the land does not remain fit for aquatic ecosystem.

It was also revealed from the findings of the present work that there was substantial increase in fishing on the lake. The increase in number of fishing practices such as fishing crafts using poisoning, dynamite fishing and fishing during the period where council closes fishing activities in the lake has negatively impacted the biodiversity (loss of habitat) and the ecological integrity of Lake Babati. It has also increased the number of fish landing site along with infrastructure development for easy access of

these sites.   The marginal increase in fishing has impact the Lake along with the degradation of lake values. Likewise, the use of illegal fishing gears (small meshed nets) also might have detrimental effect on lake. The direct observation and Participatory Rural Appraisal revealed that, some fishermen were using illegal ways of fishing in line with illegal fishing gears which have destroyed some breeding sites of fishes.

Human settlement impacted the Lake Babati and this impact can be attributed to increase in the area of housing in the study area driven by increased household size, urbanization, and solid waste discharge from these human settlements along with the increase in hotels close to shorelines of the Lake. This implies that increase in settlement has caused impact on Lake Babati. These results are in line with Rebelo et al. (2010) and Wang et al. (2008) who argue that land reclamation and wetland conversion for human settlement and other land uses has cause wetland fragmentations together with their values. These results are in line with Rebelo et al. (2010) and Wang et al. (2008) who portray that land reclamation and wetland conversion for human settlement and other land uses has cause wetland fragmentations together with their values.

Solid waste disposal significantly affecting the Lake Babati by a high multiplicative factor. This impact can be attributed to increase in the area of housing and human economic activities in the study area driven by increased population, urbanization, and waste disposal from these human settlements along with the increase in hotels close to shorelines of the Lake.

In the present study it was shown that although majority of people were aware of proper disposal of solid wastes they could not put such knowledge to practice due to poor existing infrastructure. Due to lack of regular collection and disposal of the waste product some have develop a habit of throwing them into the lake.

The current tendency tremendously affect the environment because some solid waste are not separated for careful disposal carefully they can destroy the lake since materials such as plastic are non-degradable. There is no clear separate disposal between solid waste and other urban waste material as an alternative they are both mixed together however their decomposing process differs.

In the present study it was seen that the wetland area around the lake was under threats of being completely degraded. Activities that pose threats to the integrity of wetlands and its biodiversity at lake Babati and in Tanzania as a whole include but not limited to. habitat change due to agriculture, grazing, housing and mining and quarrying; cutting of aquatic and other vegetation for fuel, housing and commercial activities; Improper fishing practices; siltation due to deposition of erosion materials that reduce the depth of the wetlands; pollution by domestic sewage, industrial effluent, and agrochemicals; siltation caused by poor agricultural methods and eutrophication leading to oxygen depletion.

The challenges facing lake Babati also face other small freshwater bodies such as Lake Rukwa, Lake Manyara , Lake Chala, Mtera Dam, and Nyumba ya Mungu Dam

where decline in water depth and eutrophication has resulted to massive bloom of aquatic weeds(Lyding, 2009).

Biodiversity is the source of economic and ecological security of present and future generations. Thus, the current and future economic, social and ecological contributions of genes, species, and ecosystems make the conservation and sustainable use of biodiversity, not just a technical concern but a political imperative as well. Diversity and variety enable humanity to adapt to local, regional and global changes.

Environmental challenges are threatening Lake Babati and its fauna. Water level in the lake has decreased in recent years and the number of hippopotamus has dwindles. In 1960s and 1970s, the lake was the sole home of hippopotamuses in northern Tanzania. Today, that is a story of the past as a vast part of Lake Babati is now being covered by weeds, twigs and shrubs, which are threatening to overlay the entire water body. The number of hippopotamus has dropped to 150 from 400 in 1990s. Local people and environmentalists link the cause with human induced activities and climate change.

Lazaro Osiligi, is environmental officer at the Babati Town Council who has taken issues of environmental conservation very seriously in the area, particularly Lake Babati. He says "Lake Babati is an important habitat for hippopotamuses, fish and other fauna. But, also plays a big role in creating micro-climate in the area".

Basing on a study carried-out by James Kahurananga for the past 20 years, Osilig says. "In trying to control and reducing the intensity of environmental hazards the council mobilizing livestock farmers to change from traditional rearing where by big stocks are free grazed into intensive system."We also encourage fertility improvement through agro forestry practices".

Babati Town Director, Mkombole (Personal Communication) also admits that hippopotamus in the lake are the victims of circumstances, as the lake is threatened by environmental degradation. "Drought has hit the lake and water line has been receding forcing the hippos into the centre of the lake where local people cannot see them clearly," he says, adding. "But, we have started working on challenges facing the lake, including planting trees and grasses as well as fencing some parts of the lake as part of conserving the lake.", "We are going to carry-out serious campaign to make sustainable management of the lake's ecosystem," Mkombole says, noting that in recent years the council has been training youths from 39 villages and streets surrounding Lake Babati in making contours for the purpose of soil conservation.

Other measures include training the community through farmers groups on Agroforestry technologies, as well as sensitizing communities living within the lake catchment on the importance of conservation. "We have also mobilized fishermen community to form Beach Management Units among themselves and train them on the importance of sustainable fishing in order for them to get rid off illegal fishing," he says.

CHAPTER SIX

6.0   CONCLUSION AND RECOMENDATION

In the present study it is clear that the level of awareness on environmental issues has increased significantly in recent years, environmental awareness is one of components in strengthening sustainable development in the Country.

Poor agricultural practices, livestock keeping, brick making and solid waste disposal observed as key activities that degraded the lake. Other activities that also degrade the lake include unsustainable fishing activities. Consequently, there was a strong relationship between land use changes and the anthropogenic activities. This was due to the increase in demand for Lake Resources to sustain the rapid grown population and infrastructure development which was the underlying cause for conversion of wetland to other land use type and loss of wetland values. Despite its great potential in supporting local people's livelihood, the wetland was found to be decreasing year due to various socio-economic activities.

This study recommends that, unless emphasis is put on the awareness raising campaign on the role and wise use of Lake Babati resources, the wetland will continue to be degraded and its impact will affect people in a vicious cycle. Good land use practices should be promoted so as to reduce the impacts that has been caused on the Lake Babati due to poor land use practices in the study area.

6.1   Suggestions for future research

In suggesting future research on this subject, I would focus more on the findings and limitations encountered in this study. For instance issues like the nature of awareness creation campaign, the reality/status of community based natural resources management and biodiversity, water quality and biodiversity (specie abundances). The study may have been adequate in combining methods but I would suggest other qualitative methods as well like participatory observations not just interviews, these were avoided on the basis of time and language barrier.

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APPENDICES

Appendix 1: Questionnaire

Date………………Questionnaire………. Street…………..Ward…………

1. Name of household's head…………………..Name of Respondent…………………

2. Age of respondent……years

3. Sex: Male   Female…..

4. Marital status (single…..married……widow…..)

5. Education level

    (a) Primary education   (b) Secondary education

    (c)Higher education   (d) Tertiary education   (e) No. formal education

6. Occupation

    (a) Farmer………(b) Government eployee……..(c) Private sector eployee………..

    (d) bussnesman……….(e) livestock keeper…………

7. What are the other major sources of income in your household? (Rank)

    (a) Employment……(b) Business…..(c) Agriculture…….(d) Brick Making………

    (e) Others…(Specify)……………………………………

8. For how long have you been living in this village?...........years

General Question

9.   Have you ever heard of the following environmental issues

S/N	Env. Issue	Yes	No	Status
1	Biodiversity			
2	Habitat Destruction			
3	Environmental degradation			
4	Pollution			
5	Deforestation			
6	Soil erosion			
7	Waste Disposal			
8	Over Fishing			
9	Sustainable development			

11. Have you ever heard of rules and regulations related to

S/N	Regulation	Yes	NO
1	Fishing		
2	Wetland management		
3	Residential Development		
4	Agriculture		
5	Waste disposal		
6	Wildlife management		

12. how could you describe the condition of lake Babati (e.g fisheries,environment etc) today? (a) Degraded……. (b) Not Degraded…..

13 Are by-laws for environmental conservation follwed? (a)Yes…..(b)No…….

If no, Why they not followed…………………………………………………………..

Agricultural Practices

14 (a) Do you practice agricultural activities? (i) Yes……(ii) No………...

(b)If Yes in (a) above, what is the total area of your cultivated land?..........Ha.

15.What is the distance from your farm to the lake buffer zone?..........m

16. Has the size of your cultivated land changed?

If yes has it: (i)increased……. (ii) decline……(iii)remained the same……..

17. What are the major crops grown on your farm in order of importance?

………………………………………………………………………………………….

18. Do you practice conservation agriculture? (a)Yes……(b) No……….

If yes , which conservation methods do you practice in your farm?

……………………………………………………………………………………………

.

19. (a) Did you practice integration agriculture in your area? (a) Yes…..(b) No…..

(b) Where is the source of water for irrigation activities?........................

20. Do you experience soil erosion in you farm/area? (a) Yes…….(b) No……..

21. What are the main causes of soil erosion/land degradation in your area?

………………………………………………………………………………………….

Livestock Keeping

22. Do you keep livestock? (a) Yes….. (b) No……

If yes in above, what is the number of species do you keep in your area

No	Species	No of species	Source of food	Source of water
Cattle				
Goat				
Sheep				
Pig				
chicken				

23. Do you practice brick making activities? (a) Yes…….(b) No…….

If yes above what is the distance is your site from the buffer zone………….m

24.Where is the source of firewood? (a) Lake Zone………(b) Non lake Zone……..

25.Do you practice fishing activities in lake Babati?

(a) Yes……(b) No……..

26. (i) is there any illegal fishing activities at lake babati? (a) Yes……(b) No……

   (ii) If yes what are they?..

27. Are fishers use acceptable and sustainable Fishing gears? (a) Yes…… (b)

No……

Settlement and Urbanisation

28. do you have a building permit/ title deed of the land you own?.......................

29. Where is the source of building materials

S/N	Building Materials	Sources
1	Stone	
2	Quarry	
3	Sand	

4	Wood	
5	Timber	

30.   how much domestic solid waste you produce per week…….kgs

31.   how are you treating that solid domestic waste you produce?

………………………………………………………………………

32.   is unsustainable domestic waste disposal associated with lake babati degradation in your area?..

33.   What should be done to improve domestic waste management in your area?

……………………………………………………………………………