

THE ASSESSMENT OF THE INFLUENCE OF POPULATION GROWTH ON WATER RESOURCES IN PANGANI RIVER BASIN IN MOSHI, KILIMANJARO, TANZANIA

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INTRODUCTION AND BACKGROUND OF THE STUDY

1.1 Background of the study

Global population is about 7.6 billion where as china is the leading country with approximately a population of 1.4 billion people (Ometres, 2018). Almost 70% of the Earth's surface is covered with water. Yet possibly 2 billion people are living in areas with persistent water shortages. Quantitative supply and water quality problems are rising and could hinder economic development and human well being in general. In other words, water no longer can be taken for granted. Fresh water is only in a small fraction (2.5) percent of all the water present on our planet. Furthermost fresh water is in form of permanent ice and snow (FAO, 1994).

Africa is estimated to have about 1.3 billion population, as a result of rapid population growth, sub-Saharan Africa has faced tremendous impact on supply of clean and safe water. Northern part of Africa has 92% safe water coverage, sub-Saharan Africa remains at low 60% of coverage leaving 40% of 783 million people in that region without access to clean drinking water. It is estimated 800 million people who live in Africa 300 million live in a stressed water environment (Archive 2016). According to FAO (2011) water shortage is growing with pollution salinization and degradation of water bodies.

Tanzania's population growth rate continues to climb with a current rate of 3.0% annually. Its estimated 2018 population is 59.09 million up from the 2014 estimation of 50.8 million ranking 24th in the world. Tanzania has 96.27km³ of renewable water resource per year. Only 50% (27 million) of Tanzania's population has access to improved source of safe water. According to WHO/UNICEF report of 2004, one out of six people lack access to safe drinking water in Tanzania. It has been well documented that water shortage has been caused by population growth, high level consumption and climate change. FAO (2008).

A recent survey revealed that the demand for water in Moshi urban is set to rise by 80% by year 2019 due to population increase. According to the 2012 census Moshi municipality had a population of 184,292. The pangani river basin begins as a series of small streams on the northern sides of Mt. Kilimanjaro and Mt. Meru and passes through Masai steppe before reaching its estuary and Indian Ocean. It is the source for drinking water for people and livestock without excluding industrial uses. Population growth, urban growth and intensification of land use for agriculture have led to an over exploitation of water resource Barchiesi, S et al(2010).

1.2 Statement of the Research Problem

Rapid population growth has led to tremendous impact to water resource in Pangani basin specifically in Moshi. The Moshi Municipal has witnessed increasing of water shortage which results to water conflict and competition among the industries, community and ecosystem. Water scarcity caused by population increase with in Moshi Municipal has become inevitable. This is due to the fact that upstream land users such as farmers and pastoralists negatively affect the downstream users such as industries and hydropower companies (IUCN, 2010).

Several studies have been conducted at Moshi Municipal some of which include Population, migration and water conflicts on the pangani river basin (Mbonile, 2005)Population growth and agricultural change in Kilimanjaro (Maro, 1975), shortage of water for irrigation and farmers response (Mwamfupe, 2001).

The above studies provided little information on population influence towards water resources, information provided are such as the challenges or problems brought by population growth towards water sources and few mitigations to tackle the situations.

It is therefore this study that attempts to point out the main activities conducted by the population that negatively or positively influence water resources mainly in pangani.

1.3 General objective

The main objective of this study was to assess the main impacts of rapid population growth including the nature of activities conducted by the population on water resources in pangani basin.

1.3.1 Specific objective

- i. To examine the existing relationship between rapid population growth and water resources in pangani basin.
- ii. To identify the main activities conducted by the population along the Pangani basin
- iii. To evaluate the measures taken by government and development parties to combat the issue of rapid population growth along the basin.

1.3.2 Research questions

- i. What is the relationship between rapid population growth and water resources in pangani basin?
- ii. What are the main activities conducted by the surrounding population along the basin?
- iii. What are the ways taken by government and development parties to combat the issue of population growth along the basin?

Conceptual frame work

The following was a conceptual framework that describes the main causes of population growth, activities conducted by the population, the effects of the activities on water resource and measures that can be taken to reduce population growth as the

main cause of depletion of water resource. The original framework was developed by FAO (1994).

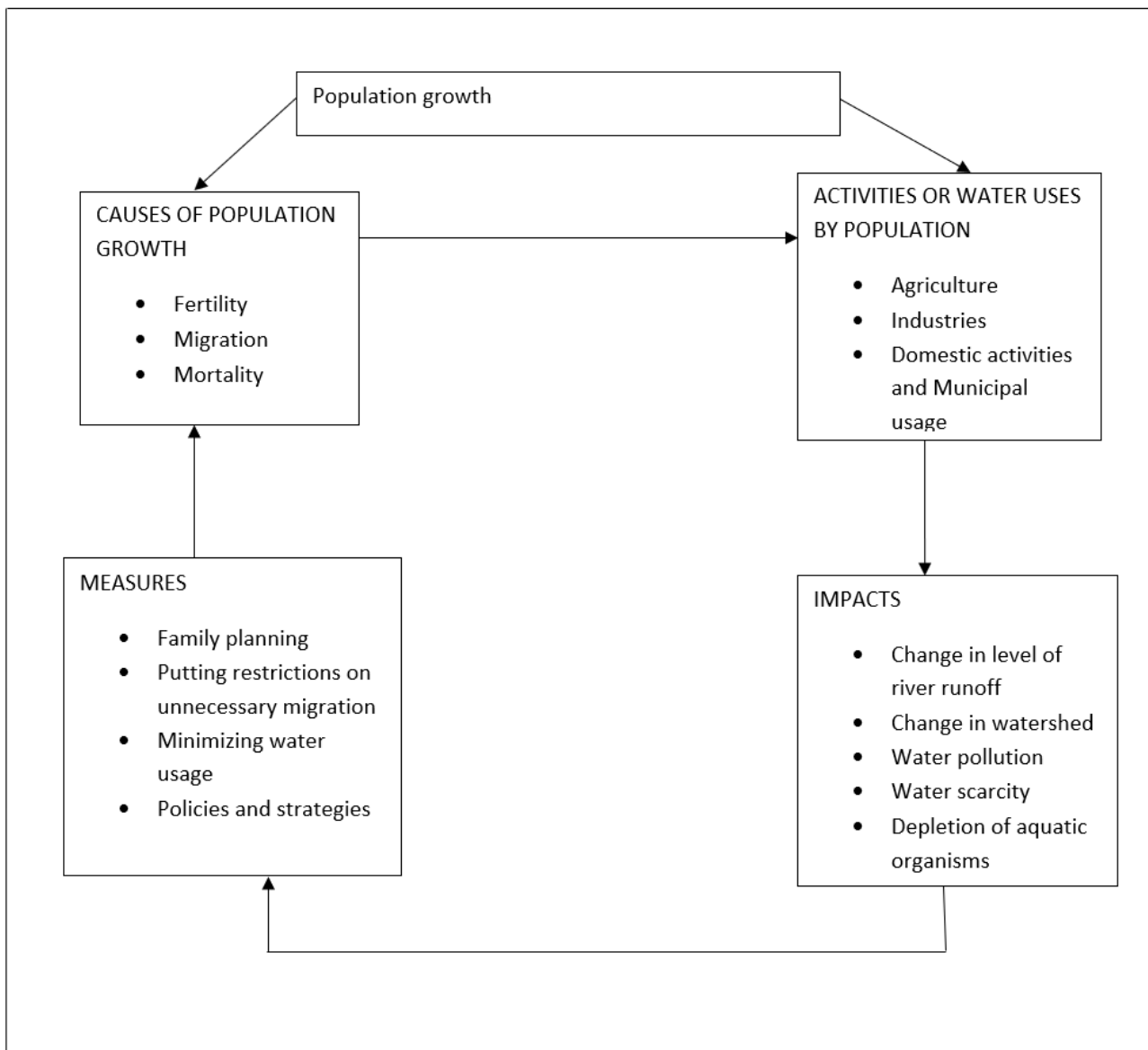


Fig: 1.1. Conceptual Framework
Source (FAO, 1994)

1.5.1 Relationship between variables

- **Population growth** refers to change in the size of a population which can be either positive or negative over time, depending on the balance of births and deaths. If there are many deaths, the world's population growth is determined to be very slowly or can even decline. Population growth is measured in both absolute and relative terms. Absolute growth is the difference in numbers

between populations over time; for example, in 1950 the world's population was 4 billion, and in 2000 it was 6 billion,

A growth of 2 billion. Relative growth is usually expressed as a rate or a percentage; for example, in 2000 the rate of global population growth was 1.4 percent (or 14 per 1,000). For every 1,000 people in the world, 14 more are being added per year. FAO(1994)Population growth is caused by several factors, the following are factors for population growth

- There are three main **causes** of population growth which are fertility, mortality and migration.

Fertility refers to ability to conceive and give birth. High fertility rate leads to rapid population growth while low fertility rate hinders population growth. Fertility is high in developing countries which in turn lead to rapid population growth.

Migration refers to movement of people from one place to another which can be a lifelong or a periodic migration. Emigration is the movement of people out of a specified geographical area while Immigration refers to the movement of people in a specific geographical boundary. Population grows as immigration increases and it decreases with the increase of emigration.

Mortality accounts for death rate taking place in a given geographical area over time. The increase of mortality leads to negative population growth whereas low mortality rate leads to positive population growth.

Therefore when there is low fertility, high emigration, and high mortality there was negative population growth and when there is high fertility, high immigration and low mortality population grows positively. When population grows positively the demand for resources such as water and land also increases, and therefore several activities are conducted by population on water resources

- Population grows rapid in areas with water resources due to the nature of activities and opportunities provided by the resource. The following are some of **activities** conducted by population on water

Agricultural activities; water is mainly used for irrigation in agricultural schemes and used by animals for drinking. This activity would not be into existence without

water resources. In large plantations water is used for irrigations using scientific methods.

Industrial activities; in industries water is essential for cooling machines, and as a raw material in some industries.

Fishing activities; this activity mainly depends on water resource, because the aquatic organisms such as fish could not exist in the absence of water resource. Fishers use various fishing methods and techniques in fishing.

Transport and transportation; water is also a means of transport whereas sources like sea, rivers and lakes are used to transport goods and people.

Domestic and municipal usage; water resources are used for domestic purposes such as drinking, washing, and cooking. The large amount of water resource is withdrawn to households and return as waste water. FAO (1994).

These activities are conducted with minimum concern on the sustainability of the resource this leads to negative impact to the resource and environment at large.

The impacts caused by the activities are such as

Change in the level of river runoff; this is due to the decrease of water in the river bank due to overuse of the resource by various sectors such as industrial, agricultural, and domestic uses.

Water pollution; the water is polluted by improper fishing activities, industrial waste, agricultural chemicals, oil leaking in transportation activities and improper waste management.

Water scarcity; overuse of any resource leads to its scarcity, scarcity of this resource is mainly due to the increase of water demand caused by rapid increase of population and decrease in quantity of water resource.

Depletion of aquatic organisms; increase in water pollution mainly contributes to disappearance of aquatic organisms or species such fishes. FAO(1994) These

noticeable negative impacts can be minimized by taking various measures to combat unsustainable activities.

- Some of the measures that can be taken to reduce the rate of population growth are

Family planning; education on family planning should be given to both women and men so as to minimize unwanted pregnancies

Putting restrictions on unnecessary migration; some movements are not necessary and therefore should be restricted to reduce high immigrations.

Minimizing water usage; water should be used when needed and not misused this will reduce over utilization of water resource

Policies and strategies; strong policies and strategies on water use have to be implemented to prevent water resource degradation FAO(1994).

1.6 Operational definition of terms

Population growth; this refers to increase of the number of the people that reside a specific nation, state, city or any other

Population; refers to the total number of all organisms of the same species, which live together in a given geographical specific geographical location.

Resource; is defined as a source of supply or aid where as benefit is obtained or produced, Such as a water resource like lake.

Water resource; these are the sources from which water is obtained and potentially used by organisms and human being, For example rivers, lakes and ocean.

River basin; this is a part of land from which all the water flows into a particular river for example the Pangani river basin.

RESEARCH DESIGN AND METHODOLOGIES

3.0 Introduction

This chapter based on presenting the research design and methodology comprising of the research design, target population, description of sample and sampling size.

Furthermore the chapter presents description of data collection tools, description of data analysis procedure and ethical consideration.

3.1 Research Design

The research design refers to the overall strategy that is chooses to integrate different components of the study in a coherent and logical way, thereby, ensure effectively address the research problem; it constitutes the blueprint for the collection, measurement, and analysis of data. The function of a research design is to ensure that the evidence obtained enables to answer the initial question as unambiguously as possible (Creswell, 1994).

3.2 Description of the Study Area

3.2.1 Location of the Study Area

This study was conducted at pangani basin specifically in Karanga River which is covers both parts of Moshi urban and Moshi rural districts. The wards which the study was conducted were pasua ward, Kirima ward and Shirimatunda.

Map of the study area

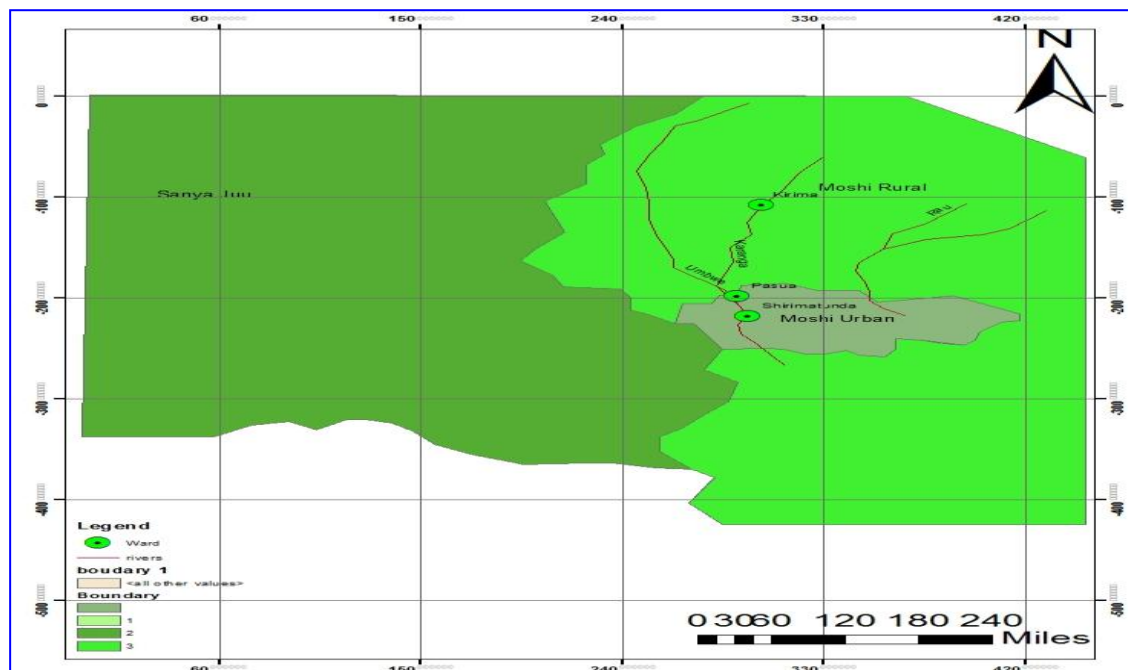


Figure 3.1 Map of study area

3.2.2 Ethnicity

There is one main ethnic group in Moshi district, which is Chagga. There are other small ethnic groups which reside in the district which are Pare, and Masai.

3.2.3 Climate

Moshi has a tropical wet and dry climate. In winter, there is much less rainfall than in summer. In Moshi, the average annual temperature is 23.4 °C. About 856 mm of precipitation falls annually. The driest month is August, with 14 mm of rainfall. Most precipitation falls in April, with an average of 282 mm.

The warmest month of the year is February, with an average temperature of 25.5 °C. In July, the average temperature is 20.7 °C. It is the lowest average temperature of the whole year. The difference in precipitation between the driest month and the wettest month is 268 mm. The average temperatures vary during the year by 4.8 °C.

3.2.4 Soils

The soil of Moshi is highly fertile influenced by volcanic mineralogy, AND ARE GOOD for coffee and banana crops cultivation. The texture of the soils in Moshi is sand to clay which indicate medium to high moisture capacity. The PH of soil varies from 5.51 which is acid soil to 7.04 which is neutral and the mean PH is 6.54 (Massawe.I.P and Mrema.J, 2017)

3.2.5 Vegetation

The condition of the vegetation on river banks and in the floodplains and swamps is a result of range of local disturbances. The most common reasons for these localized declines are clearance for agricultural land or urban areas, harvesting, or invasion by exotic species. Healthy vegetation along the banks acts as a buffer, protecting the river from sediments, fertilizers and pesticides moving downhill from the surrounding land, and also provides habitat for a wide range of wildlife. Narrow, poorly vegetated riparian zones leave the river vulnerable to pollution and a range of other disturbances.

3.2.6 Population

According to the census of 2012 Moshi urban district had a total 184,292; while Moshi rural had a total of 466,737 where as total female population was 240,970 and 225,767 males (URT 2012). (10709 kirima), (13460 pasua), and (4485 shirimatunda)

3.2.7 Socio-Economic Activities

3.2.7.1 Farming Activities

About 80% of Pangani River Basin's population relies on agriculture, directly or indirectly, for their livelihoods. Irrigated agriculture is a significant consumer of water in the basin. Coffee, sugar, flowers, and fruits and vegetables, much of these for export, are irrigated in large plantations or estates in the northern part of the basin. Many other crops, including rice, maize, beans, bananas and vegetables are grown for local markets. There are large farms such as the Tanzania Planting Company (TPC) which is about 17000 ha and the Kilimanjaro Agricultural Development Programme

3.2.7.2 Industrial Activities

There are three hydropower stations on the Pangani River, Nyumbaya Mungu, Hale and Pangani Falls which supply up to 91.5 MW or 17% of Tanzania's power. Though hydropower production does not consume water it instead uses it. Irrigation system and aquifers are sources of water in Sugar production industry TPC (Tanzania Production Company) which.

3.2.7.3 Livestock

Most rural households in the Pangani River Basin keep livestock. The most common types of livestock are chickens, cattle, goats, and sheep. The average number of cattle and goats is highest in the central areas of the basin, which include a significant number of Masai households who tend to keep larger herds of cattle and goats.

3.3 Target Population

The target population is the entire group a researcher is interested in, the group about which the researcher wishes to draw conclusion for example, suppose take a group of men aged 18-40 who have suffered an initial heart attack, the purpose of the study could be to compare the effectiveness of two drugs regimes for delaying or preventing further attack therefore target population here would be all men meeting the same general conditions as those actually include in the study (Kothari, 2004).

The targeted population in this study was the Water board officers such as PRBO specifically in Moshi district, WEOs, farmers, villagers and district environmental officers. The reason for selecting the mentioned sampling frame was due to the fact that the water board officers were aware of the extent which population growth affects the quality and quantity of water and how to manage water supply when the quantity is lowering. WEOs are the Ward Officers so they knew the population growth rate and the demand and consumption rate of water in their respective wards, farmers were one among various economic stakeholders that depend on water resources at high percentages for irrigation, villagers were aware of the impacts of population growth on water resources and the district environmental officers knew the situation and how to manage water resource.

3.4 Description of sample and sampling procedure

The simple random sampling was used in the proposed area during data collection. The simple random sampling was used in the wards found in the district. The sample consisted of villagers, farmers, water board, WEOs, in which they represented members of the whole population. The sample included sample size.

3.4.1 Sample size

Sample size is the act of choosing the number of observation or replicates to include in a statistical sample. The sample size is an important feature of any empirical study in which the goal is to make in reference about a population from a sample (Ahn, 2014).

$$n = \frac{N}{1+N(e)^2} \text{ (israel)}$$

Where by:

n= sample size

N= Total population

e= percentage of the error rate

$$100-90=10$$

$$\frac{10}{100} = 0.1$$

$$n = \frac{1841292}{1+1841292(0.1)^2}$$

$$n = 99$$

Sample Size in Wards

$$n = \frac{\text{population in a ward}}{\text{sum of population} \times 99}$$

kirima ward

$$n = \frac{10709}{28654 \times 99} = 37$$

Pasua ward

$$= \frac{13460}{28654 \times 99} = 47$$

Shirimatunda

$$n = \frac{4485}{28654 \times 99} = 15$$

$$n = 37+47+15 = 99$$

DATA ANALYSIS, PRESENTATION, DISCUSSION AND INTERPRETATION OF FINDINGS

4.0 Introduction

This chapter consists of demographic characteristics of respondents and the discussion is based on the objectives of the study which are: to examine the existing

relationship between rapid population growth and water resources in Pangani basin, to identify the main activities conducted by the population along the Pangani basin and to evaluate the measures taken by government and development parties to reduce the impact of rapid population growth on Pangani basin.

4.1 Demographic Characteristics

The characteristics of the respondents which were collected and analyzed for discussion include gender, age and economic activities.

4.1.1 Age of Respondents

The age of the people living around the basin determine the nature of activities that are conducted within the basin. The following are the ages of respondents which were the sample chosen among the entire population.

Table 4.1: Age of Respondents

| Age | Frequency {f} | Percent {%} |
|--------------|---------------|-------------|
| 18-20 | 8 | 8.1 |
| 21-40 | 36 | 36.4 |
| 41-60 | 38 | 38.4 |
| 61-80 | 15 | 15.2 |
| 80 and above | 2 | 2 |
| Total | 99 | 100 |

Source: Field Survey (2019)

The results have shown that 8(8.1%) of the respondents were between 18-20 years, 36(36.4%) were 21-40 years, and 38(38.4%) were between 41-60 years, 15(15.2%) were between 61-80 years and 2(2.0%) had 80 years and above. The majority of the population are between the age of 41-60 which involve themselves in various economic activities such as agriculture and small business to sustain their lives followed by the age of 21-40, 61-80, and 80 and above this implies that the age that depend much on the basin and its benefits lies between 21-60.

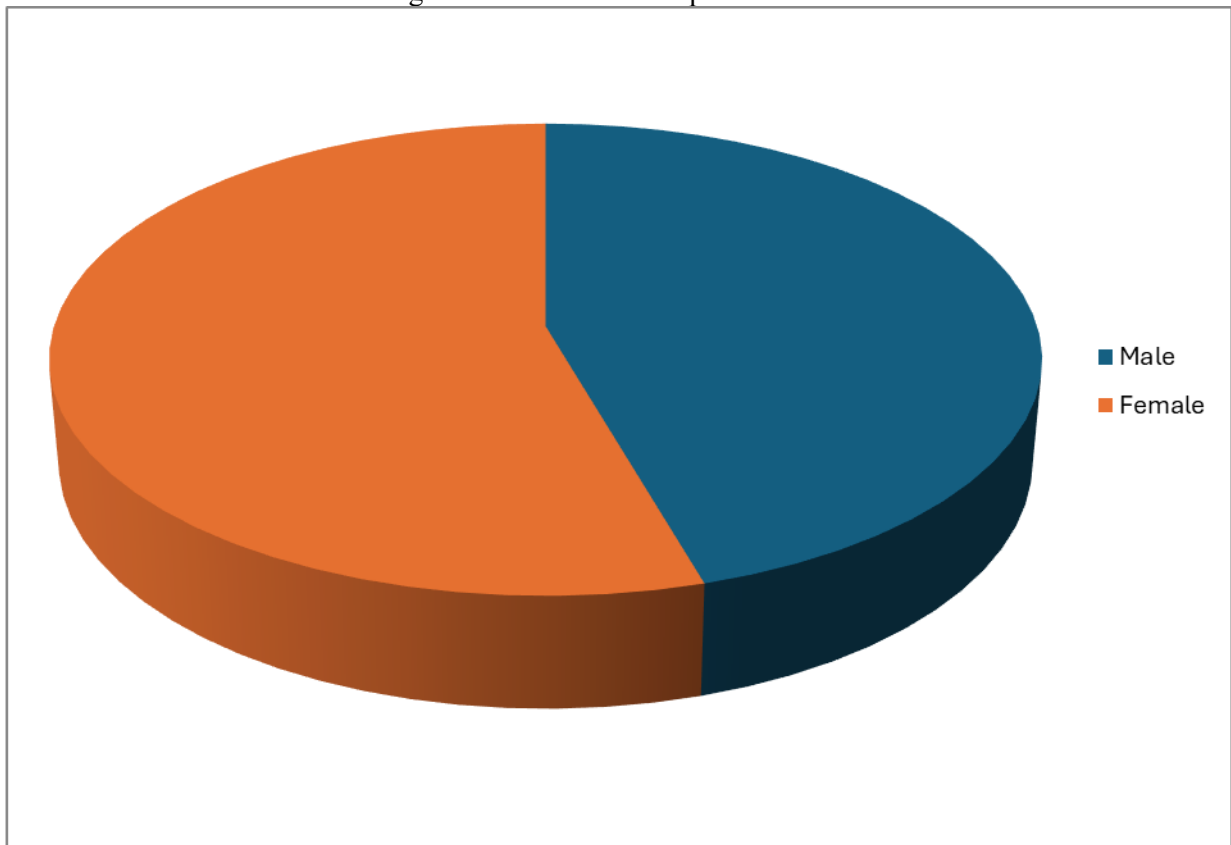
Furthermore according to PAI (2011) at the household level, demand for water and use of water resource is determined by demographic factors including household

size, composition, and age structure. Whereas the younger age tend to utilize water resources than the older ones.

4.1.2 Gender of Respondents

The gender of respondents determines the nature of activities that are conducted along the basin; the following figure shows the gender of respondents.

Figure 4.1: Gender of Respondents



Source: Field survey(2019)

The result shows that 54 (54.5%) of the respondents were female while 45(45.5%) of the respondents were male. The above results indicate the nature of activities whereas most of the females were found conducting several social economic activities such as small scale agriculture and washing clothes along the basin while minority of the population (males) were much involved in quarrying activities which are done in small quantity compared to agricultural activities. This also implies that most men do engage themselves in office work than women who are involving themselves in non office work such as agriculture and domestic activities.

According to PAI (2011) the genders of the people living along the river have a great influence on the condition of the basin. Males tend to conduct very destructive activities such as stone mining compared to women.

4.1.3 Economic Activities

Economic activities along the basin indicate the situation and quality of water within the basin. The economic activities were as shown in the table below.

Table 4.2 Economic Characteristics of the Respondents

| Economic activities | Frequency {f} | Percent {%} |
|----------------------------|---------------|-------------|
| Farming | 47 | 47.5 |
| Business | 36 | 36.4 |
| Livestock keeping | 11 | 11.1 |
| Not applicable | 5 | 5.1 |
| Total | 99 | 100 |

Source: Field Survey, (2019)

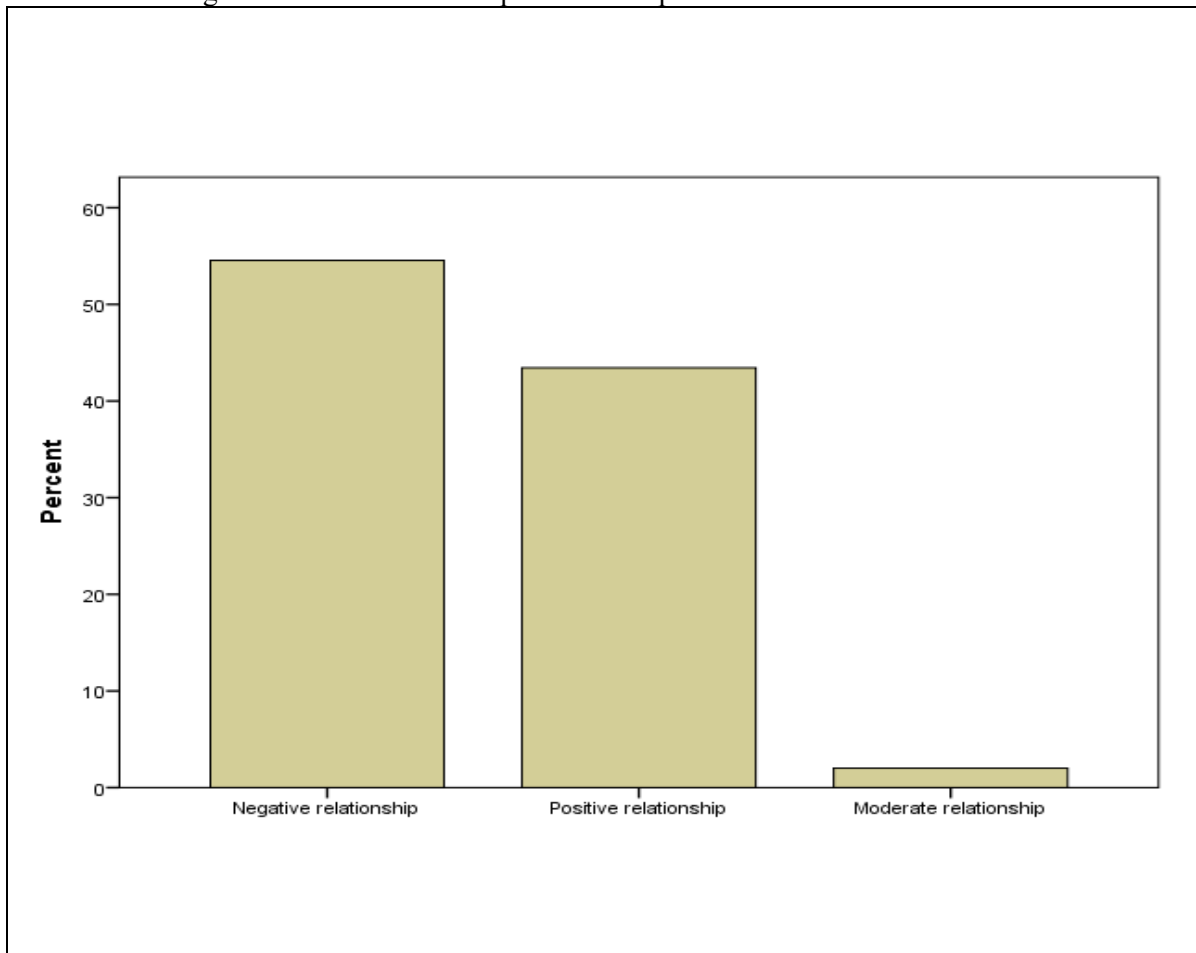
The results have shown that 47(47.5%) of the respondents conduct farming activities along the basin. 36(36.4%) of the respondents carry out business activities, 11(11.1%) of depend on livestock keeping while only 5(5.1%) of the respondents do not conduct any economic activities. Farming activities are highly conducted due to availability of enough water and fertile soil. Business activities are conducted due to the increasing population and demand on various services and goods. Livestock keeping is another economic activity conducted due to availability of enough pasture and land for grazing and the other 5(5.1%) implies a dependence group which is either very young or old to work.

These activities adversely impact water resources and this is supported by Ruminaite (2011) who suggested that the impact of anthropogenic activities on the environment is negative, and it is impossible to protect properly the river water from pollution and to avoid possible ecologic problems without regulation of economic and industrial activities, without isolation of pollution sources.

4.2 The Existing Relationship between Rapid Population Growth and Water Resources in Pangani Basin.

Both population growth and water resources influence each other. Population growth along the basin was observed due to availability of water resource. On the other hand the quality and quantity of water in the basin is mainly influenced by the nature of activities done by the population.

Figure 4.2: The Relationship between Population and Water Resources.



Source: Field Survey (2019)

In the above figure 54(54.5%) of the respondents suggested a negative relationship between population growth and water resources. This is because population growth imposes negative and high rates of destruction on water resources such as pollution and water shortages due to various economic activities such as agriculture and industrial activities. 43(43.4%) of the respondents suggested a positive relationship between water resources and population growth this is due to the fact that water

resources accelerates the increase of population on the other hand population growth leads to formulation of adaptive measures used to conserve and manage water resources. The minor respondents 2(2.0%) suggested moderate relationship between population growth and water resources.

This is supported by IUCN (2003) at its core, the problems that face resource use in the Pangani River Basin (PRB) relate to an increasing population against a background of high levels of poverty. Poverty and environmental degradation are often perceived to be interlinked.

4.2.1 Level of Awareness on the Influence of Population Growth on Water Resources

The situation of the quality and quantity of the basin is greatly influenced by the level of awareness that the users have. It may also be due to factors other than awareness of the population such as climatic condition and natural disasters.

Table 4.4: The Level of Awareness on Water Management

| Percentage of awareness | Frequency {f} | Percent {%} |
|-------------------------|---------------|-------------|
| Less than 10% | 17 | 17.2 |
| 10-30% | 45 | 45.5 |
| 30-60% | 30 | 30.3 |
| Above 60% | 7 | 7.1 |
| Total | 99 | 100 |

Source: Field Survey (2019)

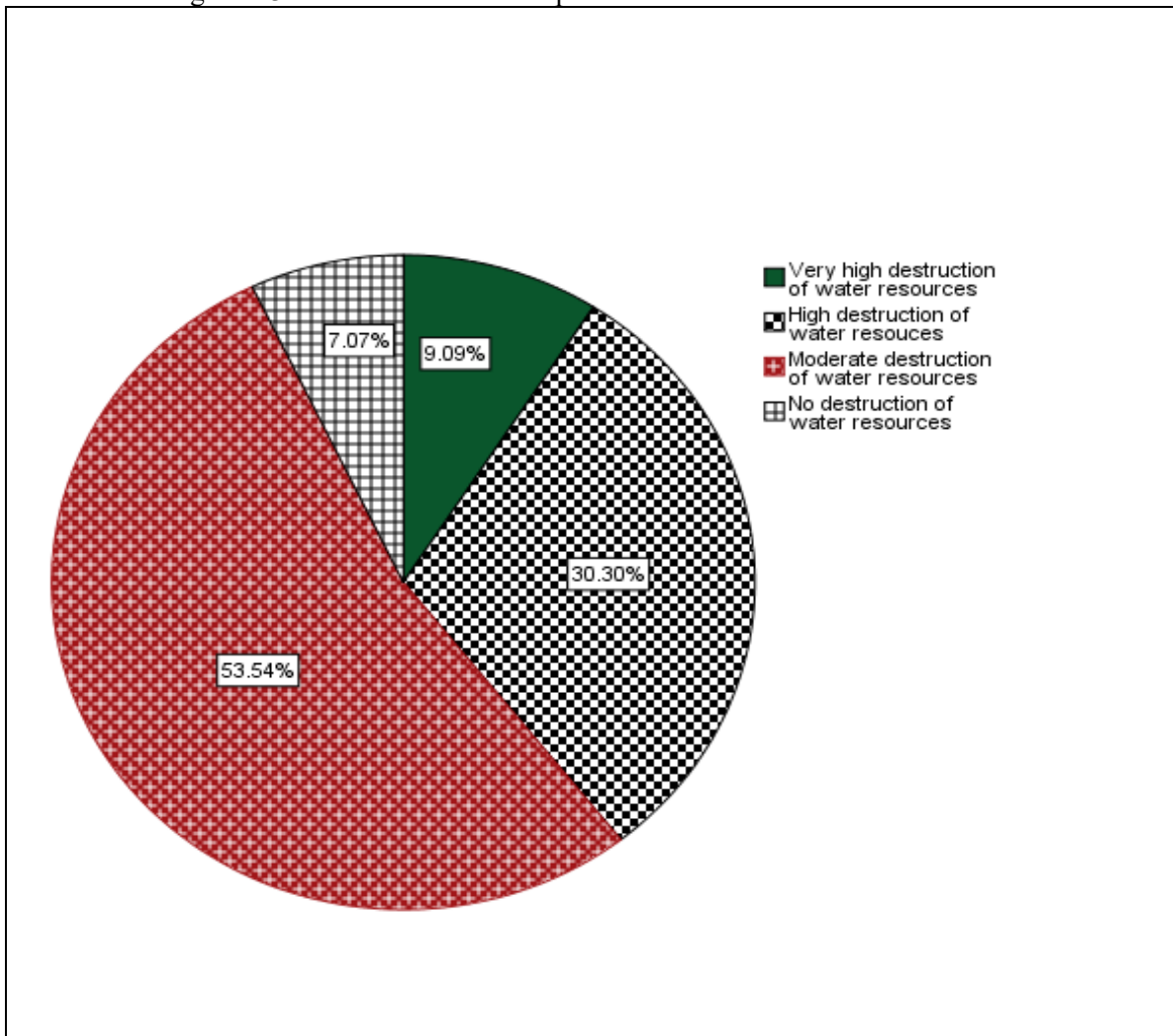
According to the results 45(45.5%) of the respondents acknowledged that people are aware 10-30% out of 100% on the influence of population growth on water resources. 30(30.3%) of the respondents admitted that people are aware 30-60%. 17(17.2%) suggested that the level of awareness is less than ten, and 7(7.1%) suggested awareness of 60% and above.

Furthermore according to PBWO(2007) there is a general lack of awareness about catchment and water conservation issues among basin inhabitants. There is little understanding among the people of the basin of the tradeoffs between resource protection and development that the government must make.

4.2.2 The Extent to Which Population Has Affected Water Resource

The growing population in the wards has posed various negative effects on water resources. The extents of these effects vary from moderate to very high rate of destruction. The rate to of destruction determines the plants and animal species available within and around the river basin. The level of destruction depends on the nature of activities conducted along the river basin.

Figure 4.3: The Rate to Which Population has Affected Water Resource.



Source: Field Survey (2019)

According to the results 53(53.5%) of the respondents suggested that the population has moderately destroyed water resources around the wards, 30(30.3%) of the respondents admitted that population has highly destroyed water resources. 9(9.1%) acknowledged very high destruction of water resources while only 7(7.1%) suggested that there is no destruction on water resources. The moderate 53(53.5%)

implies that many people in the wards have access to tap water and they do not directly interact with the sources of water.

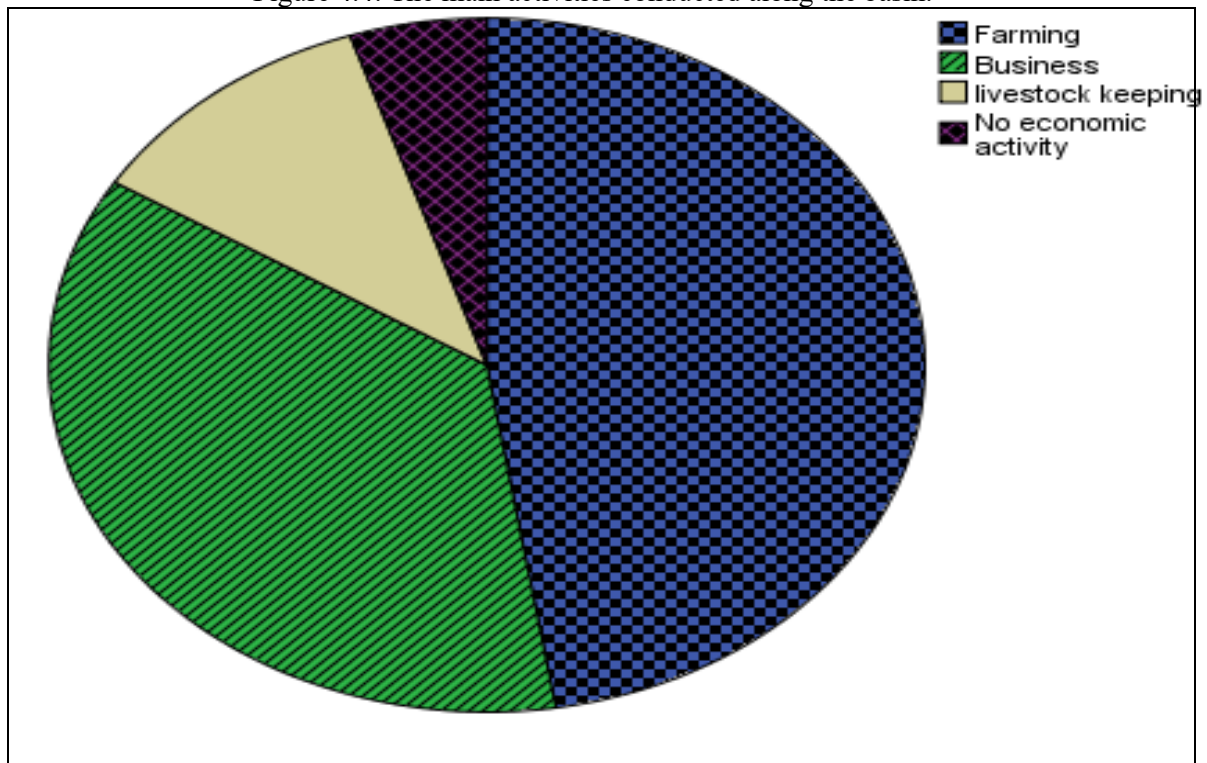
While the 30(30.3%) who suggested high rate of water destruction implies the lower rate of awareness on water management has led to poor practices conducted by the population along the basin. 9(9.1%) acknowledged very high destruction of water resources this is because the growing population conducts poor farming, quarrying and construction activities along the basin something that has led to destruction of species. 7.1% suggested that there is no destruction on water resources.

However PBWO (2007) suggested that river's plants and animals change in species and numbers depending on environmental conditions: some species are sensitive and can only survive in undisturbed parts of the system; others are quite robust and can tolerate various levels of pollution and habitat destruction.

4.3 The Main Activities Conducted By the Population along the Pangani Basin

The main activities conducted by the population in the wards are farming, business and livestock keeping as shown in the chart below.

Figure 4.4: The main activities conducted along the basin.



Source: Field Survey (2019)

As shown in table figure above 47(47.5%) of the respondents conduct agricultural activities this is due to the availability of fertile soil which enhances production of crops such as maize and vegetables and water resources that support irrigation activities.

Figure 4.5: Farming Activities in Shirimatunda Ward Depending On Irrigation.



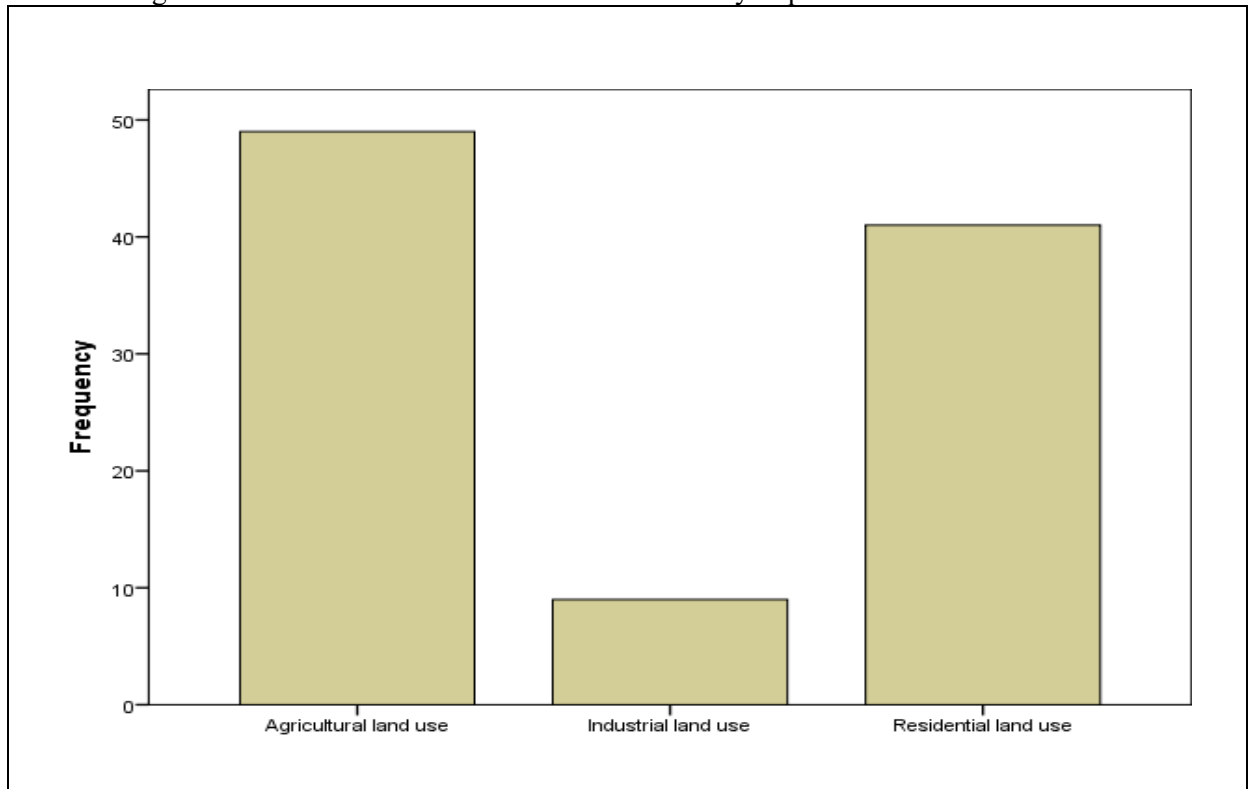
36 (36.4%) of the respondents conduct various business activities along the river. This is observed due to the growing population along the basin. Businesses activities such as selling vegetables and other products are conducted within the wards. 11(11.1%) of the respondents involve in livestock keeping this is due to availability of pasture around the wards. 5(5.1%) of the respondents do not engage themselves in any economic activities this is because they are in dependence group either younger than the working age or above the working age.

However, in the IUCN report of (2007) stated that people living near rivers use its resources for survival and to generate income. The river provides water for drinking, washing, industries and cooking, medicines, building material, firewood, and food such as fish and crops from fertile floodplains. Some of these goods are harvested for household use and some for creating income. Rivers additionally provide many ecosystem services of great economic value, such as storage of flood waters and thus more dependable flow in the dry season, and purification of wastewaters

4.3.1 Land Use Activities That Adversely Impact Water Resources

There are many land uses along the basin but this study aimed at pointing out the main land use activities with adverse impacts on water resource. The chart below shows the main land use with adverse impact on water resource.

Figure 4.6: The main land use activities that adversely impact water resources.



Source: Field Survey (2019)

According to the results 49(49.5%) of the respondents suggested agricultural land use as the leading activity which adversely affects water resource. This is because of the increasing use of chemicals and demand that affect the quality and quantity of water resources. High rate of irrigation activities on agriculture affects the quantity of water and leads to water shortage. Furthermore livestock keeping affects the quality of water around the wards.

41(41.4%) of the respondents suggested that residential land use is one among the activities that adversely affect water resource. 9(9.1%) of the respondents suggested that industrial land use to be the land use that has adverse impact on water resources. This is because industries tend to discharge polluted water to the streams also some industries are constructed near the river banks leading to erosion of the river banks. This is supported by IUCN (2003) report that pointed out that main land use in the Zigi catchment is agriculture leading to erosion, practiced mainly on a small-scale level. Crops such as maize, cassava, banana and fruit are cultivated, while cash crops such as sisal, tea and forest like the Longuza Teak Plantation project. To a minor extent, cattle grazing are also practiced.

Construction of residents and industries done 30-60 meters within the water bodies affects the geology of the river and accelerates soil erosion along the river banks.

Furthermore IUCN noted that the quality of water is also affected due to improper dumping of waste done by the habitants around the basin. In addition agricultural activities are one of the leading land uses with 49.5% that affect both the quality and quantity of water through overuse of water resource in irrigation and discharge of pollutants.

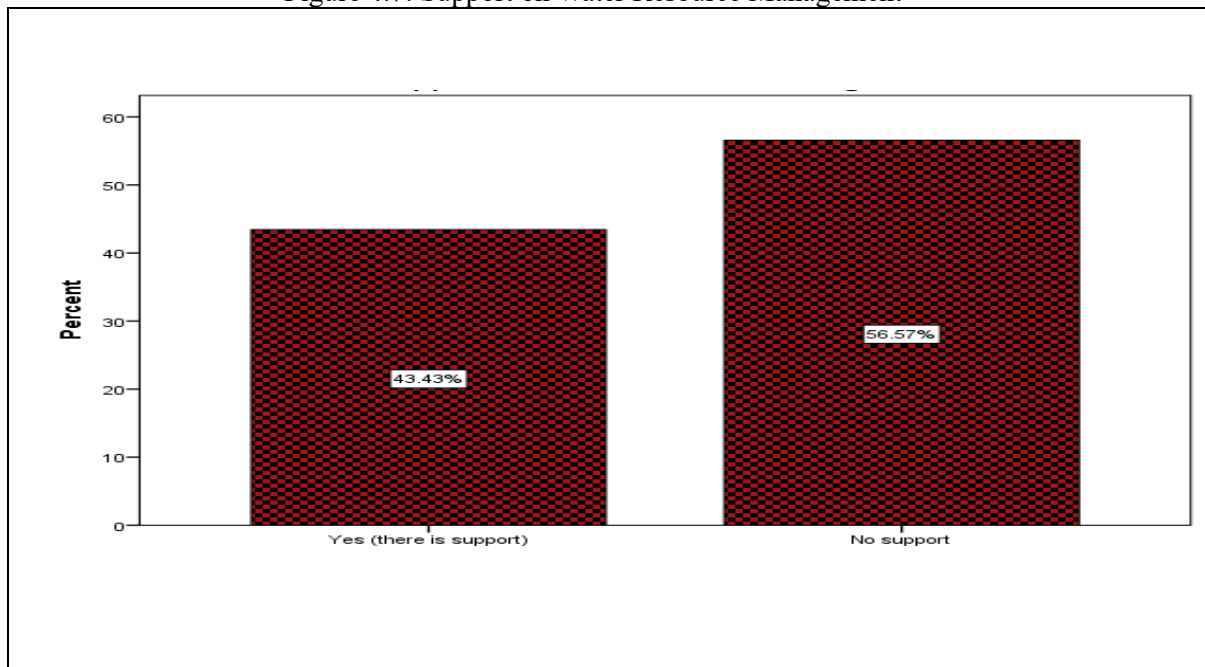
4.4 The Measures Taken By Government and Development Parties to Reduce the Impact of Rapid Population Growth on Pangani Basin.

There are various measures taken by government and development parties to minimize the impacts imposed on water resources by population growth.

4.4.1 Support on water resource management.

To some extent several developmental parts and the government have involved themselves in managing water resources as shown in the figure below.

Figure 4.7: Support on Water Resource Management



Source: Field Survey (2019).

43(43.4%) of the respondents pointed out that the support provided are in terms of education on water management whereas farmers and other villagers are educated on proper farming methods so as to minimize the risk of water pollution, encouragement

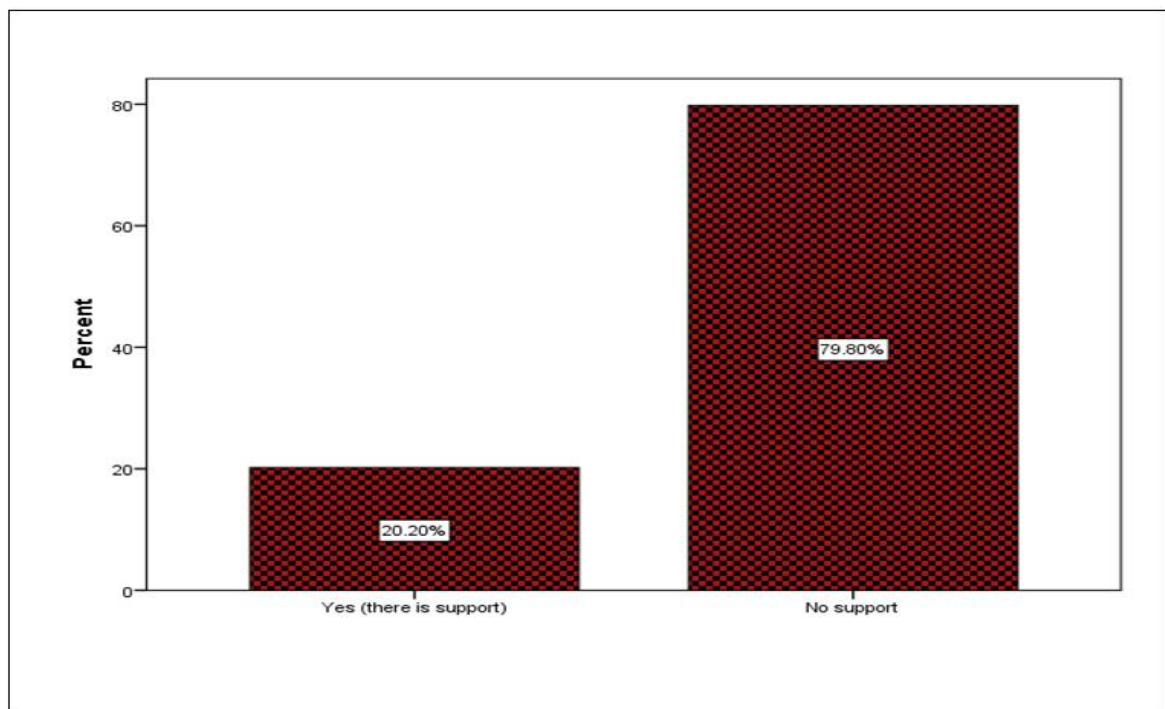
of afforestation along the river basin is also one of the supports provided to minimize the rate of erosion along the basin, construction of bridges across the river channels and furrows reduce water pollution and enactment of bylaws and laws on water conservation so as to ensure that the growing population becomes less harmful to the basin. Whereas 56(56.5%) of the respondents pointed that there was no any kind of support on water management.

According to IUCN (2007) Water Resources in Tanzania are managed by the Ministry of Water under the Water Utilization (Control and Regulation) Act No. 42 of 1974 and its subsequent amendments. As part of its sector reforms, the Ministry of Water launched a new National Water Policy (NAWAPO) in 2002. This implies the involvement of government in managing water resource.

4.4.2: Support on Population Control

There are various measures taken by the government and development parties to ensure that the population along the river does not exceed the maximum projected population. The figure below indicates the views of respondents on the support provided.

Figure 4.8: Support on Population Control along the Basin.



Source: Field Survey (2019)

20(20.2%) of the respondent who said there is support on population control pointed out education on the importance of controlling rapid population growth, encouragement of family planning and the enactment of bylaws to control population along the basin. Whereas 79(79.8%) who pointed out that the government and NGO's do not provide any kind of support on controlling population growth.

Furthermore Mbonile (2007) water conflicts between farmers and pastoralists will persist if the in-migration of farmers to former pastoral lands is not controlled. The squeezing of pastoralists into ecologically poor marginal lands has continued unabated since the 1930s, even as the population of pastoralists and their livestock has grown. This implies that there is less effort taken in controlling population growth along the basin

SUMMARY, CONCLUSION AND RECOMMENDATIONS OF THE STUDY

5.0 Introduction

This chapter concludes this report it comprises the summary of the study, conclusions and recommendation of the findings

5.1 Summary of the Study

The aim of this study was to assess the influence of population growth on water resources in Pangani basin in Moshi, Kilimanjaro. Specifically, the study focused on examining the existing relationship between rapid population growth and water resources in pangani basin; identifying the main activities conducted by the population along the pangani basin and evaluating the measures taken by government and development parties to reduce the impact of rapid population growth on pangani basin.

Responses from the sample show that relationship between population growth and water is mainly negative. Population increase along the basin leads to the increase in unfriendly human activities such as agricultural activities, construction of settlements, disposal of domestic wastes along the river and industrial activities. Others revealed that there is positive relationship due to the fact that availability of

water resource leads to increase in population while some suggested a moderate relationship between population and water resources.

A greater number of respondents along the basin conducted agricultural activities which involve both farming and animal keeping while a small number of respondents engage themselves on business activities. This has mainly affected the condition of the basin including the quality and quantity of water resource.

To reduce the impact of population growth along the basin, several practices have been implemented by both government and the private sector. Such practices include provision of education on family planning and water resource management and conservation, enactment of laws and bylaws, and encouragement of afforestation along the river.

5.2 Conclusion of the Study

Based on the results and discussions this study has revealed that population growth has negatively influenced water resources specifically the pangani basin. This has mainly been observed through the relationship between population growth and water resources and the main economic and land use activities that adversely impact water resource. The data showed that among all land uses, agriculture is the most destructive agent of water resource because it leads to discharge of harmful chemicals and destruction of river banks. The second leading destructive land use is construction of settlements along the basin which leads to discharge of domestic wastes and destruction of the river geology.

As the result of the above consequences of population growth on water resources, several measures have been developed by the government and private sectors to reduce the effects on water resource. For example bylaws have been enacted that prohibit the construction of settlements 30-60 meters from the water sources.

5.3 Recommendation of the Study

On the subject of the above conclusion a large percent of the population is less aware of family planning and water resource management. The laws and bylaws are well known by the population around the river but people are reluctant to abide to the

laws based on water management practices. There is also minimum support from the government and private sector on conserving water and controlling population along the basin.

Therefore, this study recommends implementation of practices and programs to all water resource stakeholders concerning water resource management so as to increase the level of awareness among people.

Furthermore, this study recommends the use of participatory systems in planning proper use of water resources for the benefit of all without intensifying the effects of human activities on water resources. This can be done by bringing all the parties and local communities around the water resource so as to make proper use of the resource. In other words, the government and the private sector should work together to conserve water resources and control population growth along the basin.

The study recommends launching new systems of administration by force to ensure that the local communities abide by laws and bylaws concerning population control along the basin and conservation of water resources.

5.3.1 Recommendation of Further Study

During the data collection different questions arose which indicate that there is a need to conduct another research project so as to come up with the possible solution of the questions. This study recommends extensive research to be done on how the socio-economic status of the population along the basin determines the state of the river

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