

Assessment of Demographic Impacts on Accessibility to Potable Water: A Case Study of Mwanga District, Tanzania

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Abstract

The debate on the impacts of large populations over fixed resources in developing countries is ongoing. However, the degree of impacts varies from one area to another depending on variability of physical and social economic factors. This study assessed the impact of population increase on accessibility to potable water supply in Mwanga District using Kileo village case study for the purpose of uncovering the major demographic factor *inter alia* which affect availability and accessibility of potable water provide possible strategies reached through a participatory approach to alleviate the problems. Quantitative and qualitative methods were employed to collect data using questionnaires and interviews administered to 120 respondents whom 70 were women and 50 men including key informants. Findings showed that, the study area experienced high population increase in disharmony with accessibility to potable water supply to households for different domestic uses. As a result, the local government had limited funds for construction of water infrastructure, climate change related to long droughts contributed to reduction of water sources. The general water shortage had various social economic impacts to the population in the study area. They included increased spread of waterborne diseases; the majority poor could not afford to buy water from private water suppliers; and women and children walked long distances to fetch water. The study concluded that, the increase in population corresponded with the negative effects of accessing to potable water compounded by climate change. Recommended the formation of village water committee to supervise and, in consultations with other stakeholders, find alternative ways of getting potable water for the growing population such as drilling water, protection and conservation of catchment areas; and fund raising to initiate community water projects.

Keywords: Assessment, demographic impact, accessibility, potable water, climate change

1.0 INTRODUCTION

Between 2025 and 2050 the total global population projection will reach about 9.4 billion; 90% is expected to be in developing countries of which, over 50%

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will be living in Africa (UN- PRWPR Bureau (2013/2018). The demand for water is projected to rise in developing countries compounded by climatic change, drought and water pollution which will add stress on potable safe water supplies for various domestic uses at household level. Obviously, the impact of population on accessibility to water sources to meet the demands placed on them by society is paralleled by the effects of population on the quality of water resources.

According to Water.org (2019), 57% of Tanzania's populations of 57 million have access to an improved source of safe water and only 30 percent of Tanzania's population has access to improved sanitation. Under these circumstances, women and girls suffer most as they spend more time traveling longer distances to fetch water. The demand for water increases as the population increases complicated by the general lack of enough capital to invest in water services. The market for water products (storage tanks, pipes, rain harvesting facilities, etc.) and suppliers appears to be dynamic. Studies have shown that even the limited supply of water currently available is not regular due to different problems varying from one area to another particular in rural areas where poverty is relatively high complicate both availability and access to quality water. This study aimed at examining the extent to which the rural population lack accessibility to safe and potable water in the study area and then come up with recommendations for improving water supply.

2.0 LITERATURE REVIEW

2.1 Definition of Key Terms

Demographic factors refer to dynamic population factors ranging from fertility on population increase, mortality, migration, sex and age which determine the total number of human inhabitants of a particular area at a given time (IUSSP, 2021).

Potable water is defined as water that is suitable for human consumption (i.e., water that can be used for drinking or cooking). The term implies that the water is drinkable as well as safe. Drinkable water means it is free of unpleasant odors, tastes and colors and is within reasonable limits of temperature (Dugan, 1972).

2.2 Theoretical Literature Review

What follows below are a number of theoretical literature reviews which relate to this study.

2.2.1 Link between Population and Water

The study on population is central for Man is the essence of development. It is not the purpose of this study to discuss how different theories show the inverse relationship between population increase and resources. A host of population, resource and environmental theories including Malthus' and Neo-Malthusian

Population Theories, Economics theories have already done this task. The literature review is entrenched in sharing experiences with other studies on how the water shortage is a critical problem under different social economic and physical conditions and various policies and strategies used to alleviate the problem. In fact, as Dzikus (2001) puts it water and population growth are twins. UN Population Division (2010) declared that majority of the world's population growth in the next 40 years will be absorbed by urban areas, particularly in less developed regions. It is envisaged to increase per capita water consumption driven by development intensifying water demand and strain local water capacity. Overall, the amount of water each person uses is expected to increase as incomes grow and consumption increases (UN-Water and FAO, 2007).

Rapid population growth and urbanization could expose more people to water shortages, with negative implications for livelihoods, health, and security. The demographic trends are rising giving huge development challenges (UN-Water and FAO, *Ibid*); contrasted by declining water availability in some areas due to climate change (Bates, B.C., Z.W. Kundzewicz, S. Wu and J.P. Palutikof, 2008).

2.3 Empirical Literature Review

There are numerous empirical literature reviews that relate to this study. Below are some of these.

2.3.1 Impact of Population Growth on Accessibility to Potable Water

Since early 1970s Libya faced a serious water shortage problem. United Nations classified Libya as one of the ten poorest countries in its renewable water resources and has experienced the situation of imbalance between water resources and water needs. The main identified factors physical, demographic and economic being variability of rainfall associated with absence of permanent rivers associated with Sahara Desert climatic conditions, rapid population growth and diversification of economic activities respectively. Libya's government water policy emphasised on expansion of irrigated agricultural areas and checked misuses of water resources due to lack of environment awareness. Although Tanzania's National Water Policy (2002) underlined investment in the water supply services since the early 1970s; water supply reporting has not been satisfactory. For example; the country's 1991 National Water Policy which set a goal of providing clean and safe water to the population within 400 meters from their households by the year 2002 had only about 50% of the rural population accessed reliable water supply service due to poor operational and maintenance arrangements. Nevertheless, since the reign of 5th Republic in 2015; new efforts have been shown in the implementation of the previous and new water infrastructure projects in rural areas.

2.3.2 Socioeconomic Challenges Facing Potable Water Supply

The Worldbank.org (2018) on water access project in ESwatini's rural water sector reported several challenges for poor sustainability of eSwatini's rural

water services which attributed to operational causes. They included; poor facility designing, low levels of tariff payment; ineffective voluntary (community) management of complex reticulated systems; above all lack of efficient baseline data about rural water facilities/services. The balance in budgetary allocation from the Ministry of finance of those eSwatini's has placed greater emphasis on a new scheme construction rather than rehabilitation.

As Megersa (2008) observed, safe drinking water remain a great challenge particularly in developing countries which are confronted by both poverty and critical climate change along with other socio-environmental issues. It calls for increased innovative and low-cost strategies for sustainable water supply systems and sanitation. According to Rose grant et al. (2002) in their research conducted in developing country in Africa, the available water sources throughout the world are becoming depleted and this problem is aggravated by the rate at which populations are increasing especially in developing countries. Currently, some 30 countries are considered to be water stressed of which 20 are absolutely water scarce. It is predicted that by 2020, the number of water scarce countries will likely approach 35. It has been estimated that, one-third of the population of the developing world will face severe water shortages by 2025 (Seckler et al., 1998). For example: In the Africa, 12 African countries will be considered to be in a "Water Stress" situation by next year. A further 10 African countries will be stressed by 2025. A total of 1.1 billion people or two thirds of Africa's population will be affected (Dzikus, 2001). The problem of water scarcity will be felt more severely in the developing countries are the most serious challenges of the twenty-first century.

2.4 Possible Strategies to Solve Problem of the Potable Water Supply

According to ADB (2022), Somalia is among water scarce countries and there is variation in water sources. For example, much of the north and northeast depend on ground water in the form of boreholes and the water is typically saline, while in the south water is accessed through rivers and shallow wells. Access to potable water is very low and viewed as an economic and social good. Sometime water stress is the core root of conflict. The situation is expected to worsen because of the declining annual renewable freshwater in Somalia.

The Tanzania Open Government Plan of 2012 expressed commitment on how to overcome the challenges of accessing potable water. It suggested a need to set clear priorities; to reflect on why previous efforts to improve access have been largely unsuccessful, to re-think current policies and practices in the sector on the basis of solid evidence regarding technical and governance matters; and insure meaningful transparency at all levels (UTR, 2012). Otherwise, the challenge of access will likely persist. While thinking to increase the gap between Tanzania and its sub-Saharan African neighbors but failing to fulfill the aspirations of millions of men and particularly women and children across the country.

2.5 Water Related Laws in Tanzania

2.5.1 The Water Resources Management Act (WRMA) 4 No.11/2009

The objective of WRMA is to ensure that the nation's water resources are protected, used, developed, conserved, managed and controlled to meet the basic human needs of present and future generations (URT, 2009). It categorically stated that, water resources are public resources and are vested in the President as the trustee for and on behalf of citizens. The WRMA stipulates that every person residing in Tanzania has a stake and duty to safeguard and protect water resources. However, as commented earlier, having a law is one thing and having it implemented is another thing altogether. Also, there is the Water Supply and Sanitation Act (WSSA) No. 12/2009 which is intended to oversee provision in water investment support and management of catchment areas serving water supply abstractions. Also, its effectiveness remains a thing in future.

2.6 Research Gap

Documentary review on accessibility increased population to clean, safe and quality potable water for various human uses is challenged by water stress in various dynamic forms which vary from one area to another. In other words, there is no common source and experience of the problem even if the list of causes of accessibility to potable are the same; they vary in degree from one geographical location to another. Therefore, there was the need to conduct this research in the study area in order to know how the population increase in combination with other factors impact accessibility to potable water so as to devise possible solutions to the problem.

2.7 Conceptual Framework

Conceptual Framework is an analytical tool with several variations and contexts that is used to make conceptual distinctions and organize ideas. Strong conceptual frameworks capture something real and do in a way that is easy to remember and apply (Maxwell, 2009).

Figure 1 presents the CF which consists of two variables; the independent and dependent variables. Independent variables include sources of potable water resource while dependent variable is a community. The former comprises government policy, climate, population growth and infrastructure. The assumption is that, if independent variables work properly positive results occur such as low cost will be paid for water services, control of climate will help for rain formation, low fertility rate will help to reduce water stress/scarcity and reduction on level of water borne diseases and water contamination. But if they do not function properly ranging from government policy, control of climate, population growth and infrastructure lead to negative results such as high cost in water services, failure to control climatic change enhance long term drought and inadequate of rain formation, high fertility rate increased water stress and scarce and lastly high level of water borne diseases and water contamination are highly

occurred. Generally, accessibility to potable water supply in the community is crucial, it remains a big challenge at local, regional and global levels it requires well thought plans and implementation strategies to insure availability, accessibility and proper utilizations of potable water resources.

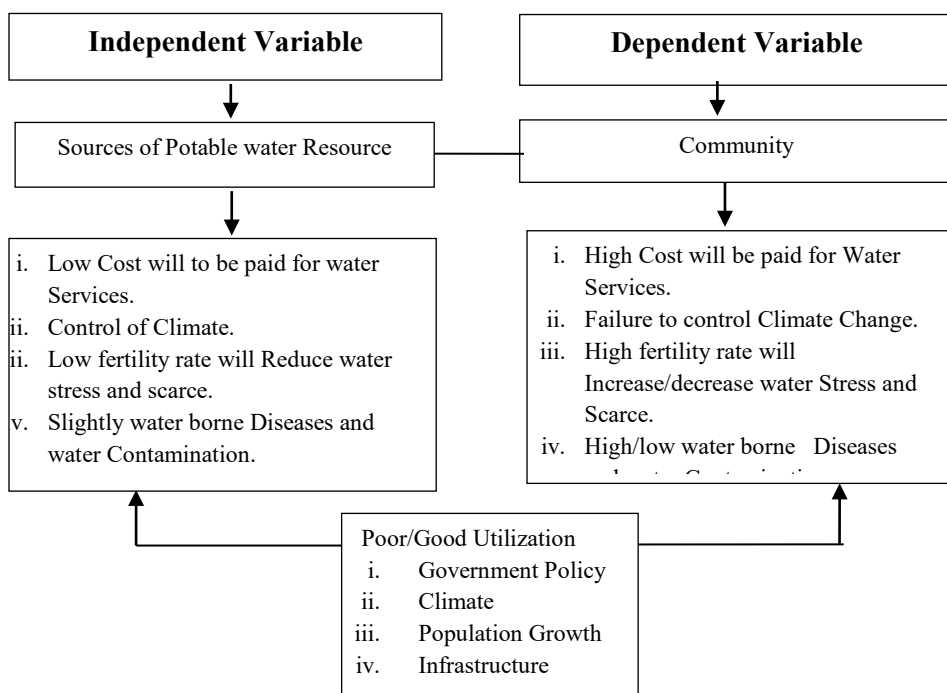


Figure1: Conceptual Framework Showing the Relationship Between Population Growth and Availability of Potable Water Resources.

Source: Own Construct, 2021.

3.0 RESEARCH METHODS AND MATERIALS

3.1 Area of Study

The study was conducted in Mwanga district whose geographical location is 3⁰ 45' S latitudes and 37⁰ 40' E longitudes (Figure 2). Mwanga is one of the districts in Kilimanjaro region located in north east of Tanzania. The main ethnic groups in the district are Pare and Chagga tribes whose main activities include business, agriculture, livestock keeping and tourism motivated by the existence of several tourist attractions such as Mt. Kilimanjaro, the highest mountain in Africa, Kilimanjaro National Park and so on. The study area is characterized by tropical climate and semi-arid climate entailing Kisangara and Mgagao found in Lembeni Ward, Jipendea division and some areas around Kileo Ward.

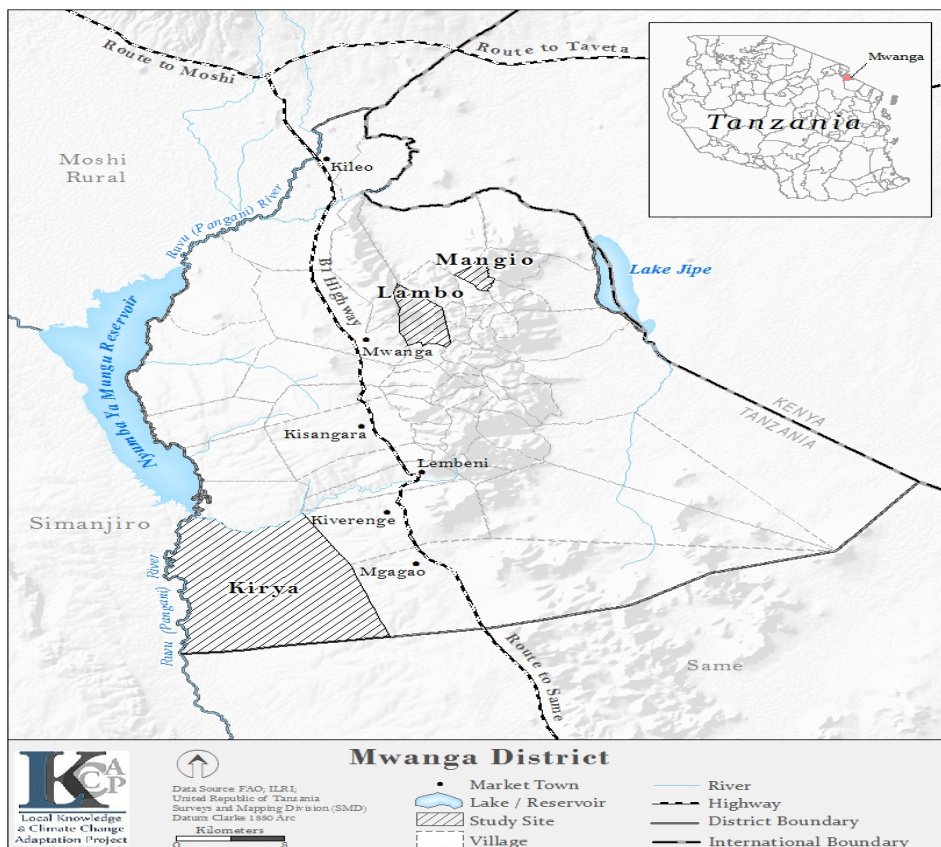


Figure 2: Map of Mwanga District, Kilimanjaro Region Tanzania.

Source: Field Data, 2021

Justification for selection of Kileo village as a case study as it threefold. One, it is one of the semi-arid land areas challenged by inadequacy of potable water. The presence of infected and polluted water leading to waterborne diseases and mortality rates in the village is another justification. By the time when this study was conducted there was no government water project in the village. is an extra justification for Kileo village to be chosen as the area of the study as the result of the study may lead to an initiation of such a government project of water to tackle the challenge of inadequacy potable water. Besides, according to Tanzania National Census (2012) shows that Kileo village is inhabited by 4,983 (2,341 males and 2,642 females) sedentary people who are farmers practicing irrigated agriculture often combined with livestock keeping. When compared to the previous census; it is a population increased by 6% which according to UN – UNFPA standards it is rapid population increase.

3.2 Research Design

The researcher used a case study employing qualitative approach involved a careful and complete observation of a social unit, such as a person, family, an institution, a cultural group or even the entire Community.

3.3 Sampling Techniques, Procedures and Size

The study used mixed methods. For selection of the study area, Kileo village, as stated under justification possessed the merits for the research to be conducted there, therefore, purposive sampling was used. But also, it used purposive sampling technique to select government officials from Mwanga district, members of the community in Kileo village; and focused discussion groups making a sample of 120 as provided in Table 3.1. The employment of purposive sampling instead of random sampling for interviews in the course of qualitative data collection where a case study approach is employed; it is justified by the following authorities. Sandelowski, M. (1996) argues that, samples in qualitative research tend to be small, thus in order to support the in-depth case-oriented analysis; it is fundamental to use purposive sampling in inquiry. Additionally, Luborsky M. R. and Rubinstein R. L. (1995) argue that qualitative samples are purposive, that is, selected by virtue of their capacity to provide richly-textured information, relevant to the phenomenon under investigation. Rijnsoever FJ. (2017) argued that recent case study research works which employ purposive sampling testified greater efficiency than those which use random sampling in qualitative studies. On this basis, the study used purposive sampling in selecting the study sample constituting 120 respondents.

Table 3.1 Different Categories of Respondents

Place of Living	Frequency (Number of respondents)	Percent
Mwanga DC	4	3.3
Kileo Centre (With One, VEO)	28	23.3
Barabarani	29	24.2
Mnoa	24	20.0
Mlaki A	17	14.2
Mlaki B	17	14.2
Kileo (WEO) Office	1	.8
Total	120	100.0

Source: Field Data, 2021

3.4 Data Collection

Questionnaires were used to collect quantitative data in the field ranging from demographic information, impacts of population increase, socioeconomic challenges facing distributions of potable water supply and the strategies to solve the problem of potable water supply. They were complimented by qualitative methods using in-depth interviews intended to obtain inner most feelings of respondents on the crux of the potable water shortage problems and strategies of

resolving the problem. Qualitative interviews way mainly directed to Key informants and FDGs.

3.5 Observation

The study employed observation to investigate physical factors whether water infrastructure existed or not; the physical distance involved in fetching water, and those engaged in fetching water by sex and age and commented accordingly.

3.6 Data Analysis

Data processing followed after the collection of raw data. It included coding especially qualitative ones and general data cleansing. SPSS (Statistical Package of Social Sciences) version 20 was employed to analyse data hence generated descriptive statistics; whereas content analysis was used qualitative data. Finally, data were presented in various statistical figures ranging from tables, charts showing percentages on specific objectives that guide the whole process of data collection from the field.

4.0 RESULTS AND DISCUSSION

The presentations of the findings are followed by discussion of the results from respondents to the item in questions. The findings are presented according to research objectives.

4.1 Demographic Characteristics

4.1.1 Sex of the Respondents

Figure 3 presents sex of 120 respondents in a nutshell.

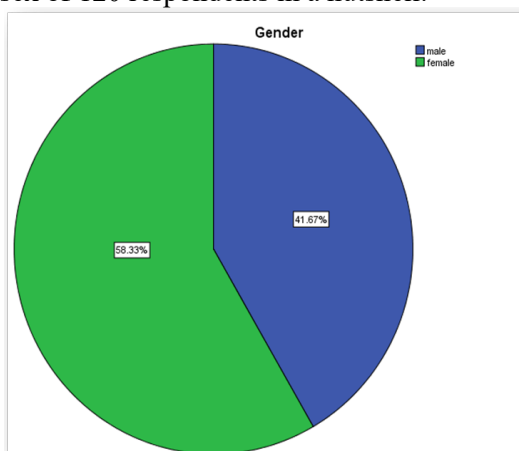


Figure 3: Sex of the Respondents

Source: Field Data, 2021

4.1.2 Age of Respondents

Table 4.2 bellow shows the age of respondents which were grouped into five-year intervals. IT shows that, a high concentration of the population lies in youths and those in the reproductive age. Demographically, such features denote

a young population characterised by high reproduction. It supports the assertion that Kileo village and Mwanga district as a whole experienced rapid population increase.

Table 4.2 The Age of Respondents

Age of respondents	Frequency	Percent
10-14 YRS	18	15
15-19 YRS	20	16.7
20-24 YRS	20	16.7
25-29 YRS	12	10
30-34 YRS	10	8.3
35-39YRS	12	10
40-44 YRS	12	10
45-49 YRS	10	8.3
50 + YRS	6	5
Total	120	100

Source: Field Data, 2021

4.2 Level of Education

Figure 4 shows different education levels achieved by the study population sample ranging from primary, secondary, diploma and university education. The majority 63(52.5%) out of 120 respondents achieved primary education level, therefore, are capable of doing the 3Rs (reading, writing and arithmetic). Such a population is an asset in the sense that it is capable of obtaining information, trainable and could participate in decision-making process related to social development in the community.

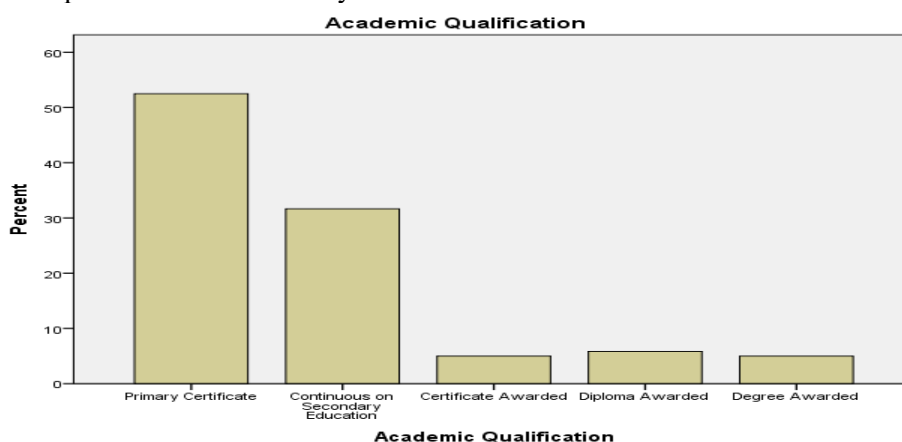


Figure 4: Education level of the respondents

Source: Field Data, 2021

4.3 Impacts of Population Growth on Accessibility to Potable Safe Water

The first research question sought to find out the impacts of population growth on accessibility to potable safe water at Kileo village. The researcher asked all

120 respondents (6 public officers and 114 community members) requesting them to mention at least three impacts of population growth on accessibility to potable water at Kileo village.

Table 4.3 The Impacts of Population Growth on Accessibility to Potable Safe Water at Kileo Village

Answers	Frequency (Number of respondents)	Percent
Destruction of distribution of water network, pollution of water resources and spread of waterborne diseases.	77	64.2
People use much water for agricultural activities.	43	35.8
Total	120	100.0

Source: Field Data, 2021

Table 4.5 shows that, human activities associated with population increase affect availability of potable water for domestic uses by interfering water network causing polluting and contamination (64%) hence lowered the quality of potable water; while, 35.8 % diverted it to agricultural activities thereby reduced the volume or quantity of water for human drinking. For example, this study was informed by Ward Executive Officer of Kileo Ward on cases of some unfaithful residents who vandalized former water infrastructure and stole water pipes and the electric power panel of Mtindi Natural spring. They were compounded by poor planned sewage system which caused pollution of potable water sources.



Figure 5: Sample of Sources of Potable Water Found in Kileo Village

Source: Field Data 2021

Figure 5 is a hand water pump located at a place between Mnoa and Kileo primary schools. The pumped water from this water pump is a major source of potable water for these two primary schools. Some of the community members of Kileo village have access to this water pump as their source of potable water. There are 6 water kiosks saving 4983 people in Kileo village. These 6 water kiosks are not sufficient to save the entire population in the village. This was a typical case of the impact of population increase on limited potable water source.



Figure 6: Sample of Sources of Potable Water found in Kileo Village

Source: Field Data 2021

Figure 6 displays some of the children in Kileo village who had gone to fetch water at a place where a manual water pump for the village is situated. It signifies the extent children had to walk great distances to fetch water often at the expense of attending school classes. These findings tallied with the UN – FAO’s (2022) observation that population growth is a major contributor to water scarcity; for growth in populations means mounting demand and competition for

water for domestic, industrial, and municipal uses. Water is also needed for agriculture and industrial use, and for the evacuation of waste materials. The most water scarce or stressed areas are typically those with few water resources, high population densities, and high population growth rates.

4.4 Socioeconomics Challenges Facing Potable Water Supply in the Study Area

Table 4.6 presents challenges facing potable supply in the study area whereby 87(72.5%) respondents said that the social economic human activities instigated climate change accounted much for the destruction of Mtindi natural spring source at Kileo village in Mwangwa District Council. While, 32(26.7%) respondents stated other factors which contributed to scarcity or inadequacy of potable water included lack of storage facility; and some villagers could not afford to buy water which was a manifestation of poverty among poor households in the study area.

Table 4.4 Socioeconomic Challenges Facing Potable Water Supply at Kileo Village in Mwangwa District

Answers	Frequency (Number of respondents)	Percent
Human activities, climate change, and destruction of Mtindi natural spring source	87	72.5
Lack of storage facility and some villagers can't afford to pay for price of water	32	26.7
Missing system	1	.8
Total	120	100.0

4.5 Possible Strategies to Solve Potable Safe Water Supply Problems

The following responses were obtained through a participatory process where the very community members were involved in giving solution to their own problem of potable water. Responses are provided in 4.11 below indicates that 101 (84.2%) respondents out of 120 respondents said that drilling shallow wells for schools and a health centre, continuity of the use of Mtindi natural spring as the source of water and to formed village water committee should be the strategies to solve the problems of potable safe water supply at Kileo village in Mwangwa District. 18(15%) respondents out of 120 said that, renovation of Kileo water project from Mtindi Natural spring, advised the Central Government to allocate funds for water project at Kileo ward and construction of sewage system which would help to reduce water contamination were the strategies to solve the problems of potable safe water supply at Kileo village in Mwangwa District. 1(0.8%) respondent did not answer. According to Ismaila R. A.(2019),strategies to solve the problem of potable water should include the provision of public standpipes and community boreholes as interim measures while expanding piped water supply. Besides household water treatment has to be taken as a stop-gap measure for improving water safety.

Table 4.5 Responses on Possible Strategies to Solving Potable Water Supply Problems in the Study area

Answers	Frequency (Number of respondents)	Percent
Drilling shallow well for school and health centre, continuous use Mtindi l spring and to form village water committee.	101	84.2
Renovation of Kileo water project from Mtindi, advice government to allocating fund and construction of sewage system.	18	15.0
Total	119	99.2
Missing System	1	.8
Total	120	100.0

Source: Field Data 2021

5.0 CONCLUSIONS AND RECOMMENDATIONS

This study has established that, population increase over fixed water resource is a liability to ensuring regular supply of potable water for domestic use purposes. However, population increase is not the only dynamic force causing water shortage. It works in combination with physical factors basically climate change; and social economic factors incited by human activities such as destruction of water networks in the catchment area rendering pollution; irrigation schemes reduce the volume of potable water. But also, majority of villagers are poverty-stricken cannot afford to buy potable water. It also brings in the cost of longer travel time especially for women and children in the course of fetching water instead of attending other useful social economic obligations. Since almost all these factors are manifestations of human population increase, therefore, population increase is the key player in influencing availability and accessibility to potable water in any given geographical area. This study capitalizes on the recommendations given by respondents in a participatory way. There is need to form a village committee empowered to monitor and supervise potable water issues in collaboration with other stakeholders including the local and central government. Such concerted efforts should consider launching a project of drilling shallow wells to minimize shortage of potable water in the study area but also to mobilise funds for the construction of sewage system which would help to reduce water contamination against water-borne for the welfare of the community and society at large.

5.1 Suggestion for Further Research

- i) To research on the relationship between National population increase and availability of potable water supply for upcoming generation.
- ii) To find possible ways on how to overcome socio-economic challenges facing population growth towards accessibility of potable water supply to all Tanzanians.

- iii) To explore the effectiveness on monitoring the impacts of population growth on accessibility of potable safe water supply.
- iv) To investigate strategies for achieving sustainable potable water resources.

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