ASSESSMENT OF THE CAUSAL RELATIONSHIP BETWEEN THE ACCESS TO IMPROVED WATER SOURCES AND HOUSEHOLD INCOME IN TANZANIA: A CASE OF MSALALA DISTRICT COUNCIL

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Master Degree of Science in Project Planning and Management

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A dissertation submitted in partial fulfilment of the requirements for the Award for the Master Degree of Science in Project Planning and Management of the Institute of Accountancy Arusha

NOVEMBER, 2023

DECLARATION

I, **Maduhu Wasala Magili**, declare that this dissertation is my original work and that it has not been presented and will not be presented to any university for a similar or any other degree award.

Signature: ……...

Date: ……..

CERTIFICATION

I, the undersigned certify that I have read and hereby recommend for acceptance by the Institute of Accountancy the dissertation entitled: “Assessment of the Causal Relationship Between the Access to Improved Water Sources and Household Income in Tanzania: A Case of Msalala District Council”, in partial fulfilment of the requirements for the degree of Master of Science in Project Planning and Management of the Institute of Accountancy Arusha.

Signature: ……

Mr. Samwel K. Nyamanga

(Supervisor)

Date: ……..

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DEDICATION

I dedicate my dissertation work to Almighty God for His love and for always protecting me. I also dedicate it to my loving and caring parents, my father Deus Wasala Mitanda and my mother Angelina Sabuyi Luchagula, for their excellent guidance that has laid a strong foundation for my life. I am grateful to my beloved wife Mrs Kundi Ngeme Seni and our lovely sons; Innocent, Ibrahim, Isack, and Isaya, for their unwavering support and encouragement during my entire period of study. May Almighty God bless them all.

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ABSTRACT

This research delved into examining the causal relationship between accessibility to improved water sources and household income in Tanzania, with a focus on the Msalala District Council in the Shinyanga Region. Specifically, the study examined whether access to improved water sources Granger causes household income in Tanzania. Furthermore, it explored the reciprocal relationship by assessing whether household income Granger causes access to improved water sources in the Tanzanian context. Additionally, the study scrutinized the presence of co-integration between access to improved water sources and household income in Tanzania. The theoretical frameworks of Human Capital Theory, Resource-Based Theory, and Capability Approach guided this investigation. The descriptive analysis of the data revealed that Household Water Connection in Msalala District Council showed a mean value of approximately 83.83, indicating a certain level of access to improved water sources. However, notable variability (with a variance of 6,943.968) and a slight right-skewness were observed, suggesting varying levels of water connection and the existence of outliers. In terms of Household Income in the study area, the figure was approximately TZS 990,215.20, showcasing significant income disparities (evidenced by high variance) and a slightly right-skewed distribution with indications of outliers. Unit root tests confirmed the stationary nature of both variables. The regression model findings illustrated that Household Water Connection elucidates 83.48% of the variance in Household Income. This relationship exhibited positivity, with a one-unit increase in Household Water Connection correlating with a 3.15-unit increase in Household Income. The Johansen test outcomes indicated cointegration, suggesting a sustained relationship between the variables over the long term. Furthermore, Granger causality tests established a directional causal link from Household Water Connection to Household Income. Diagnostic tests validated the model's integrity and dependability, collectively implying that Household Water Connection significantly influences Household Income in the studied region. Continuing with the analysis, these findings carry significant implications for both theoretical understanding and practical applications. The presence of a Granger-causal relationship from Household Water Connection to Household Income suggests that interventions and policies aimed at improving access to clean water sources can be strategic in fostering economic growth in the Msalala District Council and, by extension, in the broader Tanzanian context.

Key terms: *Water Connection, Granger causality, Household Income.*

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LIST OF ABBREVIATIONS

ADF	Augmented Dickey-Fuller
ARDL	Autoregressive Distributed Lag
ed.	Edition
et al.	And others
GDP	Gross Domestic Product
HWC	Household Water Connection
NBS	National Bureau of Statistics
p.	Page
pp.	Pages
RSDMS	RUWASA Service Delivery and Management System
SDGs	Sustainable Development Goals
TZS	Tanzanian Shilling
VAR	Vector Auto Regression
VECM	Vector Error Correction Model
WB	World Bank

CHAPTER ONE

GENERAL INTRODUCTION

This chapter covers the background to the problem, statement of the problem, research objectives, research questions, and scope of the study, significance, limitations, and significance of the study.

1.1 Background to the Problem

Globally, many people still pass away from diseases associated with inadequate water supply, despite the fact that the United Nations recognized access to clean drinking water and sanitation as a human right nearly a decade ago (Jepson, 2019). The government and its partners should continue to upscale efforts aimed at increasing access to improved drinking water supply services, especially in rural areas, to reduce the disparity that exists between urban and rural households.

Projections show that, by the year 2050, more than half of the world's population will live under moderate water stress, with 80% of these located in developing regions. Even though the proportion of the global population using improved drinking water sources stood at 91% in 2015 (a Millennium Development Goal (MDG) target achieved by the year 2010), 785 million people still lacked basic drinking water services in 2017 while 159 million still collected drinking water directly from surface water sources (58% of whom live in sub-Saharan Africa) (Pedro., 2017).

As many nations work towards meeting target 6.1 of Goal 6 of the Sustainable Development Goals (SDGs), aimed at achieving universal and equitable access to safe and affordable drinking water for all by the year 2030, it is important to document the determinants of access to improved drinking water sources in order to identify key areas and disparities that nations still need to address as they strive to meet this target (UNICEF & WHO, 2015).

Access to improved water is associated with lower morbidity, lower mortality, and a lower risk of diarrhoea among children (<5 years). On the other hand, the risk of mortality from access to

unimproved water sources is reportedly higher among children aged less than 5 years, while absent, inadequate, or inappropriately managed water services increase the risk of transmission of diseases like cholera, diarrhoea, dysentery, hepatitis A, typhoid, schistosomiasis, and polio, this led to increased high expense due to waterborne diseases (Klarin, 2018).

The effects of improved drinking water quality on early childhood growth have been well documented, whereby the risk of children being underweight is reportedly lower among children from households with improved drinking water than from those with unimproved water sources (Zhang, 2021). The World Bank argued that when water comes from improved and more accessible sources, people spend less time and effort physically collecting it, and that allows them to be productive in other ways while enjoying greater personal safety as the need to make long or risky journeys to collect water is eliminated (Rusca, 2019).

In the long run, having improved drinking water sources also translates to less expenditure on health, as people are less likely to fall ill and incur medical costs. Access to improved drinking water sources can also ensure better health and, therefore, better school attendance for children as they become risk-free from water-related diseases (Nagesh, 2019).

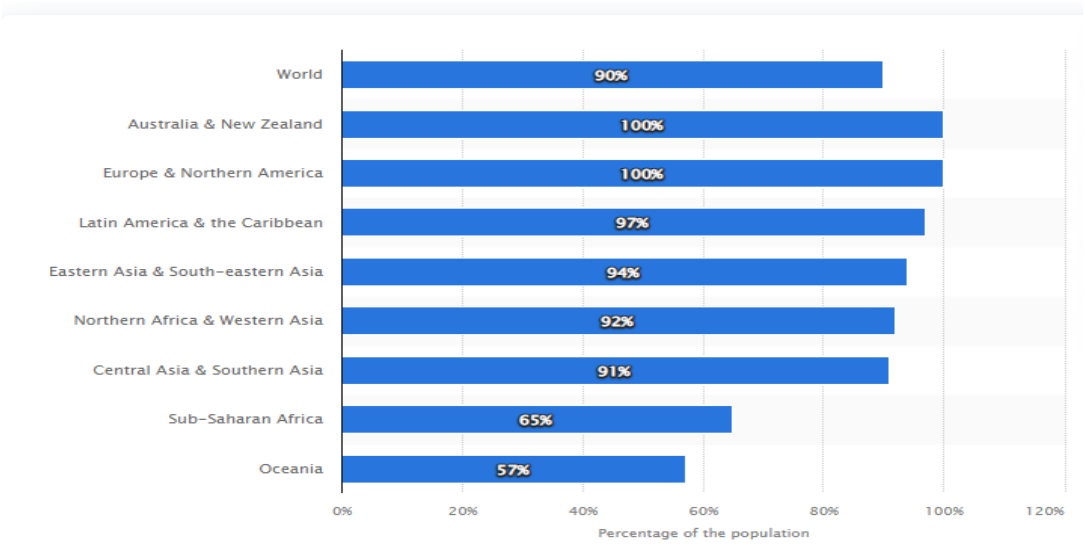
Even though the target for safe drinking water was the first of all the MDGs to be met, disparities still exist between countries in sub-Saharan Africa and between rural and urban settings in those countries. Previous research has shown that in Africa some of the factors associated with access to improved household water sources include the place of residence, wealth status, education, ethnicity, access to electricity, gender, water collection time, and the number of rooms in a household (Bartniczak, 2019).

Regardless of that, water is one of life's essential needs, water crises are becoming more commonplace around the world, as billions of people continue to suffer from a lack of access to clean water, sanitation, and hygiene. The risk of droughts is also becoming an alarmingly

reoccurring issue across the world and is likely to be exacerbated in the future due to climate change (Guido, 2015).

In 2020, an estimated 90 percent of the world's population had access to at least basic drinking water services. Access was highest in Europe and North America as well as Australia and New Zealand, with 100 percent of both regions having access to at least basic drinking water services (Ladha, et al., 2020). Improved drinking water refers to a source that can be adequately protected from outside contamination, mostly by faecal matter.

Figure 1. 1: Estimated share of global population with access to at least basic drinking water services



Source: (Ladha, et al., 2020)

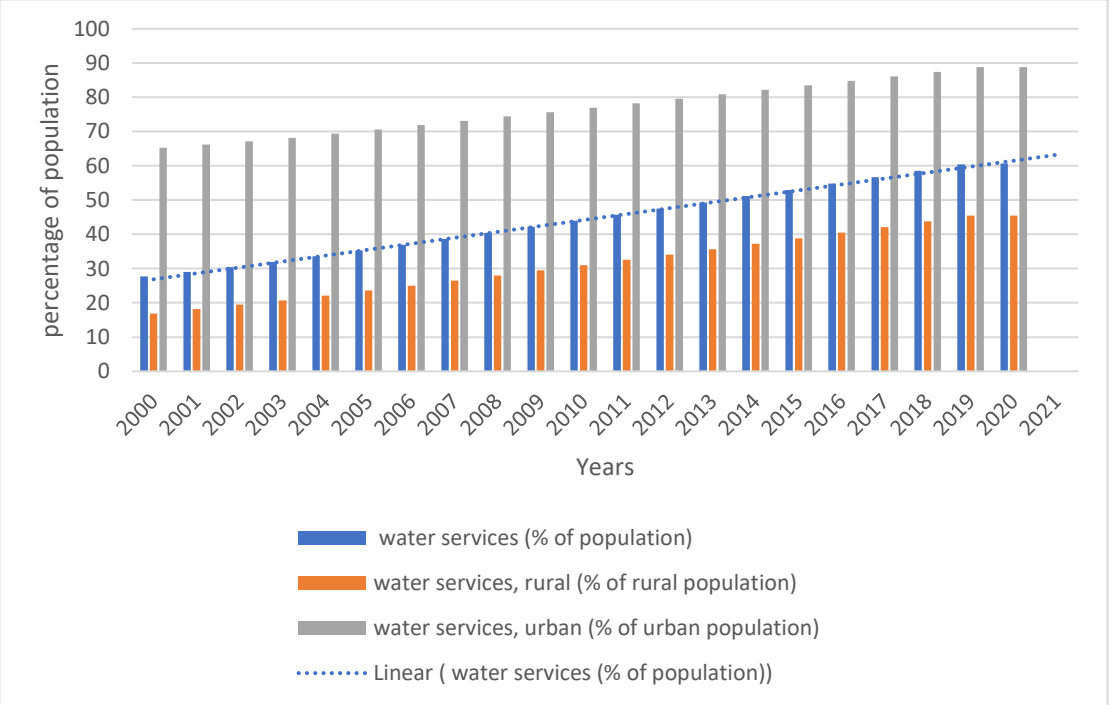
In most regions of the world, 90 percent of the population has access to at least basic drinking water services. However, just 65 percent of the population in sub-Saharan Africa and 59 percent of the population in Oceania had basic access in 2020 (Phukan, 2023). In sub-Saharan Africa, about 16 percent of people had access to unimproved water sources and eight percent only had access to surface waters. Unimproved water sources include bottled water and tanker trucks. Currently, eight out of ten people living in rural areas still lack even basic drinking water services.

A lack of access to safe water is considered one of the top risks based on its impact on global societies (Wong, 2023).

Furthermore, water is an essential resource that has economic value in all its rival uses and should be accepted as an economic good. It is well known that access to a water supply is very important for improved quality of life and well-being, especially when linked with other social services, as well as economic growth (Bu, 2023). This aligned with sustainable development goal number 6, which focuses to ensure the availability and sustainable management of water and sanitation for all, the major intention is to ensure access and supply of water to all people towards a sustainable economy (Sarkkola, 2023).

The argument above is supported by Tanzania, the 2002 national water policy which recognizes access to safe and clean water as a basic need and right for all, and aims to provide adequate, affordable, and sustainable water supply services to the population (URT, 2002; 2008). World Bank revealed the reality of water access in Tanzania as indicated in figure 1.2 below.

Figure 1. 2: Access to water services in Tanzania



Source: World Bank database (2023)

The above figure shows that there has been a linear increase in water services access since year 2020 to currently as the manifestation of the implementation of TDV 2025, the Millennium development goal, sustainable development goal number 6 and lastly Tanzania, the 2002 national water policy which recognizes access to safe and clean water as a basic need and right for all. Since water is regarded as an essential resource with economic value, this study intends to quantify the causality numerical value of access to improved water sources and household income in Tanzania, through Granger causality model as research methodological gap to fill on this study.

Therefore, the current research aims to assess the impact of access to improved water sources on household income in Tanzania: a case of Msalala District Council by doing so the study will enable policymakers to realize the numeracy effort done by the government through water access on the household concerning household income but policy makes more initiative on water access to realize TDV 2025 and SDG 1 and 2 about zero poverty and no hunger to the nation.

1.2 Statement of the Problem

Despite the efforts undertaken by the government and various stakeholders to enhance access to clean and safe water in Tanzania, a notable portion of households continues to face challenges in obtaining water from improved sources. Specifically, in the study area, Msalala District Council, the prevailing water supply coverage is estimated to be at 68%.

This lack of access to clean water can have significant negative impacts on household welfare and economic development, including household income. However, there is limited research on the specific impact of access to improved water sources on household income in Tanzania, and the mechanisms through which this impact occurs are not well understood.

Therefore, there is a need for further research to understand the relationship between access to improved water sources and household income in Tanzania and to identify the pathways through which this relationship operates. Such research can provide insights into the potential benefits of improving water access and inform policy and programmatic interventions to support household welfare and economic development in Tanzania.

Furthermore, this study has highlighted the need for further research to investigate the relationship between access to improved water sources and household income in Tanzania and to identify the mechanisms through which this relationship operates. This will provide insights into the potential benefits of improving water access and inform policy and programmatic interventions to support household welfare and economic development in Tanzania.

1.3. Research Objectives

1.3.1 General Objective

The general objective of this study was to assess the causal relationship between the access to improved water sources and household income in Tanzania: A case of Msalala District Council.

1.3.2 Specific Objectives

This study was guided by the following specific objectives:

(i) To examine whether access to improved water sources Granger causes household income in Tanzania using the vector error correction model (VECM).

(ii) To examine whether household income Granger causes access to improved water sources in Tanzania using the VECM.

(iii) To examine the long-run relationship between access to improved water sources and household income in Tanzania using the Johansen cointegration test.

1.3.3 Research Questions

The study was guided by the following questions:

(i) Is the access to improved water sources Granger causes household income in Tanzania?

(ii) To what extent does household income Granger cause access to improved water sources in Tanzania?

(iii) Is there any co-integration between access to improved water sources and household income in Tanzania?

1.4 Scope of the Study

The study focused on assessing the contribution of the impact of access to improved water sources on household income in Tanzania: a case of Msalala District Council, specifically examined whether access to improved water sources can Granger cause household income in Tanzania, followed by examining whether the household income can Granger cause access to improved water sources in Tanzania and lastly examined whether there is co-integration between access to improved water sources and household income in Tanzania.

1.5 Limitations of the Study

In the course of this study, the researcher encountered the following limitations:

(i) Time constraint: Only one month was set aside for data collection, this duration is very limited, and therefore the researcher was required to have self-initiatives and a high degree of commitment to ensure that he works hard to cope with the deadlines for submission.

(ii) Cost constraint: conducting a research study of this nature was somehow expensive. This could limit the scope of the study. To address this limitation, the researcher used the available secondary data from reliable sources, such as the RUWASA Service

Delivery and Management System (RSDMS), the National Bureau of Statistics (NBS), and the World Bank (WB).

1.6 Significance of the Study

The study on access to improved water sources and its impact on household income in Tanzania has multiple significant implications. It can inform decision-making, improve health outcomes, increase productivity, and support poverty reduction efforts. The following context has addressed these significances:

(i) Policymakers: the research on the impact of access to improved water sources on household income in Tanzania is significant to policymakers as it can inform evidence-based policy decisions aimed at improving access to clean water and supporting economic development. Policymakers can use the research findings to identify the most effective interventions to improve water access and support income-generating activities that are dependent on water. This can inform the development of policies and programs aimed at reducing poverty, improving health outcomes, and supporting economic growth in Tanzania.

(ii) Politicians: The findings of this research are significant to politicians as they can inform campaign promises and policy platforms related to access to clean water and economic development. Political leaders can use the research findings to advocate for policies and programs aimed at improving water access and supporting income-generating activities that are dependent on water. This can help to address critical development challenges in Tanzania and improve the welfare of the population.

(iii) Non-profit organizations: Non-profit organizations working on issues related to water and economic development can benefit from the research on the impact of access to improved water sources on household income in Tanzania. Such organizations can use

the research findings to inform their programs and interventions aimed at improving access to clean water and supporting income-generating activities that are dependent on water. This can help to maximize the impact of their interventions and support the achievement of development goals.

(iv) Individual persons: The findings of this research are significant to individuals in Tanzania as access to clean water is a key determinant of household welfare and economic development. Individuals can use the research findings to advocate for improved access to clean water in their communities and to inform their decision-making related to income-generating activities that are dependent on water. This can help to improve household income and support economic development at the individual and community levels.

(v) Academicians: This study has led to contributing to the existing knowledge, hence the study on the impact of access to improved water sources on household income in Tanzania can contribute to the existing body of knowledge on water and economic development. It can provide new insights into the pathways through which improved water access can support household income; and can help to identify the most effective interventions to support income-generating activities that are dependent on water.

1.7 Brief Organization of the Dissertation

This study is organized into five chapters. Chapter One presents the introduction part which encompasses the problem setting, which entails the introduction of the study. It includes the background of the problem, the statement of the problem, the research objectives including the general objectives and the specific objectives, the research questions, significance of the study.

Chapter two presents a review of related literature, including theoretical and empirical literature review, as well as knowledge gaps. Chapter three outlines research methodology, including

research design, data collection methods, population and sampling procedures, data analysis, presentation and interpretation plans, validity, reliability, and ethical considerations.

Chapter four deals with the presentation and discussion of findings, and chapter five elucidates the summary, conclusions and policy implications.

CHAPTER TWO

LITERATURE REVIEW

2.1. Introduction

This chapter presents a comprehensive literature review, including theoretical and empirical analyses, identification of knowledge gaps, and development of both theoretical and conceptual frameworks.

2.2. Definitions of the Key Terms

2.2.1 Household Income

Household income refers to the total income earned by all members of a household, including wages, salaries, self-employment income, income from investments or property, and any other sources of income. It is a measure of the economic resources available to a household and is an important indicator of household well-being (Besustringue, et al., 2023).

In the concept of this proposal, household income is important in the context of development as it is closely linked to economic growth and poverty reduction. Improving household income can support economic development by increasing consumer spending, boosting local businesses, and supporting investments in education, health, and infrastructure.

2.2.2 Access to improved water sources

Access to improved water sources refers to the availability of clean and safe water for domestic use by members of a household. It is an important indicator of access to basic needs such as drinking water, sanitation, and hygiene. Access to improved water sources is essential for maintaining health, preventing disease, and supporting economic activities that rely on water, such as agriculture and small business operations (Lebel, et al., 2022).

Access to clean and safe water can be affected by various factors, including geography, climate, infrastructure, and socioeconomic conditions. In many parts of the world, including Tanzania,

access to clean water is limited, particularly in rural areas, and can have significant health and economic consequences.

Improving access to improved water sources is a critical component of development efforts, aimed at reducing poverty and improving health outcomes. This can be achieved through a variety of interventions, such as investment in water infrastructure, improving water management practices, and promoting behaviour change related to water use and hygiene.

2.2.3 Impact

Impact refers to the effect or influence that a particular action, event, or policy has on a specific individual, group, or society as a whole. In the context of the research topic "Impact of Access to improved water sources on Household Income in Tanzania," impact refers to the effect that access to improved water sources has on the income of households in Tanzania.

The research seeks to identify the relationship between access to improved water sources and household income by examining the ways in which access to clean water affects economic activities such as small business operations, agriculture, and wage employment.

The impact of access to improved water sources on household income can be positive or negative, depending on a range of factors, including the quality and reliability of the water supply, the efficiency of water use, and the availability of other resources needed for income-generating activities.

Understanding the impact of access to improved water sources on household income is essential for policymakers, development partners, and Students working to improve economic outcomes and reduce poverty in Tanzania. By identifying the factors that influence the impact of access to improved water sources on household income, interventions can be designed to maximize the positive impact and minimize any negative effects.

2.3 Theoretical Literature Review

The theoretical literature review provides a critical analysis of the existing theories and concepts that are relevant in the context of the Impact of Access to improved water sources on Household Income in Tanzania, the theoretical literature review will focus on the theories and concepts that explain the relationship between water access and household income. Hence, below are the relevant theories:

2.3.1. Human Capital Theory

The Human Capital Theory was first developed by Nobel Laureate economist Gary Becker in the 1960s. The theory posits that investments in education, training, and other forms of human capital can lead to increased productivity and higher income (Wright & Constantin, 2021).

Becker argued that individuals can be viewed as "human capital" assets that can be invested in to increase their productive capacity. This investment in human capital can take various forms, such as formal education, on-the-job training, and skill development through experience. The theory also suggests that individuals can make choices about how to invest in their human capital based on the expected return on investment.

The concept of human capital theory has been applied in various fields, including labour economics, education, and public policy. Pioneer studies in the field of human capital theory include Becker's seminal work "Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education", published in 1964.

The study variables in human capital theory include education level, job training, work experience, and skills. These variables are believed to be positively correlated with productivity and income, as individuals who invest in their human capital are more likely to have higher skills and abilities that translate into higher productivity and higher-paying jobs.

The Human capital theory has also been applied to the analysis of gender and income inequality. Studies have found that gender disparities in education and employment

opportunities can lead to a significant gender wage gap, with women earning less than men on average. This highlights the importance of investing in human capital for both men and women to reduce gender inequality and increase economic opportunities (Simon, 2019).

Globally, the human capital theory provides a framework for understanding the relationship between education, training, and other forms of human capital investment and economic outcomes such as productivity and income. Hence, this theory posits that investing in human capital through education and training leads to increased productivity and higher income. This theory can be applied to the context of water access by suggesting that access to clean water, which is necessary for maintaining health and hygiene, can improve productivity and therefore increase household income.

2.3.2 Resource-Based Theory

The Resource-based theory is a management theory that was developed in the late 1980s and early 1990s by scholars such as Jay Barney and Birger Wernerfelt. The theory posits that the availability and quality of resources held by a firm or organization can have a significant impact on its competitive advantage and economic performance (Barney, et al., 2021).

The resource-based theory suggests that resources can be both tangible, such as physical assets and financial resources, and intangible, such as intellectual property, reputation, and human capital. The theory also argues that resources must have certain characteristics to contribute to competitive advantage, such as being rare, valuable, difficult to imitate, and difficult to substitute.

One of the pioneers of the resource-based theory is Jay Barney, who published an influential article in 1991 titled "Firm Resources and Sustained Competitive Advantage." Barney argued that firms with a sustained competitive advantage have resources that are valuable, rare, difficult to imitate, and non-substitutable.

Another pioneer of the resource-based theory is Birger Wernerfelt, who developed the "resource-based view" of the firm. Wernerfelt argued that the ability of a firm to adapt to changing environments depends on the resources it holds; and that the value of resources is dependent on their context.

The study variables in resource-based theory include the availability and quality of resources, their characteristics, and how they are utilized by organizations. The theory suggests that organizations with superior resources and capabilities will have a competitive advantage and outperform their competitors.

The Resource-based theory has been applied in various fields, including strategic management, entrepreneurship, and marketing. The theory has also been used to analyse the impact of environmental factors on the resources of organizations and their competitive advantage. Overall, the resource-based theory provides a framework for understanding the importance of resources and capabilities in achieving sustained competitive advantage and economic performance.

This theory suggests that the availability and quality of resources can impact the economic activities of households. In the context of water access, this theory suggests that households with better access to clean water will have a competitive advantage in economic activities that rely on water, such as agriculture and small business operations.

2.3.3 The Capability Approach

The capability approach is a theory of justice and well-being that was developed by economist and philosopher Amartya Sen and philosopher Martha Nussbaum in the 1980s and 1990s. The approach posits that the focus of development policies should be on expanding people's capabilities, or their ability to do and be what they value and choose (Luz & Portugal, 2022).

According to the capability approach, individual well-being should not be measured solely in terms of income or material resources, but also in terms of a person's ability to live a fulfilling

life. This can include access to education, healthcare, political participation, social networks, and other opportunities that can enable individuals to realize their full potential.

Amartya Sen is considered the founder of the capability approach, and his seminal works include the book "Development as Freedom" and the article "Equality of What?" Martha Nussbaum has also made significant contributions to the development of the approach, particularly in her book "Creating Capabilities: The Human Development Approach.

The study variables in the capability approach include various aspects of human development and well-being, such as education, health, income, political participation, social networks, and freedom of choice. The approach emphasizes the importance of expanding people's capabilities in all of these areas in order to promote well-being and reduce poverty and inequality.

The capability approach has been widely applied in development economics, public policy, and social welfare research. It has also been used to analyse the impact of various policies and interventions on human well-being, and to evaluate the effectiveness of development programs in improving people's lives. The approach has been particularly influential in shaping the United Nations' human development paradigm, which emphasizes the importance of expanding people's capabilities as a central goal of development policies.

Furthermore, this approach emphasizes the importance of access to basic needs such as water and sanitation, which can be applied to the context of water access and household income. This theory suggests that improving access to clean water is not only an end in itself but also a means of enhancing the capabilities of individuals and households to participate fully in economic activities and improve their well-being.

2.4 Empirical Literature Review

2.4.1 Impact of Access to Improved Water Sources and Household Income - Globally

In China, several studies have found a positive correlation between improved water access and household income. For example, a study by (Young, et al., 2019) found that access to clean drinking water was positively associated with household income in rural China.

Also, research on the impact of access to improved water sources on income in Russia is relatively scarce. However, a study by (Meehan, et al., 2020) found that households with access to improved water sources had higher levels of income and better living conditions than those without. This study aligned with study in the United States, whereby several studies have examined the relationship between water access and household income, particularly in marginalized communities, also, a study by (Perdiguero & Sanz, 2019) found that households in low-income communities with inadequate water access experienced higher water bills and financial hardships.

Furthermore, in Europe, the impact of access to improved water sources on income has been studied in various contexts, including rural communities and marginalized urban areas. A study by (Gomez, et al., 2019) found that rural households in the Netherlands with better water access had higher income levels than those without. Another study found that marginalized urban communities in Germany with inadequate water access experienced higher water bills and financial burdens (Gomez, et al., 2019).

Hence, studies in Israel; cemented the impact of access to improved water sources on income has been studied in both rural and urban contexts. A study (Teschner, et al., 2020) found that households in rural areas with improved water access had higher levels of income and better agricultural productivity. Another study (Chow, 2020) found that low-income households in urban areas faced financial hardships due to high water bills.

Globally, the literature suggests that access to improved water sources can have a significant impact on household income in various global contexts. While the specific findings vary depending on the location and population studied, the general trend suggests that improved water access can contribute to economic development and poverty reduction.

2.4.2 Impact of Access to Improved Water Sources and Household Income - Africa

In Ghana, several studies have examined the impact of access to improved water sources on income, particularly in rural areas. A study by (Charles, et al., 2019) found that households with improved water access had higher income levels than those without in the Upper East Region of Ghana, hence cementing, that households with access to piped water had higher income levels than those without in Accra, the capital city.

Also, in Nigeria, research on the impact of access to improved water sources on income is limited but growing. A study by (Adeoye, et al., 2019) found that households with improved water access had higher income levels than those without in Ibadan, a city in southwestern Nigeria. Another study by (Adeoye, et al., 2019) found that households with access to clean water had higher income levels than those without in a rural community in the Niger Delta region.

Apart from Ghana and Nigeria, studies in Egypt, addressed the impact of access to improved water sources on income has been studied in both urban and rural areas. A study by (Otter, et al., 2020) found that households with access to clean water had higher income levels than those without in the city of Alexandria. Another study by (Marzouk, 2019) found that households in rural areas with improved water access had higher income levels.

Furthermore, in South Africa, several studies have examined the relationship between water access and household income, particularly in marginalized communities. A study by (Ogundeji, et al., 2020) found that households with improved water access had higher income levels than those without in the Eastern Cape Province. Another study by (Oyenubi & Nwosu, 2021) found that low-income households in Johannesburg faced financial hardships due to high water bills.

Generally, the literature suggests that access to improved water sources can have a significant impact on household income in various African contexts, particularly in rural and marginalized communities. While the specific findings vary depending on the location and population studied, the general trend suggests that improved water access can contribute to economic development and poverty reduction in Africa.

2.4.3 Impact of Access to Improved Water Sources and Household Income - East Africa

In Uganda, several studies have examined the impact of access to improved water sources on income, particularly in rural areas. A study by (Mushavi, et al., 2020) found that households with improved water access had higher income levels than those without water access in the Luwero District. Another study by (Butler, et al., 2020) found that households with access to piped water had higher income levels than those without in the Kampala District.

Also, in Rwanda, research on the impact of access to improved water sources on income is limited but growing. A study by (Habimana, et al., 2023) found that households with improved water access had higher income levels than those without in the rural areas of the Western Province. Another study by (Baudron, et al., 2021) found that households with access to piped water had higher income levels than those without in Kigali, the capital city.

Kenya: In Kenya, the relationship between water access and household income has been studied in both rural and urban areas. A study by (Meunier, et al., 2019) found that households with improved water access had higher income levels than those without in the rural areas of Machakos County. Another study by (Colonna, 2019) found that households with access to piped water had higher income levels than those without in Nairobi, the capital city.

Burundi: In Burundi, the impact of access to improved water sources on income has been studied in both rural and urban areas. A study by (Minani, et al., 2021) found that households with improved water access had higher income levels than those without in the rural areas of the Ruyigi Province. Another study by (Habimana, et al., 2023) found that households with

access to piped water had higher income levels than those without in Bujumbura, the capital city.

Authors suggest that access to improved water sources can have a significant impact on household income in various East African communities, particularly in rural areas. While the specific findings vary depending on the location and population studied, the general trend suggests that improved water access can contribute to economic development and poverty reduction in these communities.

2.5 Knowledge Gap

Apart from the lack of a comprehensive understanding of the impact of access to improved water sources on household income in Msalala District Council, it is acknowledged that access to clean water is essential for economic development and improving household income in Tanzania, there is limited data available on the extent of this impact and the factors that contribute to it. This knowledge gap is significant as it makes it difficult to design and implement effective interventions to improve water access and economic development in the region. Furthermore, the lack of data on the relationship between access to improved water sources and income in Msalala District Council makes it challenging to identify the most appropriate policies and strategies to address this issue. Therefore, there is a need to address this knowledge gap and provide a more comprehensive understanding of the relationship between access to improved water sources and income in Msalala District Council and other regions of Tanzania through accessing the causality between access to improved water sources and household income.

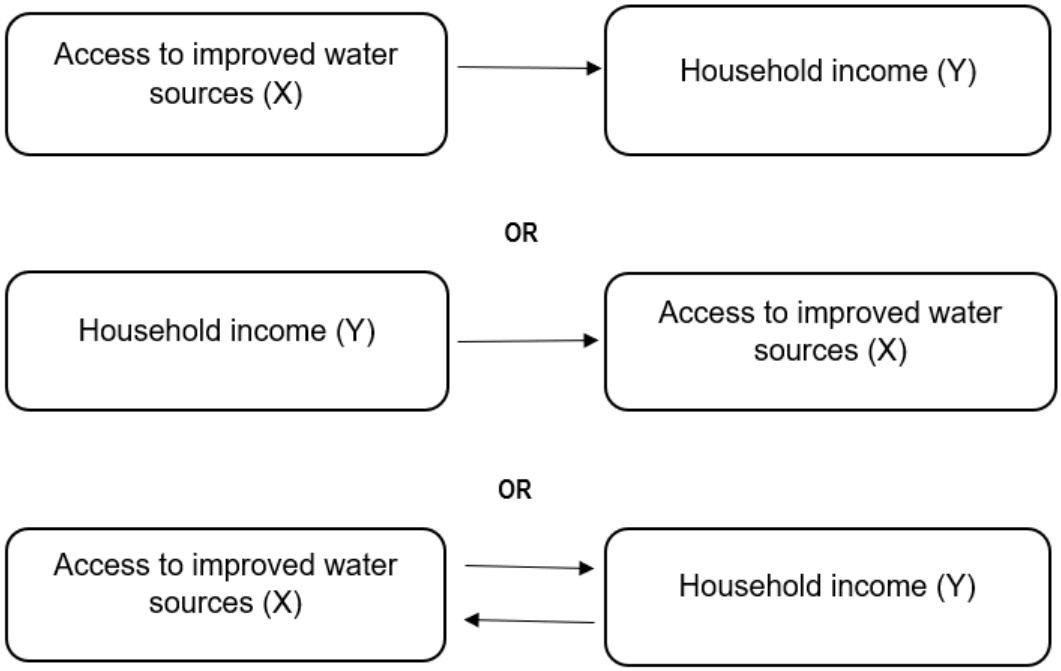
2.6 Conceptual Framework

The simple Granger causality test was employed using the VECM to test the causal relationship between access to improved water sources (X) and household income (Y). The study is underpinned by the theory of human capital, which hypothesizes that access to improved water

sources can lead to improvements in health and productivity, which can then lead to higher household income.

Since the Granger causality model of analysis was adopted in this study due to its nature, to assess the impact and causality of the variables, both variables stand as either independent or dependent variables.

Figure 2. 1: Conceptual Framework X and Y



Source: Theories and modified from literature review (2023)

The aforementioned figure 2.1 illustrates that there is a causal relationship between access to improved water sources and household income, or conversely, household income causes changes in access to improved water sources, or both phenomena are interconnected. This was substantiated through the application of the Granger causality test.

The variables in this study were organized as time series data, sourced as secondary data covering the period from 2001 to 2023. This data was extracted from databases such as

RSDMS, NBS, and the WB. The subsequent table outlines the study variables and their corresponding measurement scales.

Study variables	Unit measurements
Access to improved water sources	Number of households with water access
Household income	Tanzania Shillings

Source: Theories and modified from literature review (2023)

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter provides a brief description of the methods and procedures that were used in this study. This includes the section of study area, research approach, research design, source of data, data collection methods, variables and model specification, data analysis techniques, validity and reliability, ethical consideration, and the limitations that influenced the research methodology.

3.2 Study Area

Msalala District Council is one of the six district councils in Shinyanga Region, covers an area of approximately 11,290 square kilometres and according to the 2022 Population and Housing Census report, had a population of about 378,214 people. The district is primarily rural, with agriculture being the main economic activity. The district is also known for its gold mines, which contribute significantly to the economy.

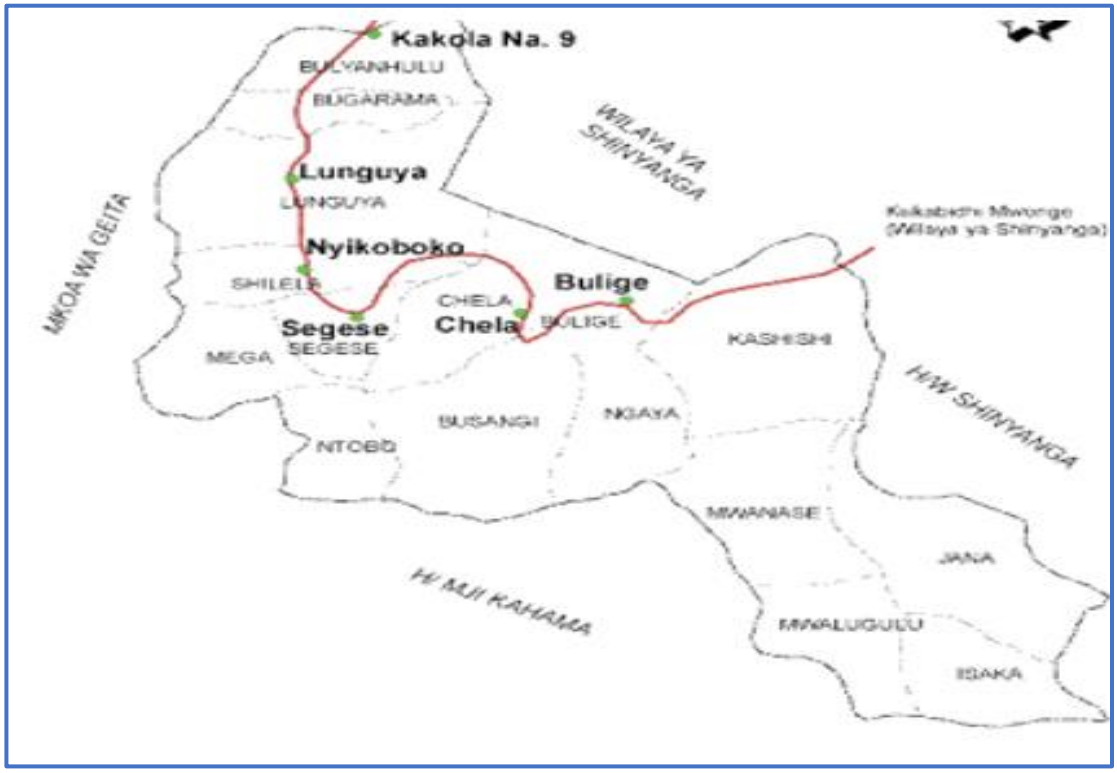
There are several reasons why Msalala District Council was to be chosen as the study area for the research topic. Firstly, the district council is a rural area with limited access to clean water, making it a suitable area to study the impact of household water access on household income. Secondly, the council is representative of many other rural areas in Tanzania, where access to clean water is limited, and the population depends mainly on agriculture for their livelihoods. Thirdly, the council is located in the Shinyanga Region, which is one of the least developed regions in Tanzania, and thus, it is an area where interventions to improve water access and economic development are urgently needed.

Furthermore, Msalala District Council was identified as one of the priority councils for intervention by the Tanzanian government and development partners, such as the United Nations Development Programme (UNDP) and the World Bank.

These organizations have implemented several projects in the district aimed at improving access to clean water, promoting economic development, and reducing poverty. Therefore, studying the impact of household water access on household income in Msalala District Council could provide valuable insights that could inform the design and implementation of such interventions.

In conclusion, Msalala District Council was an appropriate study area for the research topic due to its rural nature, limited access to clean and safe drinking water and other uses, and its representation of many other rural areas in Tanzania. The district's location in one of the least developed regions in Tanzania also makes it a priority area for intervention, and studying the impact of household water access on household income in the district could provide valuable insights for the design and implementation of interventions aimed at improving water access and economic development in the region.

Figure 3. 1: Map Showing Msalala District Council



Source: Msalala DC (2023)

3.3 Research Design

This study used a causal research design to test the hypothesis and determine causal and effect relationships that exist between variables. By using this design, the secondary data were analysed from the year 2001 to 2023**.**

The data were obtained from RSDMS, NBS and the WB databases. The design was chosen because of its ability to set up changes in the behaviour of time series data over time with the introduction of various policies.

3.4 Research Approach (Research Type)

In carrying out this study the researcher employed a quantitative research approach (Apuke, 2017) argued that the selection of an approach to be employed in any research normally rests on the nature of the question under consideration and the objectives of the research itself.

According to (Kumar, 2014), the quantitative approach involves the generation of data in a quantitative form which can be subjected to rigorous quantitative analysis formally and rigidly. A Quantitative research approach was adopted in this study since the results obtained were generalized to the entire population. The researcher used the Granger causality in investigating the time series data by using STATA software.

3.5 Population, Sample Size and Sampling Techniques

3.5.1 Targeted Population

(Bless, et al., 2006) define population as the entire set of objects or people, which is the focus of the research and about which the researcher wants to determine some characteristics. Msalala District Council is made up of 92 villages and 18 wards, out of these, 29 villages in 12 wards have access to clean and safe water through Household Connections (HHC).

As per the RSDMS report, by September 2023, a total of 1,268 households had access to clean and safe water through HHC. For this study, the focus was on 479 households in Bulyanhulu ward, which has 3 villages, namely: Bushing'we, Kakola, and Kakola Na.9. The selection of Bulyanhulu ward as the representative of the 12 wards was based on its easy accessibility and familiarity with the researcher.

3.5.2 Sample Size

A sample is a subgroup of the population which is the focus of research enquiry and is selected in such a way that it represents the study population (Kumar, 2014). According to Smith (1984) in sample size determination, in agreement with Taro Yamane sample size determination technique (1967), which stated that if the population is above 400, there is a need to use the Taro Yamane formula to reduce the population.

According to Yamane (1967), the sample size of a study was derived as follows:

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

Whereby:

n = Sample size

N = the population

e = the margin of error (assumed at 5%), and

1 = constant

From: Population (N) = 479 Households

e = 0.05

Then, sample size (n) is calculated as follows:

$$n = \frac{479}{1+479(0.05)^2} = \frac{479}{2.1975} = 217.97 \approx 218$$

n = 218

Therefore, the study included 218 households with household water connections in its sample size. The distribution of respondents in the proposed sample is presented in Table 3.1 below**:**

Table 3. 1: The proposed sample distribution of respondents

Village	Number of respondents
Bushing'we	49
Kakola	162
Kakola Na.9	7
Total	**218**

Source: The researcher (2023)

3.5.3 Sampling Techniques

Sampling is refereed as a process of selecting a few respondents (a sample) from a bigger group (the sampling population) to become the basis for estimating the prevalence of information of interest to you (Kumar, 2014). Under this study, a simple random sampling was adopted to select the respondents from a list of households with access to clean and safe water through household connections as a sampling frame.

3.6 Data Collection Methods

This study used time series secondary data and primary data that were collected through questionnaires.

3.6.1 Time Series Secondary Data

To achieve all the objectives and gain a thorough understanding, this study utilized annual time series secondary data. The data, ranging from 2001 to 2023, was collected from credible sources such as the RSDMS, the National Bureau of Statistics of Tanzania, and the World Bank databases. These sources were chosen for their high credibility and reliability.

3.6.2 Questionnaires

The researcher employed questionnaires to gain real-time information from the respondents in which quantitative data were collected. The researcher designed a set of questions to generate the data necessary for accomplishing the objectives of the research project (Kothari, 2004). The data collection process involved the use of questionnaires that contained closed-ended questions. The questionnaires were distributed to members of households, with a preference for either the father or mother to complete them. Each respondent was given ample time to fill in the questionnaire, after which the researcher collected them. To assess the degree of causality between water access and household income, a 4-point Likert scale of 1 to 4 was adopted.

The questions in the questionnaire revolved around various aspects of water access, including the reduction of expenditure on water-borne diseases, women's engagement in business and other income-generating activities, time-saving, irrigation for small-scale farming at home, accessibility and availability of nutritious food at a household level, availability of improved water, and climate change mitigation.

3.7 Data Analysis Methods

To determine the impact of one variable on another, the Granger Causality (1969) method was traditionally used. In this study, this method was used to examine the effect of access to improved water sources on household income in rural areas of Tanzania.

Basically, the concept of Granger Causality is that; If X causes Y, then a change in X occurred first, followed by a change in Y (if past values of a variable Y significantly contribute to forecast the value of another variable Xt+1, then Y is said to Granger cause X and vice versa). Regression normally used to talk about the relationship between variables and not about the causality, for instance X causes Y or Y causes X.

To test the cause of one variable to another, the study opted to adopt the Vector Auto Regression (VAR) model since VAR model is one of the best and most suitable models for multivariate time series analysis. The study used access to improved water sources and Household income as the variables.

3.7.1 Data Analysis and Procedures

Before conducting the analysis, preliminary tests such as the unit root test were performed. The data were analysed using the STATA software, one of the most powerful statistical packages for quantitative data analysis. The unit root tests were selected to ensure that the time series data was stationary, to reduce the risk of spurious regression results, and to provide a strong foundation for further analysis such as regression, cointegration, and Granger causality testing. The decision criteria for choosing the Phillips-Perron test were carefully considered and reflect a systematic approach to data analysis in the context of the research objectives.

3.7.2 Model Specification

Following the existing studies on the effects of macroeconomic factors on economic growth (Mbulawa, 2015; Denbel et al., 2016) and several other studies employed the Granger causality test and the VAR model. The Granger causality test is a statistical hypothesis test for determining whether one time is useful in forecasting another.

A time series *X* is said to Granger-cause *Y* if it can be shown, usually through a series of t-tests and F-tests on lagged values of *X* (and with lagged values of *Y* also included), that those *X* values provide statistically significant information about future values of *Y*. Granger defined the causality relationship based on two principles:

(i) The cause happens before its effect.

(ii) The cause has unique information about the future values of its effect.

Given these two assumptions about causality, Granger proposed to test the following hypothesis for identification of a causal effect of X on Y, that is, access to improved water sources and Household income. In this study, the simple linear regression model was used to study the relationship between a dependent variable and one independent variable**.** The generic form of the linear regression model is:

Access to improved water sources = f (Household income)

$Y = f(HI, \varepsilon)$

$Y = \beta_0 + \beta_1 AIWS + \varepsilon$

Whereby

f = Function

HI = Household income

Y = Access to improved water sources

Ɛ = Error term

(β_0 -β_1) = Beta coefficient.

The underlying theory will specify the dependent and independent variables in the model. Also, the model will be formulated in the following form:

$HWA= \beta_1 AIWS_{t-i} + \beta_2 HI_{t-k} + Ɛ$…… (i)

$HI_t = \beta_3 HI_{t-i} + \beta AIWS_{t-k} + Ɛ$……..….. (ii)

Hypotheses

H_0: Access to improved water sources cannot Granger cause Household income.

H_1: Access to improved water sources can Granger cause Household income.

H_0: Household income cannot Granger cause Access to improved water sources.

H_1: Household income can Granger cause Access to improved water sources.

Whereby:

$AIWS_t$ = Access to improved water sources at time t

HI_t = Household income at time t

Ɛ = Error term

(β_1, β_2, β_3, β_4) = Coefficient

The above model assumes that $AIWS_t$ and HI_t are stationary and if not, the stationary will be tested by using either unit root test or natural logarithms. Effort to make them stationary will be taken to test for Granger causality.

3.7.3 Diagnostic Tests

This section explains the diagnostic test used in this study.

3.7.3.1 Unit Root Test

The time series variables are stationary when mean, covariance and variance do not vary with time (variance, mean and covariance are constant over the time). The non - stationary (unit root) data can cause spurious regression. To avoid this, the stationary of the data will be tested using the Augmented Dickey-Fuller (ADF) test in order to check the direction of integration for all variables (Nerlove & Diebld, 1990).

In time series analysis, it is a requirement to check whether or not the variables are stationary. If the statistic is less than critical value, the variables are said to be stationary or integrated to level zero or can be written as I (0).

If the data are non- stationary at level, ADF test is executed on the first difference of X, and if it is found to be stationary, then the series is said to be integrated to Level 1 as I (1). Test was employed after integrating all variables used in multivariate model of level one (1), to find out whether or not variables are co-integrated.

Time series data test for stationarity performed through the ADF test followed by the Phillips–Perron (P-P) which is the non-parametric test to ADF is the presence of the unit root in order to get the robust result of accepting the null hypothesis or rejecting null hypothesis which is false. This is because the ADF test results are sensitive to different lag lengths of the dependent

variable, thus biased towards non-rejection of unit roots when the structural breaks are incorporated in the data set (Indraratna, 2009; Mwamkonko, 2019).

3.7.3.2 The Autoregressive Distributed Lag (ARDL)

The Autoregressive Distributed Lag (ARDL) bound test, proposed by (Pesaran, et al., 2001), allows determination of the long-run relation existing in series. The ARDL approach become more known for exploring the relation of climate change with other agricultural factors in several countries such as Ghana (Owusu, 2016), because of its difference in the ability to identify long-/short-run relationships among variables compared to the previous approaches.

The ARDL was applied respectively to find the integrations of variables, which is also a good fit for small sample data. Therefore, this study used Autoregressive Distributed Lag to test long term association in series.

3.7.3.3 Johansen's Test

This approach determines if three or more-time series are co integrated. More specifically it assesses the validity of a co integrating relationship using a maximum like hood estimates approach. This will be applied for the study of the long run relationship between Household water access and Household income.

Therefore, the Student will assess the variables like household water access can granger cause household income to examine stationary status. The test will be guided by the following null hypothesis: H_0: There is no co-integration among variables.

i. Decision Criteria Based on Johansen Co-integration

   Following the STATA output and if the author of this study will find that the trace statistics is greater than critical value at 5% significant level can reject the null

hypothesis. If the trace statistics is less than critical value can accept the null hypothesis.

ii. Decision Criteria for Granger test Causality

The researcher applied VAR model to develop a test for Granger causality test by using a statistical package and F- statistics was used in making decision to accept or reject the hypothesis at 5% level, specifically when the p-value are all less than 0.05 alpha level, the null hypothesis was rejected.

3.8 Validity and Reliability

3.8.1 Reliability

Reliability will be considered in this study. According to (Mohajan, 2017), reliability refers to the consistency, stability and repeatability of results, that is, the result of a researcher is considered reliable if consistent results have been obtained in identical situations, but different circumstances. Several measures will be employed to ensure that the results are free from material errors from the collection of the secondary data to interpretation of the results.

Such measures include prior review of collected data by the supervisor and the collection of those data are taken from the trustworthy source such as RSDMS, NBS, and the WB databases. The measurement was done to ensure that if repeated a second time gives the same results as it did the first time.

3.8.2 Validity

According to (Mohajan, 2017), validity is the extent to which any measuring instrument measures what it is intended to measure. The content of validity of the data collection instrument was determined through discussing the Research instrument. Validity in this study dealt with

persons, settings and times to which findings can be generalized. Data need not only to be reliable but also true and accurate. This was addressed in this research during the planning stage. The following strategies were adopted; sorting and checking the consistency of data reported in trustworthy source for the purpose of measuring theoretical meaningfulness of the concepts.

3.9 Ethical Considerations

As this study made use of data from secondary sources, some ethical considerations were observed when collecting data from secondary sources, such as plagiarism which is one of the important ethical issues in using data from secondary sources (Kumar, 2014). The study considered to be on the best of the researcher knowledge. This depends on the reviewed literature material that has been presented as widely as possible to avoid confusing effects. The model applied is not new and has been adopted from other researchers but in different environment and data. Due diligence was taken where work of another person was used. Paraphrasing without citing was used only when the information paraphrased is common knowledge in the field.

In the other hand, the respondents were assured of the confidentiality of their participation in the study and each respondent gave his/her full consent for the study.

3.10 Limitations that Influenced Research Methodology

The following limitation was imposed by the methods, strategies, and procedures:

Time constraints: To move with this limitation researcher relied on time series data but also two people were hired and trained to collect data through questionnaires within a short period of time.

CHAPTER FOUR

PRESENTATION AND DISCUSSION OF FINDINGS

4.1 Introduction

The aim of this study was to examine the causal relationship between access to improved water sources and household income in Tanzania, specifically focusing on the Msalala District Council. The variables being studied included Household Water Connection and Household Income (in Tanzanian Shillings). The initial segment of this chapter commenced with the presentation of descriptive statistics, followed by a preliminary analysis addressing the unit root issue, and subsequently proceeded to the estimation of the model.

4.2Presentation and Findings

4.2.1 Descriptive analysis

The researcher conducted a detailed descriptive analysis on the raw data, aiming to observe the patterns and behaviour inherent in the time series data. Additionally, the objective was to ascertain whether the time series exhibited a normal distribution or deviated from such a distribution.

Table 4. 1a: Descriptive results of the study variables

Stats	Mean	Variance	Skewness	Kurtosis
Household Water Connection	83.82609	6,943.968	1.22236	4.015446
Household Income (TZS)	990,215.2	4.62e+11	0.23348	1.311637

Source: The researcher (2023)

The mean score for Household Water Connection is approximately 83.83. This implies that, on average, households within the study area possess a certain level of access to improved water sources. The variance, standing at 6,943.968, indicates a noteworthy level of variability in the

extent of household water connection across the sample. This suggests that there is a considerable diversity in the level of access to improved water sources among different households, with some likely enjoying better access compared to others.

A positive skewness value of 1.22236 indicates a slight right-skew in the distribution of household water connection. This implies that a significance proportion of households may possess comparatively higher levels of water connection, presenting a positive aspect. The kurtosis value of 4.015446 signifies that the distribution of household water connection has heavier tails and is more leptokurtic than a normal distribution. This suggests the potential presence of extreme values or outliers in the data, prompting consideration for further investigation into these unusual observations.

The mean Household Income is approximately TZS 990,215.20, signifying the average income per person in the study area. This figure holds significance as an essential indicator of economic well-being. The considerable variance in Household Income, denoted by 4.62e+11 (in scientific notation), indicates a high degree of variability in income levels among individuals in the area. This high variance implies significant income disparities, with some individuals likely experiencing substantially higher incomes compared to others.

A positive skewness value of 0.23348 indicates a slight right-skew in the distribution of per capita income, suggesting that a portion of the population may have relatively higher income levels. The kurtosis value of 1.311637 signifies that the distribution of per capita income is more leptokurtic than a normal distribution. This implies the potential existence of some extreme values or outliers in the data, prompting consideration for further exploration of these unusual observations.

Exploring these extreme values could provide valuable insights into factors influencing unusually high per capita income, potentially uncovering unique economic circumstances or

disparities within the population. Further investigation into these outliers may enhance the overall understanding of the income distribution dynamics in the studied area.

Table 4.1b: Descriptive statistics for questionnaires results

	N	Mean	Std. Deviation	Variance	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Reduced expenditure WBD	218	4.75	0.433	0.187	-1.177	0.165	-0.620	0.328
Women-IGA	218	4.61	0.490	0.240	-0.435	0.165	-1.828	0.328
Time saving	218	4.90	0.302	0.091	-2.668	0.165	5.166	0.328
Irrigation	218	4.20	0.402	0.162	1.496	0.165	0.240	0.328
Food access	218	4.15	0.576	0.332	-0.011	0.165	-0.148	0.328
Improved water	218	4.50	0.501	0.251	-0.018	0.165	-2.018	0.328
Climate change mitigation	218	4.26	0.767	0.588	-0.475	0.165	-1.154	0.328
Valid N (listwise)	218							

Source: The researcher (2023)

Reduced expenditure WBD:

The mean value for "Reduced Expenditure WBD" stands at 4.75, implying that, on average, households exhibit a tendency towards reduced expenditures on water-related disease expenses. The low standard deviation of 0.433 suggests that data points are relatively close to the mean, indicating a consistent pattern in reduced expenditures on water-related diseases.

The variance, recorded at 0.187, further supports this observation, highlighting a relatively low level of variability in reduced expenditures on water-related diseases among households.

This consistent and reduced level of expenditure on water-related diseases is reflected in the low standard deviation, indicating a tight clustering of data points around the mean. The variance, representing the average squared difference of each data point from the mean, reinforces the notion of limited fluctuation in reduced water-related disease expenses across households. The observed stability in expenditure patterns could be indicative of effective measures or interventions in place, leading to a more uniform reduction in expenses related to waterborne diseases. Further analysis and exploration of the factors contributing to this consistency may provide valuable insights into successful strategies for managing and mitigating water-related health expenses at the household level.

Women's income generating activities (Women-IGA) and household income:

The mean value for "Women-IGA" is 4.61, signifying those women within the sample are moderately engaged in income-generating activities. The standard deviation of 0.490 suggests a degree of variability in the extent of women's involvement in income-generating activities. This observation indicates a moderate, yet not uniform, level of participation in income-generating activities among women in the study. The standard deviation underscores that there is some dispersion in the data, implying that while the average level of engagement is moderate, there are variations in the degree of involvement across individuals. Further exploration into the factors influencing this variability could provide valuable insights into the dynamics of women's participation in income-generating activities within the context of household income.

Time saving and household income:

An analysis of time-saving practices and their potential impact on household income reveals that households generally conserve time, with the mean value of 4.90. This time management

could positively influence income generation. The consistency of time-saving practices is evident in the low standard deviation of 0.302, indicating that these practices are relatively uniform across the sample.

Furthermore, the mean value of 4.90 for time saving suggests that households, on average, manage to save time in their daily routines. This saved time can potentially be utilized for income-generating activities, such as pursuing additional work opportunities, enhancing skills, or engaging in entrepreneurial ventures. The potential for increased income generation highlights the importance of time-saving practices in improving household financial well-being.

Moreover, the low standard deviation of 0.302 for time saving implies that these practices are relatively consistent across the sample. This consistency suggests that time-saving strategies are not limited to a specific group or demographic, but rather can be adopted by a wide range of households. The pervasiveness of time-saving practices further underscores their potential to positively impact household income.

Irrigation:

The mean value for irrigation is 4.20, signifying that households, on average, are moderately engaged in irrigation activities, which may be correlated with agricultural income. The standard deviation of 0.402 indicates some variability in the extent of participation in irrigation among households.

This moderate mean score of 4.20 suggests a consistent, though not extensive, level of involvement in irrigation practices among the households under study. The standard deviation of 0.402 implies that there is variability in the degree to which households participate in irrigation. Some households may be more actively engaged in such activities, while others may have a lower level of involvement, contributing to the observed variability in the data.

Understanding the extent of household involvement in irrigation is essential, as it can provide insights into the potential impact on agricultural income. Higher levels of engagement may indicate a greater reliance on agriculture as a source of income, while lower levels may suggest a more diversified income portfolio. Further analysis and modelling would be necessary to explore the specific relationships between irrigation activities and household income in the context of the study area.

Food access and household income:

The mean value of Food Access stands at 4.15, indicating that, on average, households in the study area enjoy relatively good access to food. This metric serves as a potential indicator of household well-being, as consistent access to an adequate food supply is fundamental for overall health and prosperity. However, the high standard deviation of 0.576 reveals considerable variability in food access among households.

This high standard deviation suggests that there is a diversity of situations regarding food accessibility. Some households likely experience exceptionally good access to a variety of food sources, while others may face challenges in securing a reliable and varied food supply. The extent of this variability is crucial to understanding the nuanced dynamics of food security within the community.

Access to improved water sources and household income:

The mean value for Improved Water is recorded at 4.50, signifying that, on average, households within the study area possess reasonably good access to improved water sources. This metric serves as an important indicator of the community's overall water infrastructure and can significantly impact the well-being of households. However, the standard deviation of 0.501 indicates a degree of variability in access to improved water sources among households.

This standard deviation implies that there is diversity in the levels of access to improved water sources within the community. Some households likely enjoy consistent and reliable access to improved water, contributing to improved hygiene and overall quality of life. Conversely, others may experience challenges in accessing these upgraded water sources, potentially impacting their daily lives and health.

Climate change mitigation and household income:

The mean value for Climate Change Mitigation stands at 4.26, indicating that, on average, households are moderately engaged in activities associated with mitigating the impacts of climate change. This level of involvement suggests a collective awareness and effort within the community towards addressing environmental challenges, which can have substantial and lasting economic implications.

However, the high standard deviation of 0.767 indicates significant variability in the extent of climate change mitigation activities among households. This variability highlights diverse approaches or degrees of commitment to practices that contribute to mitigating climate change effects. Some households may actively adopt eco-friendly measures, demonstrating a strong commitment to environmental sustainability. In contrast, others may exhibit less involvement, potentially indicating varying levels of awareness or resource availability.

Hence, descriptive statistics offer insights into the variables studied in the context of their potential impact on household income in Msalala District Council, Tanzania. The data indicates varying levels of involvement in different activities, for example irrigation, women's income-generating activities and potential correlations with household income. Further analysis and modeling would be needed to establish causal relationships between these variables and household income as explained below.

4.2.2 Unit root test

The primary rationale behind conducting a unit root test is to ensure that the data's stationarity trend is assessed. Failing to check for stationarity before employing the data in regression models may yield inaccurate or spurious results. Stationarity is vital in time series analysis to establish a stable and consistent framework for drawing meaningful conclusions from regression models. Therefore, by conducting unit root tests, researchers aim to ascertain and address any potential non-stationarity in the data, enhancing the validity and trustworthiness of the subsequent regression analysis.

The researcher gathered secondary data pertaining to Household Water Connection and Household Income (TZS) in the form of time series data for Msalala District Council. To mitigate the risk of producing spurious results inherent in time series data, the author took measures to ensure the stationarity of the data, thereby enhancing the validity and reliability of the study's outcomes. The time series data utilized in this research spanned 23 observations, encompassing the period from 2001 to 2023. By ensuring the stationarity of the data, the study aimed to establish a robust foundation for conducting meaningful and accurate analysis across the specified timeframe.

To examine stationarity, the data for Household Water Connection and Household Income (TZS) underwent a unit root test, employing the Phillips-Perron test, a less conventional yet reliable method for assessing unit root. The obtained results indicated the validity of all variables within the model. If the p-value is above a critical threshold/value, the null hypothesis cannot be rejected, suggesting the presence of a unit root in the time series data. The results for Validity, specifically trend regress at lag two and drift regress at lag two, are detailed for both Household Water Connection and Household Income (TZS) in Table 4.2 and 4.3 below. These results contribute crucial understandings into the stationarity characteristics of the variables, laying the groundwork for subsequent analyses.

Table 4.2: Phillips-Perron test for unit root of household water connection: lags (2) trend regress

```
. pperron loghwc, trend regress

Phillips-Perron test for unit root                Number of obs   =        22
                                                  Newey-West lags =         2

                                                    Interpolated Dickey-Fuller
                    Test            1% Critical       5% Critical      10% Critical
                 Statistic            Value             Value            Value
------------------------------------------------------------------------------
Z(rho)          -15.639            -22.500           -17.900          -15.600
Z(t)             -3.788             -4.380            -3.600           -3.240
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0172

------------------------------------------------------------------------------
     loghwc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
------------+-----------------------------------------------------------------
     loghwc |
         L1. |   .2406432   .1998969     1.20   0.243    -.1777458    .6590321
      _trend |   .0395229   .0175559     2.25   0.036     .002778    .0762678
       _cons |   .7774896   .3291736     2.36   0.029     .0885214    1.466458
------------------------------------------------------------------------------
```

Source: The researcher (2023)

Decision Criteria and interpretation

The null hypothesis is rejected when the absolute value of the test statistic is less than the absolute value of the critical value at a significance level of 5%. In this instance, the test statistic is -15.639, which falls below the critical value of -17.900 at the 5% significance level. Consequently, the researcher rejects the null hypothesis and accepts the alternative hypothesis, indicating that Household Water Connection exhibits no unit root and is stationary. Additionally, the model is deemed valid at lag 2, reinforcing the reliability of the findings.

Table 4.3:Phillips-Perron test for unit root of household income (TZS): lags (2) trend regress

```
. pperron gdppercapitaincometzs, lags(2) trend regress

Phillips-Perron test for unit root                Number of obs   =        20
                                                  Newey-West lags =         2

                                                  Interpolated Dickey-Fuller
                 Test            1% Critical       5% Critical      10% Critical
                 Statistic       Value             Value            Value
------------------------------------------------------------------------------
 Z(rho)          -5.382          -22.500           -17.900          -15.600
 Z(t)            -1.993           -4.380            -3.600           -3.240
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.6053
```

gdppercapi~s	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
gdppercapi~s						
L1.	.7912554	.1087772	7.27	0.000	.5617554	1.020755
_trend	26379.76	12096.79	2.18	0.044	857.7749	51901.75
_cons	4402.014	47805.15	0.09	0.928	-96458.03	105262.1

Source: The researcher (2023)

Decision Criteria and interpretation

The null hypothesis is rejected when the absolute value of the test statistic is less than the absolute value of the critical value at a 5% significance level. In this case, the test statistic is -5.382, which is lower than the critical value of -17.900 at the 5% significance level. As a result, the researcher rejects the null hypothesis and embraces the alternative hypothesis, indicating that Household Income (TZS) does not possess a unit root and is stationary. Furthermore, the model is affirmed as valid at lag 2, strengthening the credibility of the analysis.

4.2.3 Regression analysis

The obtained R-square value of 83.48% indicates a well-fitted model that effectively explains the relationship. This interpretation implies that Household Income is influenced by Household Water Connection. In the context of Msalala District Council in Shinyanga region, Tanzania,

Household Water Connection explains 83.48% of the variance in Household Income. The remaining 16.52% is attributed to factors not accounted for in the model.

This high R-square value suggests that the inclusion of Household Water Connection in the model significantly contributes to understanding and predicting changes in Household Income. It highlights the substantial impact of access to improved water sources on the income of households in Msalala District Council.

The findings underscore the importance of Household Water Connection as a determinant of economic well-being in the region. The substantial explanatory power of 83.48% implies that variations in Household Water Connection can be closely linked to corresponding variations in Household Income. This insight is crucial for policymakers and stakeholders seeking to address economic disparities and enhance overall living standards in Msalala District Council.

Table 4. 4: Regression analysis results

Source	SS	df	MS
Model	582.248752	1	582.248752
Residual	115.208125	20	5.76040623
Total	697.456876	21	33.2122322

Number of obs =	21
F(1, 20) =	101.08
Prob > F =	0.0000
R-squared =	0.8348
Adj R-squared =	0.8266
Root MSE =	2.4001

loggdpperc~a	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
loghwc	3.153998	.3137138	10.05	0.000	2.499602	3.808393

Source: The researcher (2023)

Referring to the Stata software's analysis of the coefficient table in the context of simple regression analysis, the variable was structured within the following function:

Household Income=β_0+β_1×Household Water Connection+Σ_t

The researcher employed the aforementioned function and executed a model expressed as:

Household Income=6.276195+3.153998×HWC+Σ_t

Here, β_0 represents the intercept, β_1 is the coefficient for the Household Water Connection (HWC) variable at time t, and Σ_t denotes the error term capturing unobserved factors influencing Household Income. The model's parameters were derived from the Stata software's analysis, providing insights into the relationship between Household Water Connection and Household Income in Msalala District Council, Shinyanga region, Tanzania.

The selection of this model was based on the linear nature observed in the relationship between Household Income and Household Water Connection, as computed earlier. The analysis revealed a constant term, denoted as β_0, with a value of 6.276195. This implies that when the Household Water Connection (HWC) is zero, the predicted value for Household Income is 6.276195. In other words, the intercept represents the estimated baseline level of Household Income in the absence of Household Water Connection.

The variable denoted as HWC in the regression equation model signifies Household Water Connection, and its inclusion suggests a positive relationship with Household Income in the local currency. Specifically, a one-unit increase in Household Water Connection corresponds to a 3.153998-unit increase in Household Income (TZS). This implies that as the level of Household Water Connection rises, there is a proportional positive impact on Household Income in Tanzanian Shillings.

Moreover, the t-statistics result revealed that Household Water Connection yielded a value of 10.05, which is greater than 1.96 as per the rule of thumb. Additionally, the p-value was recorded as 0.000, which is less than the significance level of 0.05. This result suggests that Household Water Connection holds statistical significance in explaining Household Income (TZS).

Consequently, it can be inferred that Household Water Connection exercises a noticeable influence on Household Income (TZS) in Msalala District Council.

4.2.4 Johansen Test for Co-integration

The co-integration test was employed in this study to examine the potential long-term association between Household Water Connection and Household Income (TZS), considering their distinct orders of integration. The hypotheses guiding the test were formulated as follows:

H0: There is no co-integration among variables.

H1: There is co-integration among variables.

Decision criteria

The decision criteria for this study stipulate that the null hypothesis should be rejected when the absolute value of the trace statistic is greater than the absolute value of the critical value at a 5% significance level.

Table 4. 5: Johansen tests for co-integration, trend(trend) lags (1)

Johansen tests for cointegration

Trend: constant — Number of obs = 20
Sample: 2002 - 2021 — Lags = 1

maximum rank	parms	LL	eigenvalue	trace statistic	5% critical value
0	2	-53.648367	.	21.6449	15.41
1	5	-45.347093	0.56401	5.0423	3.76
2	6	-42.825929	0.22285		

Source: The researcher (2023)

Cointegration is considered an indirect test of long-run causality. Following the rule of thumb for testing cointegrations in STATA, if the trace statistic exceeds the critical value at a 5%

significance level, the null hypothesis can be rejected. Conversely, if the trace statistic is below the critical value, the null hypothesis is accepted. In this context, the null hypothesis was rejected based on a trace statistic of 21.6449 which is greater than the critical value of 15.41 at 5% significance level. This indicates that there is cointegration among variables, specifically between Household Water Connection and Household Income (TZS). Consequently, there exists a long-run association between Household Water Connection and Household Income (TZS).

4.2.5 Granger Causality Model

Furthermore, the researcher aimed to examine the Granger Causality between Household Water Connection and Household Income (LCU). The estimation of any VAR model necessitates the selection of an appropriate lag length. Consequently, the researcher computed the VAR model results to determine the suitable lag length and employed it to estimate the Granger causality. The results for the VAR model are presented in Table 4.6 below.

Table 4. 6: VAR for household water connection and household income (TZS), lags (1/2)

Sample: 2003 - 2021 No. of obs = 19
Log likelihood = -255.0018 AIC = 27.89492
FPE = 4.58e+09 HQIC = 27.97905
Det(Sigma_ml) = 1.56e+09 SBIC = 28.392

Equation	Parms	RMSE	R-sq	chi2	P>chi2
gdppercapitain~s	5	102375	0.9820	1034.474	0.0000
loghwc	5	.527899	0.2977	8.05392	0.0896

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
gdppercapi~s						
gdppercapi~s						
L1.	1.448822	.2017082	7.18	0.000	1.053481	1.844162
L2.	-.4447353	.2097142	-2.12	0.034	-.8557677	-.033703
loghwc						
L1.	-14831.28	44279.81	-0.33	0.738	-101618.1	71955.54
L2.	-23317.72	40640.65	-0.57	0.566	-102971.9	56336.49
_cons	105164.2	78529.78	1.34	0.181	-48751.38	259079.7
loghwc						
gdppercapi~s						
L1.	2.13e-07	1.04e-06	0.21	0.837	-1.83e-06	2.25e-06
L2.	2.00e-07	1.08e-06	0.19	0.853	-1.92e-06	2.32e-06
loghwc						
L1.	.0560646	.2283301	0.25	0.806	-.3914543	.5035834
L2.	.0946525	.2095647	0.45	0.652	-.3160868	.5053918
_cons	.9291333	.4049412	2.29	0.022	.1354631	1.722803

Source: The researcher (2023)

In the context of time series analysis, the author aimed to know whether changes in one variable would influence changes in another variable. The Granger causality test, employed in this study, serves as a technique to assess the usefulness of one time series in predicting another. It facilitates the determination of whether a causal relationship exists between the variables under consideration.

Decision criteria

If the probability of the chi-square is less than the 5% significance level (0.05), the null hypothesis is rejected.

Table 4. 7:Granger causality result table of household water connection and household income (TZS)

```
. vargranger, separator(1)
```

Granger causality Wald tests

Equation	Excluded	chi2	df	Prob > chi2
loghwc	loggdppercapita	**14.372**	2	**0.001**
loghwc	ALL	**14.372**	2	**0.001**

Source: The researcher (2023)

The Granger causality results presented in Table 4.7 above, indicate a significant relationship between Household Water Connection and Household Income (TZS). The probability of the chi-square statistic was found to be 0.001, which is below the 5% significance level. This suggests that Household Water Connection is a Granger cause of Household Income (TZS), meaning changes in the former can predict and influence changes in the latter. Additionally, the vice versa scenario holds true, signifying a bidirectional causality: variations in Household Income (TZS) can also predict changes in Household Water Connection.

4.2.6 Diagnostic tests

Various diagnostic tests were conducted, including assessments for serial correlation, normality, heteroscedasticity, and structural stability of the models. These tests were implemented to ensure that the regression model adheres to the assumptions of the classical linear regression model. Additionally, the goal was to ascertain the stability of the estimated parameters over time.

4.2.6.1 Serial Correlation Test

The model undertook diagnostic tests, including the Breusch-Godfrey Serial Correlation LM test and the Durbin Watson test, to assess the presence of serial correlation within the model. In the context of the Breusch-Godfrey LM test, an insignificant result suggests that the researcher cannot reject the null hypothesis, indicating that the model is devoid of serial correlation. Meanwhile, the Durbin Watson test was employed, with a DW value exceeding 1.8 signifying the absence of autocorrelation issues within the model, thereby indicating no serial correlation. The serial correlation test was formulated with the following hypotheses:

H0: There is no serial correlation in the model.

H1: There is serial correlation in the model.

Table 4. 8: Breusch-Godfrey serial correlation LM test

```
. estat bgodfrey

Breusch-Godfrey LM test for autocorrelation
```

lags(*p*)	chi2	df	Prob > chi2
1	**0.354**	**1**	**0.5516**

H0: no serial correlation

Source: The researcher (2023)

The findings presented in Table 4.8 reveal that the probability of the Chi-square exceeds the 5% significance level. Consequently, we do not reject the null hypothesis, indicating that there is no evidence of serial correlation in the model.

4.2.6.2 VIF Test for Multicollinearity

Multicollinearity arises when independent variables in a regression model exhibit correlation. To mitigate this issue, multicollinearity was assessed through Variance Inflation Factor (VIF) analysis, as it is essential for independent variables to remain uncorrelated. Elevated correlations among variables can potentially lead to complications during model fitting and pose challenges in result interpretation.

Table 4. 9: VIF and ARCH effect test result

```
. estat vif, uncentered
```

Variable	VIF	1/VIF
loghwc	**1.00**	**1.000000**
Mean VIF	**1.00**	

```
. estat archlm
LM test for autoregressive conditional heteroskedasticity (ARCH)
```

lags(*p*)	chi2	df	Prob > chi2
1	**0.071**	**1**	**0.7900**

H0: no ARCH effects *vs.* H1: ARCH(*p*) disturbance

Source: The researcher (2023)

Thus, as presented in Table 4.9, the Variance Inflation Factors (VIFs) for the regression model indicate a VIF value of 1. This signifies an absence of correlation among the predictor or independent variable and the remaining predictor variables, aligning with the general rule of thumb where VIFs exceeding 4 warrant further investigation. Importantly, VIFs exceeding 10 are indicative of serious multicollinearity, necessitating correction. In this context, the selected

independent variables, namely water connection and per capita income, demonstrate independence, affirming their suitability for explaining economic growth as the dependent variable without encountering multicollinearity issues.

4.3 Discussion of Findings

4.3.1 Granger causality between access to improved water sources and household income in Tanzania

Improved water sources and household income in Tanzania yielded significant findings since the regression model aimed to understand the relationship between Household Water Connection (HWC) and Household Income (TZS) in Msalala District Council, Shinyanga region, Tanzania.

The model was expressed as Household Income = 6.276195 + 3.153998HWC + Ɛ. The constant term (β0) of 6.276195 represents the value of Household income when Household Water Connection is zero.

While coefficient of HWC (3.153998) indicates a positive relationship between Household Water Connection and Household Income. A one-unit increase in HWC led to a 3.153998 unit increase in Household Income (TZS).

The t-statistics result of HWC was 10.05, which is significant (greater than 1.96) and the p-value was 0.000, less than 0.05, demonstrating that HWC significantly influences Household Income (TZS) in Msalala District Council.

Granger causality tests whether changes in one variable can forecast changes in another variable, determining causality relationships between them. The study applied this test to assess the causal relationship between Household Water Connection and Household Income (TZS).

The results revealed that Household Water Connection "Granger causes" Household Income (TZS), as indicated by a probability of chi-square of 0.001, which is less than the 5% significance level. This implies that changes in Household Water Connection precede and forecast changes in Household Income (TZS) in Msalala District Council.

The high R-squared value of 83.48% in the regression model indicates that Household Water Connection explains a substantial portion of the variance in Household Income (TZS), with only 16.52% being attributed to other unidentified factors. These findings have important implications for policy and development efforts aimed at improving access to clean water sources and household income in the region.

Furthermore, significant positive relationship between Household Water Connection (HWC) and Household Income in Msalala District Council, and the Granger causality analysis showing that HWC precedes and forecasts changes in income have important implications for policy and development efforts in the region. This information can be instrumental in guiding the adoption of this research for implementation.

Research's use of regression analysis to provides a solid quantitative foundation for understanding the connection between access to improved water sources and household income.

The positive coefficient of HWC (3.153998) and its high statistical significance indicate that improving water access can lead to tangible economic benefits for households in the area. This information is crucial for policymakers, as it suggests that investments in water infrastructure can have a measurable impact on the well-being of the local population.

The Granger causality analysis is particularly noteworthy, as it indicates that changes in HWC serve as a leading indicator for changes in income. This means that interventions to enhance water access can be a strategic way to foster economic growth. It implies that, by prioritizing

water infrastructure development, decision-makers can not only improve living conditions but also set in motion a positive economic ripple effect.

The high R-squared value of 83.48% in the regression model underscores the strong explanatory power of Households Water Connection concerning income levels, with only 16.52% attributed to other unidentified factors. This suggests that efforts to improve access to clean water are a highly effective means of boosting household incomes in the region.

In terms of practical implementation, the findings advocate for investments in water infrastructure and services in Msalala District Council. Policy initiatives and development projects aimed at expanding and improving access to clean water should be prioritized, as they have the potential to yield substantial economic returns. For instance, efforts to develop and maintain water sources, sanitation systems, and hygiene programs can be key components of a comprehensive strategy.

Furthermore, partnerships with local communities, non-governmental organizations, and international agencies can be pivotal in securing the necessary resources and expertise for these initiatives. The research outcomes provide a persuasive argument for securing funding and support for such projects.

Policymakers, local authorities, and development agencies should take these results and collaborate to develop and implement programs that address the water access needs of the community. By doing so, they can not only improve living conditions but also drive economic growth in the region, leading to more prosperous and sustainable livelihoods for the local population

The finding that R-squared value of 83.48% in the regression model indicates that Household Water Connection explains a substantial portion of the variance in Household Income (TZS),

with only 16.52% being attributed to other unidentified factors linked to the Human Capital Theory, Resource-Based Theory, and The Capability Approach in the following ways:

Human Capital Theory, this theory posits that investment in human capital (education, skills, health) results in increased productivity and income. Access to a household water connection can be seen as an investment in human capital because it can improve health outcomes by reducing the incidence of waterborne diseases and save time that would otherwise be spent on fetching water. This saved time can be used for productive activities, such as education or work, which can increase household income.

Resource-Based Theory, this theory suggests that firms or households can achieve competitive advantage and higher earnings by utilizing their resources more effectively. A household water connection is a valuable resource that can be used for a variety of purposes, such as irrigation for home gardens, which can contribute to household income. Moreover, the availability of a water connection can save households the cost of purchasing water from vendors or the opportunity cost of time spent fetching water from distant sources.

The Capability Approach, which was developed by Amartya Sen, emphasizes the importance of enhancing individuals' capabilities to lead the kind of lives they value. Access to clean water is a fundamental capability that enables people to maintain good health and engage in productive activities. By improving this capability, a household water connection can indirectly contribute to increased household income.

Generally, these theories suggest that a household water connection is not just a physical asset but also a means of enhancing human capital, effectively utilizing resources, and expanding capabilities, all of which can contribute to higher household income.

4.3.2 Granger causality between household income and access to improved water sources in Tanzania

The Granger causality used to determine whether one time series can be useful in forecasting, applied in the context of econometrics to examine causal relationships between economic variables. The test was used to analyze the relationship between Household Water Connection and Household Income in Tanzania (TZS).

The result table 4.8, suggests that Household Water Connection Granger causes Household Income (TZS) because the probability of the chi-square statistic was found to be 0.001, which is less than the 5% significance level (0.05).

This finding implies that there is evidence to support the idea that changes or variations in Household Water Connection can be used to forecast or predict changes in Household Income (TZS). In other words, there is a temporal causal relationship where the past values of Household Water Connection can help to predict future values of Household Income.

Finding also suggests that the reverse relationship, i.e., Household Income (TZS) Granger causes Household Water Connection, is true. This means that variations in Household Income (TZS) can be useful in predicting or forecasting changes in Household Water Connection. It suggests a bidirectional causal relationship, where each variable can help predict the other.

The finding that Household Water Connection Granger causes Household Income (TZS) has practical implications. It could mean that improvements in access to household water connections may have a positive impact on the economic well-being of the population, as reflected in the Household.

On the other hand, the reverse relationship implies that changes in economic prosperity, as represented by Household income, could also influence the availability and affordability of

household water connections. This can have implications for policy decisions, as investments in one area may lead to positive outcomes in the other.

As Granger causality test reveals a directional causal relationship between Household Water Connection and Household Income (TZS). It suggests that changes in Household Water Connection can be used to predict changes in Household Income. In other words, improvements in access to household water connections can have a positive impact on economic well-being.

This is a critical finding because it highlights the importance of infrastructure development, such as providing clean and reliable water sources to households, as a means to promote economic growth and raise living standards.

Household Income Granger causes Household Water Connection. This implies that economic prosperity can influence the availability and affordability of household water connections. This bidirectional causality is significant because it indicates a feedback loop: as the economy improves, more resources may be allocated to infrastructure development, which, in turn, benefits the well-being of the population.

These findings have clear policy implications. Governments and policymakers in Tanzania, as well as in other regions with similar economic and infrastructure challenges, should consider the two-way causal relationship. Investments in water infrastructure not only address a basic human need but can also be seen as an economic development strategy. Improved access to clean water can lead to increased productivity, better health outcomes, and overall well-being, all of which can contribute to higher Household income.

Also, align with the Sustainable Development Goals (SDGs) set by the United Nations. Access to clean water and sanitation (SDG 6) is intrinsically linked to economic growth and reduced inequalities (SDG 10), as well as improved health and well-being (SDG 3). The bidirectional

relationship between Household Water Connection and Household Income underscores the interdependence of these goals and the need for a holistic approach to development.

Furthermore, changes in Household Income may have a long-term impact on investment decisions for water infrastructure. Policymakers should consider these findings in conjunction with other data and studies.

Access to clean water is not only important for economic growth, but it also plays a crucial role in improving the overall well-being of a community. Access to clean water contributes to better health, reduces the burden of diseases, and empowers women and girls who often have to bear the responsibility of water collection. These benefits should not be overlooked when discussing the advantages of investing in household water connections.

The study findings support Human Capital Theory, showing a causal relationship between household water connection and income.

As per the theory, investing in human capital, such as health and time, has been found to increase productivity and income. Access to reliable water sources can play a significant role in improving health by reducing waterborne diseases and saving time that would otherwise be spent on fetching water. This extra time can then be used for income-generating activities.

According to the Resource-Based Theory, having unique resources can give a competitive edge. The study confirms this theory by showing that having a household water connection is a unique resource that can increase income. For example, it can be utilized for small-scale activities like gardening or livestock rearing, which can add to the household income.

According to the Capability Approach, individuals can lead fulfilling lives by enhancing their capabilities. Access to clean water is one such fundamental capability that enables people to maintain good health and engage in productive activities, eventually leading to increased

income. The findings of this study support this theory by demonstrating a causal relationship between water access (a basic capability) and income.

The findings of the study contribute to three theories in the following ways. Firstly, Human Capital Theory is supported by empirical evidence, which shows that investments in human capital (in this case, access to water) result in increased income. Additionally, the theory is expanded by demonstrating how access to basic amenities like water can be considered a form of human capital investment.

The study enriches Resource-Based Theory by showing how a household water connection, which may seem like a simple resource, can help to increase household income. It offers a new perspective on what can be considered a 'resource' and highlights how basic amenities can contribute to income generation.

The Capability Approach is reinforced by research that empirically demonstrates the impact of improving access to clean water, which is a basic capability, on income. This study provides a measurable way to quantify the benefits of enhanced capabilities and expands the scope of the theory to include basic amenities like water. By providing empirical evidence, this study not only aligns with these theories but also contributes to their development.

4.3.3 Long-run relationship between access to improved water sources and household income in Tanzania

The Johansen test for co-integration was applied to determine whether there is a co-integration relationship between Household Water Connection and Household Income (TZS), indicating a long-run association between these variables.

The trace statistic value was 21.6449, and the 5% critical value was 15.41. Since the trace statistic (21.6449) is greater than the critical value (15.41), the null hypothesis was rejected,

rejection of the null hypothesis implies that there is co-integration among the variables examined, which in this case are Household Water Connection and Household Income (TZS).

The Study has found evidence of co-integration between Household Water Connection and Household Income (TZS). This means that these two variables have a long-run association or relationship, which is not due to random fluctuations.

The co-integration result indicates a long-term connection between Household Water Connection and Household Income (TZS). This implies that changes in one variable will have a lasting impact on the other. In practical terms, it suggests that as Household income (TZS) changes, there will be a corresponding change in Household Water Connection over time and vice versa.

Understanding this long-run association is crucial for policymakers and researchers. It suggests that interventions aimed at improving Household Water Connection can have an enduring effect on the economic well-being of the population, as reflected in Household income (TZS). This knowledge can inform policy decisions related to water infrastructure development and income equality.

4.4 Summary

The descriptive analysis of the study's data reveals that Household Water Connection in Msalala District Council, Tanzania, has a mean value of approximately 83.83, indicating some level of access to improved water sources, but with significant variability (variance of 6,943.968) and slight right-skewness, suggesting differing levels of water connection and the presence of outliers.

The Household Income in the study area is around TZS 990,215.20, with high income disparities (high variance), a slightly right-skewed distribution, and evidence of outliers. Unit root tests confirm the stationary nature of both variables.

The regression model demonstrates that Household Water Connection explains 83.48% of the variance in Household Income, with a positive relationship and a one-unit increase in Household Water Connection associated with a 3.15 unit increase in Household Income.

The Johansen test indicates co-integration and a long-term relationship between the variables, while Granger causality tests establish a causal link from Household Water Connection to Household Income. Diagnostic tests confirm the model's validity and reliability, ultimately suggesting that Household Water Connection significantly impacts Household Income in the region.

CHAPTER FIVE

SUMMARY, CONCLUSSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter provides a summary of the research findings and conclusions, recommendations, and areas for further investigation. Therefore, the key findings and findings of the model used in the study are presented, ordinary least square Johansen co-integrations test was conducted to determine long-run relationships between variables.

5.2 Summary of Findings

Descriptive Analysis revealed Household Water Connection in the study area has a mean value of approximately 83.83, indicating some level of access to improved water sources. There is significant variability in Household Water Connection, with a variance of 6,943.968.

The distribution of Household Water Connection is slightly right-skewed, indicating that some households have relatively higher levels of water connection, while kurtosis of Household Water Connection suggests the presence of extreme values or outliers in the data.

Household Income in the study area is approximately TZS 990,215.20. There is a high variance in Household Income, suggesting significant income disparities among individuals. The distribution of Household Income is slightly right-skewed with some relatively higher income levels while kurtosis of Household Income suggests the presence of extreme values or outliers.

A unit root test was conducted to check the stationarity of the time series data for Household Water Connection and Household Income (TZS). Results showed that both variables are stationary, indicating that there is no unit root problem.

The R-squared value of 83.48% suggests that Household Water Connection explains 83.48% of the variance in Household Income in the study area. The regression model showed a positive relationship between Household Water Connection and Household Income, with one unit increase in Household Water Connection leading to a 3.153998 unit increase in Household Income (TZS).

The Johansen test was used to examine the long-run association between Household Water Connection and Household Income (TZS). The test results revealed that there is co-integration between these variables, indicating a long-term relationship.

Granger causality tests were conducted to determine the causal relationship between Household Water Connection and Household Income (TZS). The results showed that Household Water Connection Granger causes Household Income (TZS), indicating a causal relationship between them.

Serial correlation tests, including the Breusch-Godfrey LM test and Durbin Watson test, showed no evidence of serial correlation in the model, indicating that the model is free from autocorrelation. VIF test for multi-collinearity confirmed that there was no significant correlation among predictor variables.

Generally, the study found that Household Water Connection has a significant positive impact on Household Income in Msalala District Council. Additionally, there is a long-term association between these variables, and Household Water Connection Granger causes changes in Household Income. The model passed various diagnostic tests, suggesting that it is valid and reliable for analysing the relationship between these two variables.

5.3 Conclusions

The regression analysis revealed a strong and positive relationship between Household Water Connection (HWC) and Household Income (TZS). This relationship was quantified with a substantial coefficient for HWC (3.153998), indicating that a one-unit increase in HWC leads to a 3.153998 unit increase in Household Income. Furthermore, the high R-squared value of 83.48% highlights that a large proportion of income variance can be attributed to improvements in water access, with only 16.52% being influenced by other unidentified factors.

One of the most noteworthy findings is the result of the Granger causality test, which demonstrates that changes in Household Water Connection "Granger causes" changes in Household Income. This implies that investing in water infrastructure and services can serve as a leading indicator for economic growth. Access to clean water not only enhances the well-being of the local population but also has a positive ripple effect on the economy.

These findings have crucial implications for policymakers, local authorities, and development agencies. It is evident that investments in water infrastructure and initiatives aimed at expanding and improving water access should be prioritized. Policy initiatives and development projects should be developed to provide clean water sources, sanitation systems, and hygiene programs to the community. Collaborative efforts with local communities, non-governmental organizations, and international agencies are essential to secure the necessary resources and expertise for these projects.

By embracing and acting on these research outcomes, the region can look forward to not only improving the living conditions of its residents but also driving substantial economic growth. The combination of improved water access and increased household incomes can lead to more prosperous and sustainable livelihoods, benefitting the entire population of Msalala District Council. These findings should serve as a call to action, encouraging stakeholders to work

together and make significant investments in water infrastructure for the betterment of the community.

Granger causality analysis conducted between Household Water Connection and Household Income in Tanzania (TZS) has yielded insightful findings with significant implications for policy and development.

The research has demonstrated a bidirectional causal relationship between Household Water Connection and Household Income. This means that variations in one variable can predict changes in the other. Such a relationship implies that investments in water infrastructure and improvements in economic well-being are interdependent processes.

The analysis suggests that enhancing access to household water connections can positively impact the economic well-being of the population, as reflected in Household income. Simultaneously, an increase in Household can influence the availability and affordability of household water connections. This mutual influence underscores the importance of coordinated economic and infrastructure development efforts.

For policymakers in Tanzania and similar regions facing economic and infrastructure challenges, these findings emphasize the need to consider a holistic approach to development. Investments in clean water and sanitation infrastructure should not be viewed merely as addressing a basic human need but as a strategy for economic growth and improved living standards.

The bidirectional relationship between Household Water Connection and Household Income aligns with the United Nations' Sustainable Development Goals (SDGs), particularly SDG 6 (clean water and sanitation), SDG 10 (reduced inequalities), and SDG 3 (good health and well-

being). This underscores the interdependence of these goals and emphasizes the importance of integrating water infrastructure development into broader development strategies.

Beyond economic growth, improved access to clean water has far-reaching benefits for overall community well-being. It contributes to better health, reduced disease burden, and the empowerment of women and girls. These aspects should not be overlooked when discussing the advantages of investing in household water connections.

Hence, the results of the Granger causality analysis reveal a dynamic relationship between household water access and economic prosperity. This understanding should guide the development policies of governments and stakeholders, emphasizing the importance of infrastructure development and clean water provision as integral components of sustainable economic growth and well-being.

Furthermore, Johansen test for co-integration has provided strong evidence of a long-term and meaningful association between Household Water Connection and Household Income (TZS). The rejection of the null hypothesis indicates that this relationship is not simply a result of random fluctuations, but rather a robust and enduring connection.

This finding has significant implications for both policymakers and researchers. It underscores the interdependence of these two variables, implying that changes in one, such as improvements in Household Water Connection, will have a lasting impact on the other, namely, Household Income (TZS), and vice versa.

For policymakers, this knowledge is crucial as it suggests that efforts to enhance Household Water Connection can lead to sustainable improvements in the economic well-being of the population, as reflected in higher Household income (TZS). It also highlights the potential for water infrastructure development to contribute to income equality.

In essence, this research provides valuable insights into the dynamics of these variables and underscores the importance of considering long-term implications when crafting policies related to water infrastructure and income growth. By recognizing and leveraging this co-integration relationship, policymakers can make more informed decisions to enhance the overall welfare and economic prosperity of the population

5.4 Policy Recommendations

Based on the results and findings presented in the study, here are some recommendations:

(i) The Government and local authorities should continue to invest in improving access to water sources in Msalala District Council. The positive relationship between Household Water Connection and Household Income (TZS) suggests that increasing access to improved water sources can contribute to economic well-being.

(ii) Efforts should be made to reduce income disparities within the district. The high variance in Household income indicates significant income inequalities. Targeted policies to support economic growth among lower-income households can help in this regard.

5.5 Further Research

This study focused on the causal relationship between Household Water Connection and Household income. Future research could explore the specific mechanisms through which improved water access impacts household income. Understanding these pathways can inform more effective policy interventions.

Consider conducting similar studies in other regions of Tanzania to assess the generalizability of the findings. Regional variations may exist in the relationship between water access and income.

Since the kurtosis values indicated the presence of extreme values or outliers in the data, further investigation is recommended to identify and understand these outliers. Outliers could be indicative of unique circumstances that impact water access and income in the district.

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APPENDICES

Appendix i: Questionnaires

Dear Respondent,

My name is Maduhu W. Magili, a student at Institute of Accountancy Arusha. I am undertaking research titled “Assessment of the Impact of Access to improved water sources on Household Income in Tanzania: A Case of Msalala District Council”. This research is part of fulfillment of the requirements for the award of Master of Science in Project Planning and Management. You have been selected to participate in this study to obtain your perceptions and views regarding to this study. There are no good or wrong answers, but your honest contribution in answering the questions will assist to realize the fact behind the study. The information provided will be treated confidential and for academic purpose only. Do not write your name in this questionnaire. I wish to acknowledge my thanks in advance for your response.

SECTION A (DEMOGRAPHIC INFORMATION: Kindly tick (√)

1. Gender: Male ( ) Female ( )
2. Education: None formal ( ) Primary ( ) Secondary ( ) Diploma ( ) Undergraduate ( ) Postgraduate ( )
3. Year of residence: Below five ( ) Above five ( )

SECTION B (Causality between Water access and Household income)

Kindly tick (√) the appropriate response

1. Strongly Disagree
2. Disagree
3. Agree
4. Strongly agree

SN.	Causality between Water access and Household income	1	2	3	4
1	Reduced expenditure in water borne diseases				
2	Women engagement in business and other income generating activities				
3	Time saving				
4	Irrigation for Small-Scale Farming at home.				
5	Accessibility and availability of nutritious food at household level				
6	Availability of improved water				
7	Climate change mitigation				

THANK YOU FOR YOUR COOPERATION

Appendix ii: Cleaned Data

Year	Household Water Connection	Household Income (TZS)	Log HWC	Log Household Income
2001	171	275,556	2.232996	5.440209872
2002	40	289,934	1.60206	5.462299147
2003	54	286,342	1.732394	5.456885054
2004	211	288,554	2.324282	0.366288904
2005	6	297,409	0.778151	5.473354107
2006	5	322,806	0.69897	5.508941598
2007	7	368,201	0.845098	5.566084964
2008	5	423,431	0.69897	5.62678265
2009	30	455,008	1.477121	5.658019033
2010	25	510,023	1.39794	5.707589761
2011	22	795,626	1.342423	5.900708967
2012	175	1,124,625	2.243038	6.051007733
2013	6	1,271,364	0.778151	6.10426991
2014	41	1,410,832	1.612784	6.149475302
2015	40	1,655,877	1.60206	6.219028074
2016	117	1,736,165	2.068186	6.239590997
2017	126	1,703,695	2.100371	6.231391849
2018	67	1,861,770	1.826075	6.269926028
2019	58	1,854,663	1.763428	6.268265008
2020	78	1,887,800	1.892095	6.275955982
2021	157	1,974,839	2.1959	6.295531695
2022	325		2.511883	
2023	162		2.209515	

Appendix iii: Research Budget

Item Nr.	Item Description	Unit	Qty.	Unit Cost (TZS)	Amount (TZS)
1.0	**Proposal Preparation**				
1.1	Internet costs	Sum	1	30,000	30,000
1.2	Printing	Sum	1	50,000	50,000
1.3	Photocopying	Sum	1	10,000	10,000
1.4	Binding	Nr	3	2,500	7,500
	Sub Total				**97,500**
2.0	**Data collection**				
2.1	Internet costs	Sum	1	30,000	30,000
2.2	Printing	Sum	1	60,000	60,000
2.3	Photocopying	Sum	1	30,000	30,000
2.4	Travel Costs (Bus Tickets)	Sum	1	175,000	175,000
2.5	Travel allowances	Person days	6	220,000	1,320,000
	Sub Total				**1,615,000**
3.0	**Data analysis, interpretation, and report compilation**				
3.1	Printing	Sum	1	50,000	50,000
3.2	Photocopying	Sum	1	25,000	25,000
3.3	Miscellaneous expenses including purchasing of statistical software	Sum	1	600,000	600,000
	Sub Total				**675,000**
4.0	**Submission and final report presentation**				
	Printing	Sum	1	120,000	120,000
	Binding	Nr	3	20,000	60,000
	Travel Costs (Bus Tickets)	Sum	1	200,000	200,000
	Travel allowances	Person days	6	220,000	1,320,000
	Sub Total				**1,700,000**
	Grand Total				**4,087,500**

Appendix iv: Fieldwork Timetable (Work Plan)

FIELDWORK TIMETABLE (WORK PLAN) FOR CONDUCTING A STUDY ON THE ASSESSMENT OF THE IMPACT OF ACCESS TO IMPROVED WATER SOURCES ON HOUSEHOLD INCOME IN TANZANIA: A CASE OF MSALALA DISTRICT COUNCIL

Task Description	Start Date	End Date	Duration (Days)	01-01-23	08-01-23	15-01-23	22-01-23	29-01-23	05-02-23	12-02-23	19-02-23	26-02-23	05-03-23	12-03-23	19-03-23	26-03-23	02-04-23	09-04-23	16-04-23	23-04-23	30-04-23	07-05-23	14-05-23	21-05-23	28-05-23	04-06-23	11-06-23	18-06-23	25-06-23	02-07-23	09-07-23	16-07-23	23-07-23	30-07-23	06-08-23	13-08-23	20-08-23	27-08-23	03-09-23	10-09-23	17-09-23	24-09-23	01-10-23	08-10-23	15-10-23	22-10-23	29-10-23	05-11-23	12-11-23	19-11-23	26-11-23	03-12-23
Selection of research topic	08/01/2023	31/01/2023	23																																														
Proposal writing	01/02/2023	20/08/2023	200																																														
Proposal defense	21/08/2023	01/09/2023	11																																														
Data collections	02/09/2023	01/10/2023	29																																														
Data analysis, interpretation, and report compilation	02/10/2023	22/10/2023	20																																														
Preparation of article and publication in IAA Journal or International Journals	16/10/2023	30/10/2023	14																																														
Final report presentation	23/10/2023	30/10/2023	7																																														
Submission of the final draft of the Dissertation	05/11/2023	12/11/2023	7																																														
Correction and incorporating suggestions given by the Supervisor and Second Marker	13/11/2023	20/11/2023	7																																														
Submission of the corrected dissertation document for bidding approval	21/11/2023	27/11/2023	6																																														
Bidding of two black books, clearing, and submission of the black books	28/11/2023	04/12/2023	6																																														

Appendix v: Request for Data Collection Letter

Institute of Accountancy Arusha

P.O. Box 2798, Njiro Hill, Arusha, Tanzania

Telephone: +255 27 2970232 Mobile: +255 763 462109 Telex: 50009 IAA TZ

Fax: +255 27 2970234 Email: iaa@iaa.ac.tz Website: www.iaa.ac.tz

Ref. No.: MSC-PPM/01/OO91/2022 **4th October 2023**

.....

.....

P.O.BOX.....

.....

Dear Sir/Madam,

RE : REQUEST FOR DATA COLLECTION

The purpose of this letter is to introduce to you **MR. MADUHU W. MAGILI** who is our student pursuing Masters of Science in Project Planning Management (MSC-PPM/01/OO91/2022). Currently, the aforementioned student is conducting a study on **"ASSESSEMENT OF THE CASUAL RELATIONSHIP BETWEEN THE ACCESS TO IMPROVED WATER SOURCES AND HOUSEHOLD INCOME IN TANZANIA: A CASE OF MSLALALA DISTRICT COUNCIL."** We would like to highlight here that this study is part of the requirement for the award of the above mentioned programme of study.

We therefore request you to extend to the above-mentioned student of our Institute any help that may facilitate him to achieve study objectives. We further request permission for him to see and talk to the staff of your Institution in connection to his study. The period for this request is granted from October to the end of December 2023.

Thank you for your continuing support.

Yours Sincerely,
INSTITUTE OF ACCOUNTANCY ARUSHA

Germanus S. Chole
FOR: RECTOR

DIRECTOR OF POSTGRADUATE STUDIES, RESEARCH & CONSULTANCY
INSTITUTE OF ACCOUNTANCY ARUSHA
P.O. BOX 2798 ARUSHA, TANZANIA
TEL: 254 9412, FAX: 254 9421

All Communications to be addressed to the Rector

Appendix vi: Permission for Conducting Research Clearance Letter

JAMHURI YA MUUNGANO WA TANZANIA

OFISI YA RAIS
TAWALA ZA MIKOA NA SERIKALI ZA MITAA

Simu Na: +255 (028) 2762222
Nukushi: +255 (028) 2762310
Barua Pepe: ras.shinyanga@tamisemi.go.tz
Tovuti: http://www.shinyanga.go.tz

Regional Commissioner's Office,
04 Boma Street,
P.O. BOX. 320,
37180 Shinyanga,
Tanzania.

In repl please quote:

Ref. No. AB.271/290/01S/77 **30 October, 2023**

District Executive Director,
Msalala District Council

Re: **PERMISSION FOR CONDUCTING RESEARCH CLEARANCE**

Please refer to the above heading.

2. The letter with Ref. No. MSC-PPM/01/0091/2022 dated on 4 Octoba, 2023 from Institute of Accountancy Arusha that describes the heading above is highly considered.

3. I am very delighted to inform you that MR. MADUHU W. MAGILI a Student Undertaking Masters of Science in Project Planning Management (MSC-PPM/O1/0091/2022) at the Institute of Accountancy Arusha (IAA) has been accepted by Regional Commissioner's Office to conduct research in issue related to ***'ASSESSEMENT OF THE CAUSAL RELATIONSHIP BETWEEN THE ACCESS TO IMPROVED WATER SOURCES AND HOUSEHOLD INCOME IN TANZANIA.'*** The Case study in Kahama District at **Msalala Distric Council**. His research is from 31 October to 14 November, 2023 .

4. With this letter, we are kindly request you to allow and asist him on pursue this research according to an ethical research clearence provided by the Institute of Accountancy Arusha.

5. However, we believe he must gather necessary data with regard of research objectives as well as course respectively.

6. Yours in Cooparation.

Deus M. Paschal
For: REGIONAL ADMINISTRATIVE SECRETARY (SHINYANGA)

Copy: Rector,
The Institute of Accountancy Arusha (IAA),
P.O. BOX 2798,
Arusha. – ***For information***

MR. Maduhu W. Magili.
Student of The Institute of Accountancy Arusha (IAA),,
P.O. BOX 2798,
Arusha. – ***For information***

ASSESSMENT OF THE CAUSAL RELATIONSHIP BETWEEN THE ACCESS TO IMPROVED WATER SOURCES AND HOUSEHOLD INCOME IN TANZANIA: A CASE OF MSALALA DISTRICT COUNCIL

ORIGINALITY REPORT

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INSTITUTE OF ACCOUNTANCY ARUSHA TANZANIA

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This certificate confirms that the manuscript listed below was edited by one or more expert English Editors. The following issues were edited: Grammar, Spelling, punctuation, Sentence Structure and Phrasing. Journal editors can contact us for a copy of the edited document that was submitted to the Authors.

MANUSCRIPT TITLE

ASSESSMENT OF THE CAUSAL RELATIONSHIP BETWEEN THE ACCESS TO IMPROVED WATER SOURCES AND HOUSEHOLD INCOME IN TANZANIA: A CASE OF MSALALA DISTRICT COUNCIL

.....

AUTHOR(S)

Maduhu Wasala Magili

&

Mr. Samwel K. Nyamanga

DATE ISSUED

21/11/2023

CERTIFICATE NUMBER

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.....

Signature Name of Editor: Wilhelimina Costantini ("PHD")