FACTORS INFLUENCING ECONOMIC SUSTAINABILITY OF WATER SUPPLY SCHEMES IN RURAL AREAS IN TANZANIA: A CASE OF NGARA DISTRICT

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CERTIFICATION

The undersigned certify that, they have read and hereby recommend for acceptance of the dissertation titled; **"Factors Influencing Economic Sustainability of Water Supply Schemes in Rural Areas in Tanzania: A Case of Ngara District,** in partial fulfilment of the requirements for the degree of Master of Project Management of the Open University of Tanzania.

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Date

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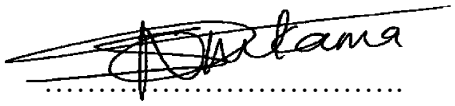
DECLARATION

I, **Simeon Wilson Ndyamukama,** declare that, the work presented in this dissertation is original. It has never been presented to any other University or Institution. Where other people's works have been used, references have been provided. It is in this regard that I declare this work as originally mine. It is hereby presented in partial fulfilment of the requirement for the Degree of project management.



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Signature

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Date

DEDICATION

This work is dedicated to my beloved wife Faith Ida Fidelis, my children Ethan Mwombeki Ndyamukama, Evan Mwesiga Ndyamukama and Evanna Karungi Ndyamukama. Also, the work is dedicated to my father Anaclet Kabalema Ndyamukama, my late mother Julieth Karashemela Rwiza and all other relatives and friends for their unwavering support throughout my studies.

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ABSTRACT

This study examined the factors influencing the economic sustainability of water supply schemes in rural areas with reference to Ngara District Council. A cross-sectional design with a mixed approach was used which allow to collect data and analyze both quantitative and qualitative data. A sample size of 74 respondents was selected where questionnaires and in-depth interviews were used to solicit information. Data were descriptively analysed while regression analysis was carried out to find the relationship between variables. The findings revealed that technology uses such as pumping and gravity influenced water supply schemes in Ngara District as the updated technology enhanced the economical pumping of water and the use of gravity water towards economic sustainability. More so, the reliance on external support has influenced water supply schemes' sustainability from the fact that donor funding has minimized the economic sustainability of water projects while reliance on government subsidy contributes to the non-economic sustainability of water supply schemes. Additionally, water users' ability to pay for services influenced water supply schemes' sustainability from the fact that the economic hardship experienced by water users resulted in water users' inability to pay for the services where poor community and household economy facilitated water users' inability to pay for the services rendered. It is concluded to have fairness in water user fees to prevent negative consequences associated with the lack of access to safe and sufficient water supply and sustainability. It is recommended that enhancing rural water supply schemes' sustainability requires pooling together maintenance and financial risks at scale supported by advances in monitoring and payment technologies.

Key words: Economic sustainability; Water supply schemes; Rural areas.

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LIST OF ABBREVIATIONS

CBM	Community Based Management
COWSOs	Community Owned Water Supply Organisations
FGDs	Focus Group Discussions
HA	Alternative Hypothesis
HO	Null Hypothesis
NGOs	Non-Governmental Organisations
O & M	Operations and Maintenance
SAPs	Structural Adjustment Programs
SPSS	Statistical Package for Social Sciences
VIF	Variance Inflation Factor

CHAPTER ONE

INTRODUCTION

1.1 Chapter Overview

This chapter presents the background and statement of the study, research objectives and questions, significance, scope and organisation of the study.

1.2 Background to the Study

Globally, water is considered both a social and economic right (Kanda et al., 2018). Water is important for human survival, health and dignity and is classified as a basic resource for human development. The world's freshwater resources are under increasing pressure (Haie, 2021). According to Kativhu *et al.* (2018) sustainability is the ability of a system or technology to continue working over a desired period of time while causing little or no damage to the environment. A study by Kativhu *et al.* (2017) further showed that in Zimbabwe only 17% of the studied water supply systems were sustainable under the community based management (CBM) approach where users' ability to pay for the service was vital. The approach was prevalent in most rural water sectors as it has been envisaged as a panacea to sustainability problems in Sub-Saharan Africa. Findings by Naughton (2017) also showed that economic sustainability of water supply systems was significantly related to community ownership.

Kativhu *et al.* (2017) asserted that some communities in Zimbabwe were not repairing minor breakdowns as they relied on external support from non-

governmental organisations (NGOs). Kanda et al., (2018) revealed that, where external support was expected, communities were not planning for operation and maintenance (O&M) of water points which increased the downtime. Furthermore, Naughton (2017) found out that dependence on external support under the CBM approach caused lack of scalability of water supply projects.

A study conducted by Konde (2016) in Kenya investigated the factors influencing sustainability of water projects in Bamba Division, Kilifi County. It was found out that economic sustainability of the projects was questionable since most of the groups had disintegrated and some projects were unattended to. The findings further established that economic factors such as presence of income generating activities and overreliance on donor funding have major effects on sustainability of community projects. The other factors according to Burk (2018) included technology and community participation especially the role played by the community in the project selection was found to have a major impact on long term maintenance of the community projects.

Kirenga et al (2018) conducted a study on the influence of external water fund on the sustainability of community managed rural water supply projects focusing on Moshi District in Tanzania and found that there was a relationship between water funding, sustainability and management of rural water projects. As per Haie (2021) the water sector continued to experience low levels of sustainability and stagnation in levels of access to water for domestic use in rural areas such as Ngara District. According to the theory of transparent water management, water is a means towards achieving

economic sustainability in terms of equity that every individual needs as a fair share considering the water needs and the ability to use the water efficiently. In order to facilitate what the theory needs, technology, water users' ability to pay for the services and external support have been vital. Moreover, factors for economic sustainability of water supply towards developing a systematic performance into social, economic, technological and environmental sustainability thereby expanding the real freedoms that people enjoy are minimally studied. It is against this backdrop that this study examined the factors influencing economic sustainability of water supply schemes in Ngara District Council.

1.3 Statement of the Research Problem

The international Structural Adjustment Programs (SAPs) in Africa emerged with ideological models that led to the evolution of community participation where communities changed from being recipients to owners as well as users of water with the mandate to plan, manage and operate water supply schemes' services (Naughton, 2017). Tanzania was not left behind in such changes as it adopted a community management model referred to as community owned water supply organisations (COWSOs) (Kirenga et al., 2018). Moreover, the ideological changes could not empower COWSOs to manage water supply projects effectively, economically and sustainably in terms of technology adoption and use, non-reliance on external support and the ability of water users to pay for the services rendered.

A study conducted by Kanda et al (2018) reported the challenges that affect COWSOs to attain sustainability include; high non-revenue water, high operational

and maintenance cost, low metering of connections, low revenue collections, water users' ability to pay for the services, governance challenges and low quality of services. Besides, such challenges may or may not be found in Ngara District with regard to water supply schemes as a few or no studies have been done to examine such factors including the adoption and use of technology,, external support, and water users' ability to pay for the service to enable the thorough sustainability of projects. It is from that backdrop that this study aimed at examining the factors influencing economic sustainability of water supply schemes in rural areas with reference to Ngara District Council.

1.4 Objectives of the Study

1.4.1 General Objective

The general objective of the study was to examine the factors influencing economic sustainability of water supply schemes in rural areas with reference to Ngara District Council.

1.4.2 Specific Objectives

i) To examine the extent to which technology influences water supply scheme's sustainability in Ngara District.

ii) To determine how reliance on external support influences water supply scheme's sustainability in Ngara District.

iii) To examine how water users' ability to pay for the service influences water supply scheme's sustainability in Ngara District.

1.5 Research Questions

1.5.1 General Research Question

What are the factors influencing economic sustainability of water supply schemes in rural areas with reference to Ngara District Council?

1.5.2 Specific Questions

i) To what extent does technology influence water supply scheme's sustainability in Ngara District?

ii) How does the reliance on external support influence water supply scheme's sustainability in Ngara District?

iii) Does water users' ability to pay for the service influence water supply scheme's sustainability in Ngara District?

1.6 Relevance of the Research

This study is relevant to water actors aiming at finding ways to sustain water projects economically in rural areas such as Ngara District. It is also a source of knowledge to water stakeholders in order to achieve a deep understanding on how water supply schemes can be economically sustained. The recommendations might lead to possible solutions in terms of policy to either improve or suggest more efficient policy management practices for water schemes that can help address future economic improvements and sustainability. Additionally, the study is for the researcher's attainment of a Masters' degree in Project Management from the Open University of Tanzania.

1.7 Organisation of the Study

This study consists of five chapters. The first chapter presents the background of the study. The second chapter presents the literature review; the third chapter presents the research methodology. The fourth chapter presents the results and discussions arriving from the study findings and finally the fifth chapter presents the conclusion and recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1 Chapter Overview

This chapter presents the literatures that underpin the study. It commences with the conceptual definitions of key terms, presents the theoretical review, empirical review, research gap and the conceptual framework; theoretical framework, statement of hypothesis and the summary of the chapter.

2.2 Conceptual Definitions of Key Terms

2.2.1 Economic Sustainability

Economic sustainability is defined as the means used to safeguard and sustain resources (human and material) in order to create long-term sustainable values by optimal use, recovery and recycling (Kirenga et al., 2018).

Economic sustainability is the ability to an economy to support a defined level of economic production indefinitely. Thus Economic Sustainability means the use of various strategies for employing existing resources optimally so that a responsible and beneficial balance can be achieved over the longer term (Jeronen, 2020)

2.2.2 Water Supply Schemes

A water supply scheme is a system for the collection, transmission, treatment, storage and distribution of water from source to consumers, for example, homes, commercial establishments, industry, irrigation facilities and public agencies for water related activities (Kanda et al., 2018).

2.2.3 Rural Area

A rural area is an open swath of land that has few homes or other buildings, and not very many people. These are open areas with few houses and few people, as opposed to urban areas which have larger populations. In rural areas population density is very low. Their homes and businesses are located very close to one another (Naughton, 2017).

Rural Areas include diverse patterns of settlement infrastructure and livelihoods and relate in complex ways with urban areas. Rural areas a spatial category associated with certain patterns of human activity but with those associations being subject to continuous change (Dasgupta, 2019).

2.3 Theoretical Review

This study was underpinned by the following theory:

2.3.1 Transparent Water Management Theory

This theory was developed by Naim Haie in 2020 with its first publication in 2021. The theory is vital for water policy, planning, sustainability and practice due to the high complexity inherent in water use systems, which, in turn, demands a coherent and clearly defined terminology for transparent and accurate analysis in terms of economic, environmental and social sustainability. In this theory, Haie (2021) provided a system of ideas intended to explain general principles based on five foundational ideas using independent principles and a basic law of nature in order to guide water management processes toward economic sustainability. Haie (2021) states that the emergence of a universal aggregative indicator and an objective

distributive approach for water use systems are significant outcomes of the theory, which served as the foundation towards economic sustainability. The author stated that there is a fundamental difference between descriptive and performance indicators of a water use system namely economic, social, technological and environmental. The former responds to the question “What is happening?”, and the latter focuses on questions such as “Does it matter? Are targets reached?” To answer these questions, Haie (2021) used efficiency as a performance indicator, which helps to attain more of the things valued and develop systemic, comprehensive and objective performance indicators based on a universal principle integrating the differentials of the three pillars of water management, namely water quantity, water quality and water economic benefit. These reveal trade-offs among the three pillars at three levels of management with climate and energy descriptors and stakeholder enablers.

Haie (2021) coined the idea of equity that is related to development, which is a process of expanding the real freedoms that people enjoy. Furthermore, freedom can be distinguished both from the means that sustain it and from the achievements that it sustains. In this theory, the author focused on water as a means having in mind that economic sustainable water equity means a fair share considering the water needs and the ability to use the water efficiently (Burk, 2018).

The theory helps users of water to appreciate the wide range of situations that the concepts and tools presented in theory should be employed in order to get a better insight into their economic functioning. The application examples are about urban

water and wastewater cycle, urban water equity, economic sustainability, irrigation under water scarcity, water-energy-food entangled systems, and the combined impact of an urban area and an irrigation zone on their common source of water, which is a river with a minimum water requirement. This theory might explain and solve the problems associated with economic sustainability of water supply schemes with reference to Ngara District.

2.4 Empirical Review

2.4.1 General Studies

The World Bank (2017) carried out a study and found that Governments and water sector stakeholders have worked hard in ensuring improvement in institutional capacities through policies and guiding frameworks for sustainable service delivery through adopting technology friendly for their use. There was a need to move beyond infrastructure development to ensuring water service providers receive capacity building with a focus on governance, technical capacity and equipping with information. The findings further showed a challenge of financing rural water supply projects since these projects cannot recover costs, capital maintenance, cost of operations and maintenance yet they collect revenues from the sale of water. It was recommended that rural schemes may require cost recovery in this line of thought where the government is usually called to fix broken parts or replace infrastructure without considering Life Cost Cycle approach.

Cook (2017) carried a study in Thailand on investments in the water sector that focused on economic value of time and cost savings through improved water systems

which would enable people to have ability to pay and use water for the saved time and costs in other productive activities which in turn boosts the chances of sustainably managing the systems. The findings revealed that an improved water supply system is defined as a system that provides water reliably, of potable quality, and of sufficient quantity to meet basic household needs like drinking, bathing, cooking, and washing.

2.4.2 Studies in African Countries

Olela and Wanyonyi (2018) carried a study on the factors for the sustainability of water supply projects in Kenya. The findings revealed that there is a positive relationship between sustainability of water supply projects and choice of technology, socio-economic factors, socio-cultural factors, water tariffs and specialized training of service teams. The significance values for relationship between sustainability of water supply projects and choice of technology, socio-economic factors, socio cultural factors, water tariffs and specialized training on technical knowledge and skills influence water tariffs and choice of technology being the most significant factors. Training, availability of spare parts and water abstraction technology were prerequisite towards sustainability resulting in reliable access to water duration and minimal breakdowns. There was lack of involvement and participation in water supply development process including tariff setting with household consumption a major factor to consider in tariff setting.

Konde (2016) in his study investigated factors influencing sustainability of water projects in Bamba Division, Kilifi County, Kenya. This study applied descriptive

survey where the population constituted of the household heads. The respondents were reached through household survey. The findings revealed that economic factors such as presence of income generating activities and overreliance on donor funding have a major effect on sustainability of community projects. Technology had an impact in ensuring the sustainability of community projects in this area. Community participation especially the role played by the community in the project selection was found to have a major impact on long term maintenance of the community projects. The study recommended that the community members need to understand the need to engage in income generating activities so as to boost their earnings.

Mamburi (2014) in his study found that sustainability rate of rural water supply systems increased as a result of communities' owning and managing their schemes through user fees, existence of management organization at the village level, protection of the water point, community cost recovery for operation and maintenance, technology type and availability of spare parts. He recommended the need for users to be capacitated in order to pay for the services they get.

2.4.3 Empirical Studies in Tanzania

Dyer et al., (2014) in their study on the effects of climate change on the sustainability of catchment areas, found that climate change is expected to have great impacts on the global hydrological cycle. It was found that many climate change studies conducted in Tanzania showed an increase in the rainfall in some parts of the country and a decrease in rainfall and increase in temperature in other parts, which would

lead to extreme natural events such as floods and drought without which adopted technologies would not save much on sustainability.

Kirenga et al (2018) conducted a study in Tanzania on the influence of Water Fund on the sustainability of community managed rural water supply projects. It was found that water funds collected were inadequate to cover the operations and maintenance costs due to low level of tariff and weak water consumption rates. It was recommended that the reliance on external funds could not predict the economic sustainability of projects when donor funding was no more.

Thompson and Hope (2015) carried out a study in Tanzania and showed that African countries and in particular, Tanzania suffer in terms of achieving sustainable water supply services due to barriers of user fees payment as only a few users could pay for the services. It was suggested that it is the availability of resources regarding the operations and management within the capacity of communities which can only make supply projects sustainable.

2.5 Research Gap

Many reviewed studies such as the World Bank (2017) focused on investing in improving institutional capacities and policies that sustain water projects towards technology use; Olela and Wanyonyi (2018) insisted on sustainability of water supply projects in general while insisting on new technology use for the economic sustainability of water supply; while Cook (2017) focused on investing in the water sector for economic value and for time and cost saving through improved water systems, ability by users to pay for the services and reliance on external support. A

few examined the factors influencing economic sustainability of water supply schemes but could not in particular examine factors for economic sustainability in rural areas such as Ngara District. This is the gap filled.

2.6 Conceptual Framework

Figure 2.1 provides the conceptual framework. This is defined as an abstract idea or a theory used to develop new concepts or to reinterpret existing ones (Yin, 2003). It gives the relationship between the dependent and independent variables. In this conceptual framework, the independent variables include; technology that uses pumping or gravity; reliance on external support such as donor funding or government support; and water users' ability to pay for the services that rely on household and community economy while the dependent variable is the economic sustainability of water supply schemes.

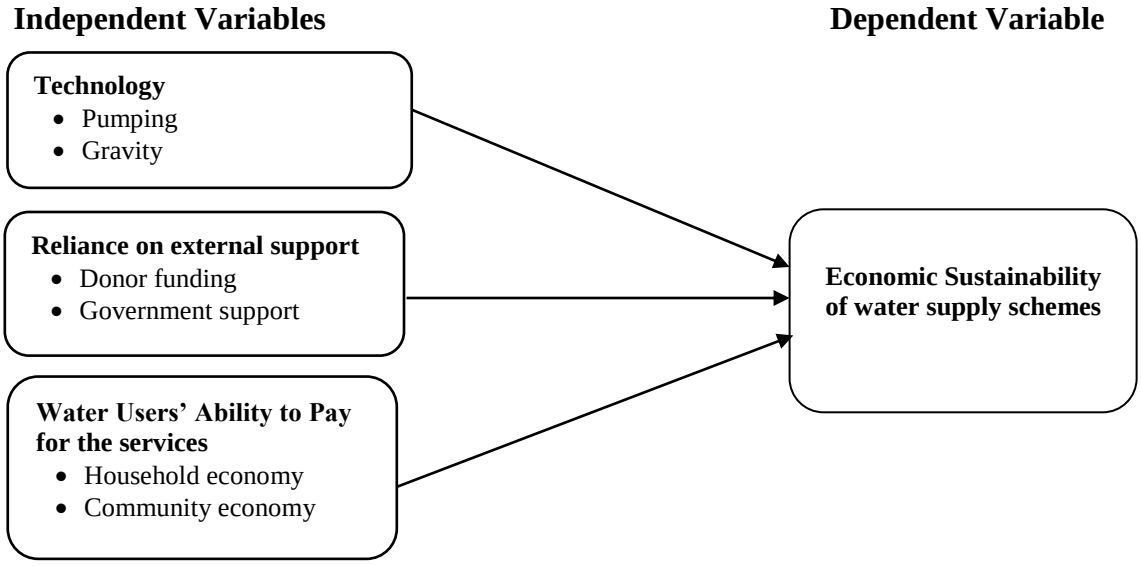

Figure 2.1: Conceptual framework

Source: Researcher's Own Model (2023)

2.7 Theoretical Framework

In this framework, the independent variables include the influence of technology, reliance on external support and water users' ability to pay for the service provided while economic sustainability is the dependent variable. The independent variables focus on the transparent water management theory where the influence of technology, external support and water users' ability to pay is operationalized.

2.8 Statement of Hypothesis

The following hypotheses are presented as per the objectives and research questions.

Null Hypothesis: (HO_1): Technology has no influence on water supply scheme's sustainability in Ngara District; *Alternative Hypothesis:* (HA_1): Technology has influence on water supply scheme's sustainability in Ngara District.

Null Hypothesis: (HO_2): Reliance on external support does not influence water supply scheme's sustainability in Ngara District; *Alternative Hypothesis:* (HA_2): Reliance on external support influences water supply scheme's sustainability in Ngara District.

Null Hypothesis: (HO_3): Water users' ability to pay for the services does not influence water supply scheme's sustainability in Ngara District; *Alternative Hypothesis*: (HA_3): Water users' ability to pay for the services influences water supply scheme's sustainability in Ngara District.

2.9 Summary

The chapter has provided the review of literatures resulting into the gap fulfillment. The relationship between the dependent and independent variable is established to aid in producing important issues for the study. However, the hypothesis were tested for the purpose of affirming or rejecting them. The chapter that follows is the research methodology.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Chapter Overview

This chapter presents the research philosophy, design and approach, the surveyed population, area of the survey, sampling design and procedures, variables and their measurements, methods of data collection, data processing and analysis, and ethical issues.

3.2 Research Philosophy

Research philosophy is a belief about how data about a phenomenon should be gathered, analyzed and used (Cresswell, 2018). Four main trends of research philosophy are discussed namely the positivist research philosophy that claims that the social world can be understood objectively where the scientist is an objective analyst; the interpretivism research philosophy that states that based on the principles it is not easy to understand the social world and the social world can be interpreted subjectively. Yet, the pragmatist research philosophy deals with the facts and claims that the choice of research philosophy is mostly determined by the research problem where the practical results are considered important as researchers have freedom of choice; and realistic research philosophy that is based on assumptions that are necessary for the perception of the subjective nature of the human (Greene et al., 2010). In this study, a pragmatic philosophy was used as it focuses on freedom of choice of approaches. Moreover, this study used a mixed approach that utilizes both quantitative and qualitative approaches.

3.3 Research Design

This study adopted a cross-sectional research design. This design utilized the questionnaire and interview guide to solicit information. According to Zheng (2015) cross-sectional research design is a research design in which the researcher investigates the state of affairs in a population at a certain point in time. Very often, the elements in the sample surveyed are selected purposively or at random to make inference about the population as a whole.

Cross-sectional design is especially useful in situations where contextual conditions of the event being studied are critical and where the researcher has no control over the events as they unfold (Cresswell, 2009). Cross-sectional design makes use of multiple methods of data collection such as questionnaires, interviews, FGDs, document reviews, archival records, direct and participant observations and subsequently thick descriptions of the phenomena under study (Yin, 2003).

3.4 Research Approach

The researcher used a mixed approach focusing on qualitative and quantitative approaches. Qualitative approach aims to explore and to discover issues because very little is known about the problem. It uses soft data and gets rich data (Cresswell, 2009). According to Yin (2003) qualitative approach is designed to help researchers understand the social and cultural contexts within which people live and work. Further, quantitative approach makes use of questionnaires, surveys and experiments to gather data that is revised and tabulated in numbers, which allows the data to be characterised by the use of statistical analysis (Yin, 2003). Quantitative researchers

measure variables on a sample of subjects and express the relationship between variables using effective statistics such as correlations, relative frequencies or differences between means. Their focus is to a large extent on the testing of theory (Kothari, 2004).

3.5 Area of Research

This study was conducted in Ngara District Council, Kagera. The reason for conducting the study is that challenges may or may not be restricted in Ngara District with regard to water supply schemes as a few or no studies have been done to examine such factors including external support, water users' ability to pay for the service and availability of technology to enable thorough sustainability of projects. It is from that backdrop that this study aimed at examining the factors influencing economic sustainability of water supply schemes in rural areas with reference to Ngara District Council.

3.6 Study Population

A target population is a large collection of individuals or objects (Cresswell, 2009). Moreover, the target population refers to the total number of items about which the information is desired (Kothari, 2004). In this study the target population included the Board of Trustees and 282 COWSOs members (Ngara District Water Supply Report, 2021).

3.7 Sample Size

A sample is a part of the population from which it was drawn. Sekaran (2003) advises that too large a sample size could become a problem and recommended

sample sizes between 30 and 500. Yamane (1967) formula was applied in determining the appropriate portion of respondents to represent the study population: where *n* is the sample size, *N* is the total target population in this case the 282 population size obtained (Ngara District Water Supply Report, 2021), and *e* is the error rate in this case 10%. The sample size for this study was calculated as shown below.

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

N = the Total Population

e = the margin of error (10% has been used to obtain the best sample given the population size)

n = the sample size

n = 282/1+282 (0.01)

n = 73.8

Therefore, the sample size is **74** respondents.

3.8 Sampling Procedures

Sample technique is the procedure used to select people, places or things to study in the target area (Yin, 2003). In this study purposive and simple random sampling was applied. Purposive sampling is a non-probability sampling, which refers to sampling procedures where the sample for the study is deliberately selected by the researcher. In this respect, elements of the population have no equal and known chance of being selected into the sample (Saunders et al., 2007). Purposive sampling was used for the Board of Trustees members in order to attain the study objectives as these respondents possess key information regarding the subject matter.

On the other hand, simple random sampling was used to select COWSOs staff where each member of staff had a chance of being chosen. In this study a complete list of members was provided and a rotary system was used to select the needed respondents (Saunders et al., 2007). Pieces of paper with Yes or No were used where those who chose the Yes papers were called to answer questions regarding the matter.

3.9 Methods of Data Collection

In this study, primary data were collected through questionnaires and interview guide. Creswell (2009) defines a questionnaire as a data collection instrument consisting of a series of questions and other prompts for the purpose of gathering information from respondents and is often designed for statistical analysis of the response. In this study, the researcher applied a structured questionnaire to collect data from COWSOs staff members. These questionnaires was self-administered and managed with drop and pick method.

Interview guide was administered for the Board of Trustees members. This is considered appropriate for this study as it enables one to obtain and elaborate answers to open ended questions from the respondents. Interviews are methods of gathering information through oral quiz using a set of preplanned core questions. Yin (2003) states that the interview tool is a very important source of getting information and it is supportive in administering cross-sectional study related matters as the study design indicates.

3.10 Reliability and Validity Analysis

3.10.1 Reliability Analysis

Reliability analysis was subsequently done using Cronbach's Alpha which measures the internal consistency by establishing if certain items within a scale measured the same construct. Further, a pilot study was carried out to determine the reliability of the questionnaires. Kothari (2009) noted that the accepted alpha value is 0.7, thus forming the study's benchmark. In this study, the Cronbach Alpha was 0.90.

3.10.2 Validity Analysis

Internal validity was achieved by ensuring that questionnaire items answered the research questions. Expert opinion was also sought from the supervisor in order to ensure validity of the tools towards the research findings. Then a pilot study was carried out to test the tools (questionnaires) for their validity.

3.11 Data Processing and Analysis

The researcher embarked on data analysis process after collecting data from the field that involved identifying common views from the respondents' description of their experiences. The responses to the close-ended items were assigned codes and labels. Frequency counts of the responses were obtained to generate information about the respondents and to illustrate the general trend of findings on the various variables that were under investigation. Quantitative data were analyzed descriptively using frequencies and percentages through Statistical Packages for Social Science (SPSS Version 20).

Qualitative data from interviews were coded and analysed through content analysis where themes and emerging patterns were coded from the interview transcripts. Content analysis involved transcribing all information from verbal discussions with informants followed by breaking the recorded information into meaningful smallest units of thematic information, subjects and tendencies and presented as a text.

However, inferential statistics using multiple regression analysis was used. Here the researcher was interested in measuring the effect of each independent variable on dependent variable.

The following regression model was used:

$$\mathbf{Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon}$$

Whereby:

Y = Dependent Variable (Economic Sustainability)

β_0 = y intercept (Constant)

β_1 = regression coefficient for the influence of technology

β_2 = regression coefficient for external support

β_3 = regression coefficient for users' ability to pay for the services

X_1 = Influence of technology

X_2 = external support

X_3 = users' ability to pay

ε = error term

3.11.1 Assumptions of Multiple Regression

Multiple regression analysis takes a number of assumptions about the collected data (Pallant, 2005). Some of the assumptions include; Linearity assumption, Normality assumption, Autocorrelations assumption, Multicollinearity assumption and Multiple linear regression analysis.

Linearity Assumption: This assumption requires that, relationship between dependent and independent variables should be linear in nature. Pearson correlation was used to check this assumption.

Normality Assumption: This assumption demands the independent variables errors to be normally distributed. Skewness and Kurtosis were employed to test normality. Moreover, all variables errors are assumed normally distributed as per rule of thumb for Skewness-Kurtosis of ± 2.58.

Autocorrelations Assumption: Autocorrelations means that errors between independent variables remain independent (Osborne and Waters, 2002). Durbin-Watson was used to check this assumption. Moreover, Field (2009) notes that, Durbin-Watson guarantees low autocorrelations when its coefficient lies between 1.5 and 2.5.

Multicollinearity Assumption: To test this assumption, the Variance Inflation Factor (VIF) and Tolerance Rate was determined. VIF and tolerance conform to the thumb rule which implies extremely low collinearity between independent variables.

Stevens (2009) suggests that, low VIF and large tolerance implies presence of low multicollinearity. Tolerance rate coefficient ranges between 0 and 1 whereas VIF ranges between 1 and 10.

Multiple Linear Regression Analysis: This assumption states that the findings of the regression analysis ought to indicate its R Square variable implying that, independent variables explain the percentage of the model variations. The results indicated that, the model is statistically significant at ($p < 0.05$).

3.12 Ethical Considerations

The researcher sought to fulfill all necessary procedures in order to conform to the ethical standards of research. The researcher sought for permission from the Regional Administrative Secretary for Kagera Region and the respective District Executive Director, Ngara before carrying out the research. All information obtained in this research was strictly used for academic purposes and respondents were assured of the confidentiality of the information given. Moreover, anonymity together with accessibility to research information was observed. Treatment was done according to the organisational protocol for the management of data collection.

CHAPTER FOUR

RESULTS AND DISCUSSION OF FINDINGS

4.1 Chapter Overview

This chapter presents the results and discussions arising from the study that was done in Ngara District, Kagera Region. It first presents the response rate, then demographic information and thereafter the objectives follow.

4.2 Response Rate

In this study, 60 questionnaires were distributed among COWSOs staff and were administered in terms of drop and pick method. All questionnaires were filled and collected to assume 100% response rate. Moreover, all 14 board members were reached and provided their opinions on the in-depth interview administered to them.

4.3 Demographic Information

The demographic characteristics of respondents included; gender, age, length of service and employment status of the respondents. The results in Table 4.1 show that with regard to gender; males occupied 70% while females occupied 30%. More so, the age distribution showed that those who were under 20 years occupied 10%, those between 21 to 30 years were 13.3%, those between 31 to 40 years were 16.7%, those between 41 to 50 years were 53.3% and those who were above 50 years were 6.7%. On the other hand, respondents were found to have worked for different years as those who had worked for less than 2 years were 3.3%, those who had worked for 3 to 5 years were 20% while those who had worked more than 5 years were 76.7%.

Additionally, respondents who worked as permanent workers were 86.7% and those who worked as casual labourers were 13.3%.

Table 4.1: Demographic characteristics

Category	Frequency	Percentage %
Gender		
Male	42	70
Female	18	30
Age (in yrs)		
Under 20	06	10.0
21-30	08	13.3
31-40	10	16.7
41-50	32	53.3
Over 50	04	06.7
Length of Service (in yrs)		
Less than 2	02	03.3
3-5	12	20.0
More than 5	46	76.7
Employment Status		
Permanent	52	86.7
Casual	08	13.3

4.4 Descriptive Statistics

4.4.1 The Extent to which Technology influences Water Supply Schemes' Sustainability

The first objective of the study examined the extent to which technology influences water supply schemes' sustainability in Ngara District Council. Questionnaires were administered to COWSOs staff therefore; the results are summarized in Table 4.2 as hereunder.

Table 4.2: Influence of technology

Statements	Strongly agree %	Agree %	Not sure %	Disagree %	Strongly disagree %
Updated technology enhances economical pumping of water	90	10	0	0	0
Updated technology enhances the use of gravity water towards economic sustainability	80	20	0	0	0
Operation and maintenance have been done in a manner that brings about economic sustainability of water schemes due to technology usage	70	0	0	30	0
Operation and maintenance determines which operations drive value creation due to technology usage	80	20	0	0	0
Updated technology has alleviated risks in assuming economic sustainability	60	20	20	0	0

The results in Table 4.2 show that 90% of respondents strongly agreed while 10% of respondents agreed that updated technology enhances the pumping of water to enable users utilize water economically. This implies that in the studied area pumping technology for water to users has been practised something that enables users' access water in a manner that cultivates a sense of sustainability of water usage. The statement above is in contrast with Tonga (2017) who reported that rural water supply systems in developing countries are categorized by their infrastructure and technology shortfall with a lack of knowledge and experience among those operating or managing the systems. Yet, water technology whether pumping or gravity fail to sustain rural water supply projects due to lack of effective involvement between local actors (local communities) and external actors (donors or agencies).

One of the interviewees was of the following view;

> *In utilizing the technology, its choice can have a significant impact on sustainability of a water supply system where, community involvement*

> *and ownership may aid the sustainability of the technology used (Interviewee, 1).*

On the other hand, the results in Table 4.2 show that 80% of respondents strongly agreed while 20% of respondents agreed that updated technology enhances the use of gravity water towards economic sustainability among users. This implies that gravity as a technology was used in the studied area as their main source being the spring that delivers water to domestic water points using public kiosks that are used to provide water to users at a given fee something that guaranteed water users towards ensuring availability and sustainability. The statement above concurs with Goal 6 of the sustainable development goals that emphasizes the availability and sustainability of water and sanitation for all humankind although rural areas still experience lower levels of access to improved water.

One of the interviewees was of the following view;

> *Water that is accessed through gravity has been of help among users. More so, this gravity technology has been hampered by environmental degradation of water paths where community involvement in conserving the environment has been a challenge (Interviewee, 2),*

Furthermore, the results in Table 4.2 show that 70% of respondents strongly agreed that operations and maintenance have been in a manner that brings economic sustainability of water schemes due to various technology usages. This implies that for gravity use, the system does not need any source of non-renewable energy or complex equipment and parts but the environment that accelerates better use of water obtained from such a source. However, 30% of respondents disagreed that operations and maintenance have been in a manner that brings about economic sustainability of

water schemes due to technology usage especially when using pumping technology from the fact that the costs related to operations and maintenance have been higher leading to poor accessibility of water services that are accompanied with poor services. The statement above is in line with Tonga (2017) who reported that where pumping technology has been used, local artisans could not solve the subsequent challenges but only solve minor technical problems like replacement of the broken valves and pipes leaving issues pertaining to the pumps and engines unsolved.

Another interviewee was of the following view;

> *Where there is pumping technology to get water, our local technicians have been unable to solve complex issues resulting into non-accessibility of water. Yet, with such complications that are unsolved, the water projects become non-functional early thus a need for proper maintenance from experienced experts is vital (Interviewee, 3).*

The statement above concurs with Mamburi (2014) who reported that sustainability of rural water supply systems using various technologies would be viable when there is a result of communities owning and managing their schemes through user fees, existence of management that caters for villagers who become part and parcel of protection of the water points and where communities are able to recover the costs of operation and maintenance regarding the type of technology available for use.

Similarly, the results in Table 4.2 show that 80% of respondents strongly agreed while 20% of respondents agreed that operation and maintenance determine which operations drive value creation due to technology usage. This implies that the choice of technology is important in creating synergy among water users with the technology used. Moreover, competence and skills to manage the operations are

needed for the proper maintenance of the facilities. This goes hand in hand with finding the cheapest solutions that are accompanied with little costs of operation and maintenance. The statement above concurs with Olela and Wanyonyi (2018) who reported that the effect of demand on local technology demands solutions that are in line with operation and maintenance of the technology. Also, this is in line with Water Aid (2010) report that stated that sustainability of any water project depends on the benefits brought about by the technology used that brings about quick solutions that are manageable by the community around. Therefore, sustainability results into lasting benefits with no time limit set on those continued services, behaviour changes and outcomes.

Additionally, the results in Table 4.2 show that 60% of respondents strongly agreed while 20% of respondents agreed that updated technology has alleviated risks in assuming economic sustainability from the fact that users become comfortable in using the technology they chose while being able to allocate funds for maintenance. Moreover, 20% of respondents were not sure of the matter. The findings above concur with Olela and Wanyonyi (2018) who asserted that the sustainability of water supply projects depends on the socio-economic factors, socio-cultural factors, and the choice of technology, water tariffs and specialized training of service teams that enable thorough functioning of projects.

One of the interviewees was of the following view;

> *The technology used to access water in rural areas has been a cornerstone of sustainability of projects. However, community participation in operations and maintenance has been emphasized in order to perpetuate the sustainability achieved (Interviewee, 4).*

Generally, the results show that technology use such as pumping and gravity influenced water supply schemes in Ngara District as the updated technology enhanced the economical pumping of water, enhanced the use of gravity water towards economic sustainability while making sure that operation and maintenance were being done in a manner that brought about economic sustainability of water schemes due to technology usage. More so, operation and maintenance determined which operations drive value creation on the technology used. It is from such value created, updated technology alleviated risks that led to economic sustainability of water supply schemes in the studied area.

4.4.2 Reliance on External Support influences Water Supply Schemes' Sustainability

The second objective of the study determined how reliance on external support influences water supply schemes' sustainability in Ngara District Council. Questionnaires were administered to COWSOs staff and the results are summarized in Table 4.3 below.

Table 4.3: Influence of external support

Statements	Strongly agree %	Agree %	Not sure %	Disagree %	Strongly disagree %
Donor funding has minimized the economic sustainability of water projects	80	0	0	20	0
Reliance on government subsidy has resulted into non-economic sustainability of water schemes	70	0	10	20	0
Performance of water supply schemes has been affected by the need for external funding	0	80	0	0	20
There has been no cost savings due to external support	75	0	20	5	0

The results in Table 4.3 show that 80% of respondents strongly agreed that donor funding has minimized the economic sustainability of water projects in Ngara District. This implies that reliance on donor funding resulted into reluctance of water users to manage their own projects thereby leading to non-sustainability of water projects. The statement above concurs with Tonga (2017) who asserted that 100% of Bahi and 98.2% of Chamwino communities declined to having shared knowledge of water supply technologies possibilities that would suit their water needs; meaning that donors and agencies made choices on their (local communities) behalf technologically, implemented water projects that were operated and maintained by donors something that brought about total reliance on donor funding.

One of the interviewees was of the following view;

> *The planning and implementing of many water projects in Ngara District has been on the part of donors or government initiated projects leaving communities without thorough participation. Upon completion and a need for maintenance, water users are called to participate something that brings challenges due to dependence syndrome cultivated (Interviewee, 5).*

Moreover, 20% of respondents disagreed that donor funding has minimized the economic sustainability of water projects but has been a steering plot that enabled water users to carry on with the operations and maintenance works on their own after project handling. Such activities included raising the funding systems that include tariff or fee collection in order to recover the costs for the support of the operations needed. Such dealings concur with the findings by Naughton (2017) who reported that economic sustainability of water supply systems was significantly related to community ownership and participation on funding the operations for the purpose of

increasing the sense of ownership where at least 20% of the system costs should be covered by water users.

On the other hand, the results in Table 4.3 show that 70% of respondents strongly agreed that reliance on government subsidy has resulted into non-economic sustainability of water supply schemes; with 10% of respondents being not sure on the matter. It was found that the subsidy provided by the government or non-government organisations resulted into non-payment of water services among users leading to poor performance of water projects. The statement above concurs with Kativhu *et al.* (2017) who asserted that some societies in Zimbabwe were not repairing minor breakdowns from the water projects handed to them as they relied on external support from non-governmental organisations to cover such costs that emanated from breakdowns. Moreover, 20% of respondents stated that reliance on government subsidy has not resulted into non-economic sustainability of water schemes but, a culture of top-down approach and the assumption that water users in rural areas are poor thus unable to run water projects have been the challenge towards sustainability. It was found that top-down approach resulted into non participation of water users in project initiation, planning and implementation something that was labelled as a full support that community members need no contribution whatsoever.

One of the interviewees was of the following view;

> *Reliance on government subsidy to run water supply schemes in Ngara District has been a norm where, water users become reluctant to contribute fees for the maintenance of the water projects. This has led to*

> *malfunctioning of water projects and their non-sustainability (Interviewee, 6).*

More so, the results in Table 4.3 show that 80% of respondents agreed that the performance of water supply schemes has been affected by the need for external funding something that undermines the community ownership of projects. This implies that, there has been a tendency to depend on external support leading to poor implementation of projects. The statement above is in line with Naughton (2017) who found out that dependence on external support under the community based management approach caused lack of scalability of water supply projects. Yet, 20% of respondents strongly disagreed that the performance of water supply schemes has been affected by the need for external funding but by the inability of some water users to pay for the fees needed when accessing the services. Other researchers point out issues such as lack of knowledge, higher maintenance costs and defaulting by beneficiaries. The statement above concurs with Nedjoh *et al* (2003) who argued that poor performance of water supply schemes is the result of lack of knowledge on maintenance costs, inadequate tariffs, poor financial management, high rates of defaulting by water beneficiaries and ineffective collection methods influenced negatively the ability of community projects to be financially sustainable.

Finally, the results in Table 4.3 show that 75% of respondents strongly agreed that there has been no cost savings due to external support while 20% of respondents were not sure on the matter. This implies that with much reliance on external funding, almost all water users operate water projects without considering the costs associated with the operations of the projects. It was found that money collected

through contributions or user fees may be misused and when failures occur; the minor repairs cannot be done leading to non-operation of projects. Moreover, 5% of respondents disagreed that there has been cost savings that are accompanied with external support from the fact that, community based management approach has enabled some water users to chip-in and manage funds that arise from their day to day fees.

One of the interviewees was of the following view;

> *In many instances, user fees have been utilized to curb minor repairs in water projects. Although there have been challenges in collecting them, water users who see the importance of being served have been active in paying their dues in time (Interviewee, 7).*

The above assertion concurs with Kirenga et al. (2018) who reported that the influence of external water funds on the sustainability of community managed rural water supply projects brings about a relationship between water sustainability, funding and management of rural water supply projects.

Generally, the results show that reliance on external support has influenced water supply schemes' sustainability from the fact that donor funding has minimized the economic sustainability of water projects while reliance on government subsidy contributes to non-economic sustainability of water supply schemes. Additionally, the performance of water supply schemes has been affected by the need for external funding where the absence of cost savings due to external support became vivid where money collected through user fees was found to be misused and when

breakdowns occur, minor repairs cannot be done leading to non-operation of water supply projects.

4.4.3 Water User's Ability to Pay for the Services influences Water Supply Schemes' Sustainability

The third objective of the study examined how water users' ability to pay for the services influences water supply schemes' sustainability in Ngara District Council. Questionnaires were administered to COWSOs staff and the results are summarized in Table 4.4 as hereunder.

Table 4.4: Water users' ability to pay for the services

Statements	Strongly agree %	Agree %	Not sure %	Disagree %	Strongly disagree %
The economic hardship experienced by water users result into inability to pay for the services	90	0	10	0	0
Poor community economy has facilitated the inability to pay for the services	80	0	0	20	0
Poor household economy has facilitated the inability to pay for the services	80	0	20	0	0

The results in Table 4.4 show that 90% of respondents strongly agreed that the economic hardship experienced by water users results into inability to pay for the services. It was found that water users in Ngara District are poor and unable to pay fully the fees charged something that result into inability to access and afford the services. Yet, 10% of respondents were not sure on the matter. This implies that the poor may spend more of their financial resources on medical services that result from poor water quality consumed. Therefore, if water users were to access and afford

improved water services, it would have saved time for collecting water and engage in productive activities that can enable them generate revenue sufficient for their households thereby improving household incomes while reducing medical expenses for health improvement. The statement above is in line with Merret (2002) who asserted that some causes for low readiness to pay for water supply services in many communities include hard economic life where households take greatest care over their household expenditures for consumption, politicians supporting non-payment, corruption by government officials, existence of a widely held view that certain public services should be free and unwillingness of government or the public water utility to exercise sanctions against non-payment because of the likely political or public health consequences. Also, the affirmations above concur with Ruijs *et al* (2008) who had a different view that fairness on pricing of water should be on the basis of affordability and socio-economic characteristics of the household. This is because water is essential for mere human survival. Therefore fairness in water user fee is essential to prevent negative consequences associated with the lack of access to safe and sufficient water supply and sustainability of community water projects.

Similarly, the results in Table 4.4 show that 80% of respondents strongly agreed that poor community economy has facilitated the inability to pay for the services. This perpetuates the reality in many rural households in Tanzania that live under 1$ a day something that necessitates the inability to pay for many services rendered. The statement above concurs with Mommen & Nekesa (2010) who argued that most users of rural water supplies are relatively poor with poor economy and not able to pay for water service without external support while external support available to

those poor communities can be from NGOs, local government institutions, national as well as the private sector. Moreover, it can be observed that payment of water charges develops a sense of ownership and empowerment among the water users. There is evidence that even the poorest and most underprivileged segments of the society are normally willing to pay for water supply so long as it is reliable.

One of the interviewees was of the following view;

> *I am unable to pay for water user fees charged by water supply authority in our town from the fact that I am poor. What I get does not fully enable the facilitation of my household expenditures in terms of food, schooling for my child etc. I opt to collect water in our community spring that is not safe for human consumption. This has also perpetuated water borne diseases that add to the challenges. So, the need for external support for such a service is vital (Interviewee, 8).*

The above statement contrasts with Cook (2017) who reported that the investments in water sector should focus on economic value of time and cost savings through improved water systems which would enable people to have ability to pay and use water for the saved time and costs in other productive activities which in turn boosts the chances of sustainably managing the systems.

20% of respondents disagreed and said that it is not the poor community economy that has facilitated the inability to pay for the water service but a wrong approach by government and donors to let households get served without payments for a long time. It was found that, many water projects were implemented and handed over to community members with no payment obligations hence creating a dependence syndrome. With such a habit, people have no choice than welcoming external

support to run the projects while paying nothing. So, when things changed, the poor households cannot access water services and become non-beneficiaries of community owned water supply organisations. The statement above concurs with Cook (2017) who reported that the ideological changes on water users could not empower community owned water supply organisations to manage water supply projects effectively, economically and sustainably in terms of serving the needy with technology adoption and use, non-reliance on external support and the ability of water users to pay for the services rendered.

Furthermore, the results in Table 4.4 show that 80% of respondents strongly agreed that the poor household economy has facilitated the inability to pay for the services with 20% of respondents being unsure on the matter. This implies that with poor household economy, the poor are unable to contribute towards water supply fees. The statement above is in line with Bannerjee and Morella (2011) who suggested that an average of 1.9% of household income is spent by rural dwellers on water services in Africa, which is below the commonly cited 3% - 5% affordability guideline. This therefore means that most Africans do not value the importance of water due to their low household expenditure on water. The assertion above is in line with a World Bank (2017) report that showed a challenge of financing rural water supply projects since these projects cannot recover costs, cost of operations and maintenance, capital maintenance, yet they collect revenues from the sale of water. Thus, the rural water schemes may require cost recovery in this line of thought where the government is usually called to fix broken parts or replace infrastructure without considering the life cost cycle approach. Therefore, scholars recommend payment for water as a

necessity for sustainability of water projects with the argument that borders on the fact that it is not possible for governments and donors to cover all the costs as users of water must share the burden.

One of the interviewees was of the following view;

> *The poor household economy has created failure of community owned water supply organisation projects to generate sufficient revenues resulting into non-repairs of such projects. Therefore, the poor households need to choose technologies that are cheaper and efficient while setting tariffs that can be managed by the poor due to the economic status of the society. This will enable the poor to afford the service rendered (Interviewee, 9).*

Yet, for a water service to be financially sustainable, the total costs should match with the total available money that can be collected from the poor households. In this sense, the affirmation by Baumann (2006) holds water from the fact that the inability of communities to collect sufficient revenue for repairs could reduce the life expectancy of installed water supplies as most rural water supply projects serve poor communities. While the question of whether such communities are actually able to pay for operations and maintenance of low cost technologies is often raised, research suggests that the willingness to pay is a more important issue than the ability to pay. This also adds on what Churchill (1988) argued for that most rural communities can afford to pay for the improved services, provided that appropriate technology is used as the rural communities are already spending large amount of time and energy on water collection.

Generally, the results show that water users' ability to pay for services influenced water supply schemes' sustainability from the fact that the economic hardship

experienced by water users resulted into water users' inability to pay for the services. Also, the poor community and household economy have facilitated water users' inability to pay for the services rendered. Therefore, to have fairness in water user fee is essential to prevent negative consequences associated with the lack of access to safe and sufficient water supply and sustainability of community water projects. This is cemented by Whittington *et al* (2008) who observed that, in rural communities cash flows are highly seasonal and have very little savings and this places many community water projects in a situation whereby they cannot generate enough of water user fee to cater for operation and maintenance of the established water systems.

4.5 Inferential Statistics

4.5.1 Assumptions of Multiple Regression

According to Pallant (2005) multiple regression analysis assumes a number of assumptions on the collected data. Some of the assumptions include; Linearity assumption, Normality assumption, Autocorrelation's assumption, Multicollinearity assumption and Multiple linear regression analysis.

4.5.1.1 Linearity Assumption

The assumption entails that the relationship between dependent and independent variables should be linear in nature. Pearson correlation was used to establish this assumption. The results show that the economic sustainability of water supply schemes has significant positive linear relationship with independent variables ($p < 1.000$) [1- Tailed]. Also, the relationship between the variable has a weak positive

value such that, technology (+ve), r (60) = 0.**210**, reliance of external support (+ve), r (60) = **0.100** and water users' ability to pay for the services (+ve), r (60) = 0**.091**, as shown in Table 4.5.

Table 4.5: Linearity assumption

Correlations					
		Economic sustainability of water supply schemes	Technology used	Reliance on External Support	Water user's ability to pay for the services
Pearson Correlation	Economic sustainability of water supply schemes	1.000	.210	.100	.091
	Technology used	.210	1.000	.131	.168
	Reliance on External Support	.100	.131	1.000	.120
	Water users' ability to pay for the services	.091	.168	.120	1.000
Sig. (1-tailed)	Economic sustainability of water supply schemes	.	.021	.002	.040
	Technology used	.021	.	.000	.000
	Reliance on External Support	.002	.000	.	.000
	Water users' ability to pay for the services	.040	.000	.000	.
N	Economic sustainability of water supply schemes	60	60	60	60
	Technology used	60	60	60	60
	Reliance on External Support	60	60	60	60
	Water users' ability to pay for the services	60	60	60	60

4.5.1.2 Normality Assumption

This assumption demands the independent variables' errors to be normally distributed. Skewness and Kurtosis were employed to test normality. Moreover, all variables' errors are assumed normally distributed as per rule of thumb for Skewness-Kurtosis of ± 2.58. The test is depicted in Table 4.6

Table 4.6: Skewness and Kurtosis coefficients

Variable	N	Skewness		Kurtosis	
	Statistic	Statistic	Std. Error	Statistic	Std. Error
Influence of Technology	60	**0.701**	.510	**0.209**	.102
Reliance on External Support	60	**0.310**	.510	**0.242**	.190
Water users' ability to Pay for the Services	60	**0.221**	.510	**0.204**	.103

4.5.1.3 Autocorrelations Assumption

According to Osborne and Waters (2002) autocorrelations means that errors between independent variables remain independent. Therefore, Durbin-Watson was used to check this assumption. Moreover, Field (2009) notes that, Durbin-Watson guarantees low autocorrelations when its coefficient lies between 1.5 and 2.5. Table 4.7 shows the results.

Table 4.7: Durbin-Watson test

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
	.589[a]	.679	.651	1.004	.056	1.407	3	56	.141	1.390

ı. Predictors: (Constant), Water users' ability to pay for the services, Technology used, Reliance or External Support

). Dependent Variable: Economic sustainability of water supply schemes

4.5.1.4 Multicollinearity Assumption

To test this assumption, the Variance Inflation Factor (VIF) and Tolerance Rate were determined. VIF and tolerance conform to the rule of thumb which implies extremely low Collinearity between independent variables. Stevens (2009) suggested that, low VIF and large tolerance implies presence of low multicollinearity. Tolerance rate

coefficient ranges between 0 and 1 whereas VIF ranges between 1 and 10. Table 4.8 shows the results.

Table 4.8: Multicollinearity assumption

odel		Collinearity Statistics	
		Tolerance	VIF
1	(Constant)		
	Technology used	.312	3.170
	Reliance on external support	.281	2.938
	Water users' ability to pay	.267	2.619

4.5.2 Multiple Linear Regression Analysis

The regression analysis findings ought to indicate its R Square variable implying that, independent variables explain the percentage of the model variations. The results indicate that, the model was statistically significant at (p<0.05). Table 4.9 shows the analysis.

Table 4.9: Regression model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Sig
1	.589[a]	.679	.651	1.102	0.003

The regression analysis indicates that the coefficient of correlation R was 0.589 an indication of positive relationship between variables. Coefficient of adjusted determination R^2 was 0.679 which changes to 67.9% an indication of changes of dependent variable that can be explained by technology used, reliance on external support and water users' ability to pay for the services. The residual of 32.1% can be explained by other variables beyond the scope of the current study. This is in

concurrence with Davis et al (2016) who reported that changes in economic sustainability of water supply schemes is the outcome of technology used, reliance on external support and water users' ability to pay for the services.

Table 4.10: Regressions Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.541	.187		1.124	.000
	Technology used	.287	.127	.202	.581	.001
	Reliance on External Support	.126	.103	.123	.706	.000
	Water users' ability to pay	.227	.301	.201	.712	.002

Regression coefficients on Table 4.9 suggest that, all variables were significant predictors (p<0.05) of the model. This informs that one unit increase of technology used explains **0.287** increase in economic sustainability of water supply schemes. An increase in one unit of reliance on external support suggests **0.126** unit decrease of economic sustainability of water supply schemes. Also, one unit increase of water users' ability to pay for the services explains **0.227** decrease in economic sustainability of water supply schemes.

The following regression model was used

$$\mathbf{Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon}$$

Whereby:

Y = Dependent Variable (Economic Sustainability of water supply

schemes)

β_0 = y intercept (Constant)

β_1 = regression coefficient for the influence of technology

β_2 = regression coefficient for external support

β_3 = regression coefficient for users' ability to pay for the services

X_1 = Influence of technology

X_2 = external support

X_3 = users' ability to pay

ε = error term

Hence,

$Y = 1.541 + 0.287\ \beta_1 + 0.126\ \beta_2 + 0.227\ \beta_3 + \varepsilon$

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Chapter Overview

This chapter presents the conclusion and recommendations arising from the study findings. It starts with the conclusion; recommendations and finally recommendation for further studies.

5.2 Conclusion

Water is important for human survival, health and dignity and is classified as a basic resource for human development although the world's freshwater resources are under increasing pressure. This study examined the factors influencing economic sustainability of water supply schemes in rural areas with reference to Ngara District Council. More so, the conclusion is prepared as per objectives as follows;

5.2.1 The extent to which Technology influences Water Supply Schemes' sustainability

The results show that technology use such as pumping and gravity influenced water supply schemes in Ngara District as the updated technology enhanced the economical pumping of water and the use of gravity water towards economic sustainability while making sure that operation and maintenance are done in a manner that brings about economic sustainability of water schemes due to technology usage. More so, operation and maintenance determined which operations drive value creation on the technology used. It is from such value created through

updated technology that alleviated risks leading to economic sustainability of water supply schemes.

5.2.2 Reliance on External Support that influence Water Supply Schemes' sustainability

The results show that reliance on external support has influenced water supply schemes' sustainability from the fact that donor funding has minimized the economic sustainability of water projects while reliance on government subsidy contributes to non-economic sustainability of water supply schemes. Additionally, the performance of water supply schemes has been affected by the need for external funding where the absence of cost saving due to external support became vivid where money collected through user fees was found to be misused such that when breakdowns occur, minor repairs cannot be done leading to non-operation of water supply projects.

5.2.3 Water Users' Ability to Pay for the Service that Influence Water Supply Schemes' Sustainability

Similarly, the results show that water users' ability to pay for services influenced water supply schemes' sustainability from the fact that the economic hardship experienced by water users resulted into water users' inability to pay for the services. Also, the poor community and household economy have facilitated water users' inability to pay for the services rendered. Therefore, to have fairness in water user fee is essential to prevent negative consequences associated with the lack of access to safe and sufficient water supply and sustainability of community water projects. This

is cemented by Whittington *et al* (2008) who observed that, in rural communities cash flows are highly seasonal and have very little savings and this places many community water projects in a situation where they cannot generate enough of water user fee to cater for operation and maintenance of the established water systems.

5.2.4 Multiple Regression Analysis

The regression analysis indicates that the coefficient of correlation R was 0.589 an indication of positive relationship between variables. Coefficient of adjusted determination R^2 was 0.679 which changes to 67.9% an indication of changes of dependent variable that can be explained by technology used, reliance on external support and water users' ability to pay for the services. The residual of 32.1% can be explained by other variables beyond the scope of the current study. This is in concurrence with Davis et al (2016) who reported that changes in economic sustainability of water supply schemes is the outcome of technology used, reliance on external support and water users' ability to pay for the services.

5.3 Recommendations

The subsequent recommendations are put forward based on conclusion as follows;

i) With regard to the influence of technology; operation and maintenance determined which operations drive value creation on the technology used. It is recommended that the value created by updated technology alleviated risks that led to economic sustainability of water supply schemes; thus its enhancement is vital.

ii) Similarly, with regard to the reliance on external support the performance of water supply schemes has been affected by the need for external funding to assist in operations. It is recommended that rural communities can afford to pay for the improved services, provided that appropriate technology is used as the rural communities are already spending large amount of time and energy on water collection.

iii) Furthermore, with regard to the water users' ability to pay for the services due to economic hardship experienced by water users; it is recommended that fairness in water user fee is essential to prevent negative consequences associated with the lack of access to safe and sufficient water supply and sustainability of community water projects.

5.4 Recommendation for Further Studies

The study examined the factors influencing economic sustainability of water supply schemes in rural areas with reference to Ngara District Council. It is advised that further studies be done on the following issues:

Examine the effect of joining together locally suitable technologies with conventional technologies on the sustainability of community water supply schemes' projects.

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APPENDICES

Appendix 1: Questionnaire COWSOs Staff

Dear Prospective Respondent;

This questionnaire is designed to solicit information from you. The purpose of this research is for the academic award of a Master's degree in project management from the Open University of Tanzania. Kindly fill in the required information as per the researcher's requirement.

Gender: Male ( ), Female ( )

Age: under 20 ( ), 21 to 30 ( ), 31 to 40 ( ), 41 to 50 ( ), over 50 ( )

Length of services with the organization (In years) ----------,

Employment status: Permanent ( ), Casual ( )

For each of the following aspects shown below rate your level of agreement using the following Likert type scale provided:

Agreement: 1= strongly agree, 2= Agree, 3= Not sure, 4= Disagree, 5= strongly disagree

No.	Influence of Technology	Level of agreement				
1.	Updated technology enhances pumping of water in an economic terms	1	2	3	4	5
2.	Updated technology enhances the use of gravity water towards economic sustainability	1	2	3	4	5
3.	Operation and maintenance have been done in a manner that bring about economic sustainability of water schemes due to technology usage	1	2	3	4	5
4.	Operation and maintenance determines which operations drive value creation due to technology usage	1	2	3	4	5
5.	Updated technology has alleviated risks in assuming economic sustainability	1	2	3	4	5
	Influence of External Support	**Level of agreement**				
6	Donor funding has minimized the economic sustainability of water projects	1	2	3	4	5
7	Reliance of government subsidy has resulted into non-economic sustainability of water schemes	1	2	3	4	5
8	Performance of water supply schemes has been affected by the need from external funding	1	2	3	4	5
9	There has been no cost savings due to external	1	2	3	4	5

	support					
	Influence of Water Users' Ability to pay for the services	**Level of agreement**				
10	The economic hardship experienced by water users result into inability to pay for the services	1	2	3	4	5
11	Poor community economy has facilitated the inability to pay for the services	1	2	3	4	5
12	Poor household economy has facilitated the inability to pay for the services	1	2	3	4	5

Appendix 2: Interview Guide for Board Members

i) To what extent does technology influence water supply scheme's sustainability in Ngara district?

ii) How does the reliance on external support influence water supply scheme's sustainability in Ngara district?

iii) Do water users' ability to pay for the service influence water supply scheme's sustainability in Ngara district

Appendix 3: Ethical Documents

THE UNITED REPUBLIC OF TANZANIA

MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY

THE OPEN UNIVERSITY OF TANZANIA

Ref. No OUT/ PG202087506 **12th October, 2022**

Regional Administrative Secretary,
Kagera Region,
P.O Box 299,
KAGERA.

Dear Regional Administrative Secretary,

RE: RESEARCH CLEARANCE FOR MR SIMEON WILSON NDYAMUKAMA, REG NO: PG202087506

2. The Open University of Tanzania was established by an Act of Parliament No. 17 of 1992, which became operational on the 1st March 1993 by public notice No.55 in the official Gazette. The Act was however replaced by the Open University of Tanzania Charter of 2005, which became operational on 1st January 2007.In line with the Charter, the Open University of Tanzania mission is to generate and apply knowledge through research.

3. To facilitate and to simplify research process therefore, the act empowers the Vice Chancellor of the Open University of Tanzania to issue research clearance, on behalf of the Government of Tanzania and Tanzania Commission for Science and Technology, to both its staff and students who are doing research in Tanzania. With this brief background, the purpose of this letter is to introduce to you **Mr. Simeon Wilson Ndyamukama, Reg. No: PG202087506)** pursuing **Master of Project Management (MPM**). We here by grant this clearance to conduct a research titled **"Factors Influencing Economic Sustainability of Water Supply Schemes in Rural Areas in Tanzania: A Case of Ngara District"**. He will collect his data at Ngara District in Kagera Region from 13th October to 13th November, 2022.

4. In case you need any further information, kindly do not hesitate to contact the Deputy Vice Chancellor (Academic) of the Open University of Tanzania, P.O.Box 23409, Dar es Salaam. Tel: 022-2-2668820.We lastly thank you in advance for your assumed cooperation and facilitation of this research academic activity.

Yours sincerely,

THE OPEN UNIVERSITY OF TANZANIA

Prof. Magreth S.Bushesha

For: VICE CHANCELLOR

Kinondoni Biafra, Kawawa Road; P.O 23409; Dar es Salaam; Tel: +255 22 2668 445;
E-Mail:vc@out.ac.tz|| Website:www.out.ac.tz

PREDIDENT'S OFFICE
REGIONAL ADMINISTRATIVE SECRETARY AND LOCAL GOVERNMENT

REGIONAL KAGERA
Addres & Telephone "REGCOM"
Telegraphic: (028) 2220215-18
Fax No. (028) 2222341
(028) 2221356
E-mail: ras.kagera@tamisemi.go.tz
Website:www.kagera.go.tz

Luhangisa Road
P.O. BOX. 299,
35180 – KAGERA.
TANZANIA

In reply please quote:

Ref. No:DA.194/228/01'O'/247 20 Oktoba, 2022

District Administrative Secretary,
P.O. Box 20,
NGARA.

RE: **RESEARCH PERMIT FOR MR. SIMEON WILSON NDYAMUKAMA**

The reference is made to the above captioned subject.

2. *I hereby introduce to you Mr. Simeon Wilson Ndyamukama a student form Open University of Tanzania.*

3. The named student is currently in our Region researching of **'Factors Influencing Economic Sustainability of Water Supply Schemes in Rural Areas in Tanzania'** at Ngara District.

4. The Regional Administrative Secretary therefore, requests you to allow the mentioned student to collect data in Ngara District as from 13th Oktoba, 2022 to13th November, 2022.

Please assist her to accomplish her task.

Emily K. Ishengoma
For: **REGIONAL ADMINISTRATIVE SECRETARY**
KAGERA

CC: Head of Department,
Open University of Tanzania,
Kinondoni Biafra,
Kawawa Road,
P.O. Box 23409,
DAR ES SALAAM.

JAMHURI YA MUUNGANO WA TANZANIA
OFISI YA RAIS
TAWALA ZA MIKOA NA SERIKALI ZA MITAA

Anwani ya Simu ADMIN
Nambari ya Simu: 028-2226018
Fax Na: 028-2226128

Unapojibu tafadhali taja:

Ofisi ya Mkuu wa (W),
S.L.P. 20,
NGARA.

Kumb. Na. NG/E.1/VOL.II/175 **Tarehe: 21/10/2022**

Meneja RUWASA,
S.L.P. 237,
Ngara.

YAH: **KIBALI CHA KUFANYA UTAFITI.**

Nimepokea barua ya Katibu Tawala wa Mkoa Kagera **Kumb. Na. DA.194/228/01 '0'/247** ya **tarehe 20/10/2022** ikihusu somo tajwa hapo juu.

(2) Barua husika inamtambulisha Bw. Simon W. Ndyamukama ambaye ni Mwanachuo wa Chuo Kikuu Huria Tanzania, kwa sasa anafanya utafiti **"Factors Influencing Economic Sustainability of Water Supply Schemes in Rural Areas in Tanzania"** katika Wilaya ya Ngara.

(3) Utafiti unaanza **tarehe 13/10/2022 hadi Novemba, 2022** tafadhali apokelewe na kupewa ushirikiano ili akamilishe kazi yake.

Natanguliza shukrani.

Tibaijuka V.J
KATIBU TAWALA (W)
NGARA

Nakala: Bw. Simon W. Ndyamukama - Mwanachuo.

MANUSCRIPT