ASSESSING THE IMPLICATIONS OF TECHNOLOGY ON SUSTAINABILITY OF RURAL WATER SUPPLY IN DODOMA, TANZANIA

EPHRAIM M. TONYA

DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE MASTERS DEGREE OF PROJECT MANAGEMENT OF THE OPEN UNIVERSITY OF TANZANIA

2015

CERTIFICATION

The undersigned certifies that he has read and hereby recommends for acceptance by the Open University of Tanzania a dissertation paper entitled assessing the implications of water supply technology on the sustainability of rural water supply in Dodoma region, Tanzania, in fulfillment of the requirements for the Masters of Project Management of the Open University of Tanzania.

é ..

Dr. Salum Mohamed

Supervisor

é é é é é é é é .é é é é é é ..

Date

COPYRIGHT

DECLARATION

I, **Ephraim M. Tonya,** do hereby declare that this is my own original work and that has not been presented and will not be presented to any other University for a similar or any other degree award.

é é é é é é é é é é é é é é é é é .

Ephraim M. Tonya

é é é é é .é é é é é é é

Date

DEDICATION

This work is dedicated to my beloved wife Advocate Margaret Alex Mbona and our daughter Livia Ephraim Tonya *"Nothing could have been possible without your love"*

ACKNOWLEDGEMENT

Many people have provided support in writing this research and the names that will appear in this part are not in order of priority. I would like to thank the Almighty God for the strength and good health during the whole course of my study. It would have been impossible to concentrate much in writing this work without a good education foundation that has been laid down by my parents, Ephrem B. M Tonya (Snr) and Hawa A. Msuya. No words can suffice to express my thanks you. Thanks to you my lovely wife Margaret A. Mbona thanks for being passionate and a good wife during the whole period of study and my daughter Livia E. Tonya, you are still young to understand the strength you are giving me every time I think of you.

I find myself wordless when I remember the material and skills support from my supervisor, Dr. Salum Mohamed from the Open University of Tanzania. Thank you for your guidance all the way towards writing this research. To the acting District Water Engineers, Mr. Buhoro of Bahi, Mr. Mzuli of Chamwino and your officers, I say thank you!

To the communities where I happened to survey during data collection, the village leaders and development committees represented by the Village Water Committees, Community Owned Water Supply Organizations, MAMADO; you are so many that is hard to write names of everyone of you here but I value so much your contribution in achieving this milestone.

ABSTRACT

This study assessed sustainability of rural water supply projects in Bahi and Chamwino districts, Dodoma, central Tanzania. The study adopted a cross-sectional research design. In order to study different types of projects two strata were created basing on extraction methods used. A total of 24 projects were surveyed across the study area and 136 respondents were interviewed. Multiple data collection methods such as FGDs and Interviews were used. The collected data were processed and analysed using descriptive analysis method. The study found that there was very limited involvement of the beneficiaries in the decision of the type of affordable and appropriate water supply technologies. Nearly all the respondents denied to have been involved in decision on water supply technology options that would suit their needs. A majority of the surveyed projects were found to be functional; however, the remaining small fraction of 10.3% and 30.4% non functional schemes in Bahi and Chamwino respectively signified that there were some communities that did not have access to safe and clean water supply due to technical challenges caused by the chosen water supply technologies. The study established a very strong negative correlation coefficient (r = -91.99%) between the technology used and sustainability of the project. It was recommended to the external actor side that transparency should be well observed at community level thereby sharing with the beneficiaries on all the technological options, their advantages and disadvantages, and wherever possible to consider and respect technologies in which the communities have experience so as to enhance sustainability of the particular rural water supply projects.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

BRN- Big Results Now

COWSOs- Community Owned Water Supply Organizations

IWRM- Integrated Water Resources Management

LGAs- Local Government Authorities

MDGs- Millennium Development Goals

MoW- Ministry of Water Tanzania

NAWAPO- National Water Policy (of Tanzania)

NKRAs- National Key Results Areas

O&M- Operation and Maintenance

RBA- Rapid Budget Analysis

TAF- Technological Applicability Framework

TZS- Tanzanian Shillings

USD- United States Dollar

WASH- Water Sanitation and Hygiene

WASHtech- Water Sanitation and Hygiene technologies (project of the European Commissionô 7^{th} Framework Program in Africa)

WCED- World Commission on Environment and Development

WPM- Water Point Mapping

WRM- Water Resources Management

WSDP- Water Sector Development Program (of Tanzania)

WSSR- Water Sector Status Report

CHAPTER ONE: INTRODUCTION

1.1 Background to the Research Problem

In many developing countries, rural water supply sector policies have been poorly defined and public sector implementing agencies are historically weak. This situation has been exacerbated as donors and implementing agencies bypass governments to set their own policies and rules for their projects (World Bank, 1998).

According to WaterAid Global Sustainability Framework of 2010, Sustainability was defined as about whether or not WASH services and good hygiene practices continue to work and deliver benefits over time, no time limit is set on those continued services, behavior changes and outcomes. In other words, WaterAid (2010); meant that sustainability is about lasting benefits achieved through the continued enjoyment of water supply and sanitation services and hygiene practices.

According to WASHtech (TAF 2013); sustainability of rural water supply is assessed in 6 dimensions namely, social; skills and know how/knowledge; economic; environmental; legal, institutional and organizational technological. On technological assessment, the buyer/user would like to have the products that can fulfill their expectations. It further explained that if expectations are not met in relation to performance, design life, quality and ease of operation and maintenance; a technology may be rejected, or users may not be willing to pay for it. However, WASHtech (2013); sensitized that if the technology enhances social status, this may also improve the willingness of users to pay for it.

Improving the sustainability of rural water supplies has a number of consequences, i.e. ensuring the ongoing provision of a service that is fundamental to improving health, reducing the burden of carrying water over long distances and enabling users to live a life of dignity (Haysom, 2006).

Today sustainability today invariably depends upon communities taking financial responsibility for their schemes, which if achieved will enable scarce resources from government and donors to be targeted specifically on areas where there is no improved water supply. The chances of achieving the Millennium Development Goals to half the proportion of people without access to safe water by 2015 will be seriously lowered unless levels of sustainability of water supply projects can be greatly improved (Moon, 2009).

Community based water projects are not excluded from the tension of failure. Despite the vital role of water in the economy and the huge investment around the globe, many of such projects lack sustainability components (Baumann, 2005). Different studies show that in developing countries a significant number of projects, including those in the water and sanitation sector, fail to deliver benefits to the society over the long term (Carter et al., 1999). For example, in Tanzania alone over 30% of rural water schemes are not functioning properly (Arvidson and Nordström, 2006). Such failures are attributed to a number of factors. A big part of the cause of this failure lies in poor understanding of the issues of sustainability, actorsô interests and their power relations (Carter et al., 1999, Kamanzi, 2007).

Previous studies have tried to assess several other ingredients of sustainability of rural water supplies such as management options, functionality rates, financial aspects of the Operation and Maintenance and cost recovery (finance and revenue collection), actorôs power and interest matrix; and how these affect sustainability. Taylor (2009); suggests that other factors such as the on-going use of traditional sources of water; poor systems of cost recovery and the distaste for the water from the improved source also contribute to undermining sustainability. However none of the above researches has specifically dwelt on how sustainability can be affected by a particular chosen technology. Therefore the water sector lacks enough grounds for addressing the issue of the use of appropriate and affordable technologies which are of low cost, easy to maintain, simple to use and readily available as one of the responses to the challenge of sustainability.

1.2 Statement of the Research Problem

(NAWAPO 2002); insists on beneficiariesô ownership of the water projects. Paul (2011); observed that if the beneficiaries participate fully in the process of identifying and selecting (from among options) the appropriate and affordable water supply technology, then there is a great chance to enhance project ownership and hence its sustainability. Moreover, upon analysis of rural water supply project circle, WaterAidôs Sustainability Framework (2010); revealed that participatory approaches are very important and should be observed in practice, especially where there are limited technological options and resources.

Sara and Katzi, (1998); and Harvey *et. al.,* (2004); insist on community participation in community managed water supplies. According to Hodgkin (1994); if communities are not well represented on the design process, not well educated on technical know-how of the technologies and their selection, if they find themselves limited to interests and powers of the facilitators/donors, ultimately, beneficiaries disown the projects and this hinders sustainability.

According to Paul (2011); on the analysis of the WSDP phase I, it was reported that the WSDP was formulated on the basis that 48% of the rural water supply schemes would be hand pump. However, analysis of investments planned for the last two years of the programme (2010/2012) showed that out of 506 villages, 210 villages (41.5%) have selected gravity schemes, 270 villages (53.4%) have selected pumped schemes, while only 26 villages (5.1%) have selected hand pumped schemes. The analysis revealed further that there were a number of weaknesses in the WSDP design and emphasized that logically surveys should precede the decision on the type of technology, number of villages/projects and budgetary allocation in respect to the technology chosen. The report continued to insist that same technology cannot apply in every location due to differences in topographical and geological nature. For example, the hand pumped technology in semi arid areas like Dodoma and Singida are not reliable since they can work only during the rainy season and turn non functional during the dry season.

Explicitly, the present research therefore will assess the implications of technology choice for rural water supply projects and the technological consequence on the sustainability of the projects. This study will as well focus on decision making processes with regard to certain technologies and weigh its future implications after the projects will have been handed over to the communities.

1.3 Research Objectives

1.3.1 General Research Objective

The general objective of this study is to assess the implications of technology on sustainability of rural water supply projects in Bahi and Chamwino districts, Dodoma region, Tanzania.

1.3.2 Specific Research Objectives

i. To assess if community was involved in reaching the decision of the chosen water supply technology.

ii. To identify the water supply technology options that were shared for the community to choose.

iii. To examine functionality of the project with the current water supply technology.

iv. To establish the relationship between water supply technology choice and sustainability of the project

1.4 Research Questions

i. How was the community involved in reaching the decision of opting for a certain technology?

ii. Did the process exhaust all the existing water supply technology options?

iii. Does the community own the project and afford to meet operational and maintenance requirements for the project with the chosen technology?

iv. What is the mathematical correlation between the chosen water supply technologies with the sustainability of the project as measured by the water supply facility functionality?

1.5 Significance of the Study

This study is significant to the rural water sector especially in water sources development. The study will identify key obstacles in projectôs sustainability caused by a particular opted technology and hence the proposals for a more practicable approach towards sustainability of rural water supply. It is envisaged that the approach will complement the Tanzanian National Water Policy that insists on addressing sustainability through enhanced functionality of the water supply services.

A sustained water supply service will improve lives of the rural communities, for example accessing improved water supply services within 400m walking distance can reduce cases of water borne diseases and save time and energy for other economic activities. This is in line with the Millennium Development Goal of improving the poor people in the world by half through accessing safe health services by 2015.

The study will inform both the academic side and the rural water sector practitioners with concrete data on the influence of participatory technology choices towards sustainability.

1.6 Scope of the Study

The study will be limited to assessing only the implications of the chosen technology to the sustainability of rural water supply projects. It will not cover other sustainability dimensions. Geographically, the study is going to focus only Bahi and Chamwino districts in Dodoma Region, Tanzania.

1.7 Organization of the Study

This book has been organized into five chapters. Chapter One provides an introduction and background of the study while Chapter Two dwells on theoretical and empirical review of literature relevant to the study. The research methodology which guided the study is in Chapter Three. Findings and results obtained from the study are provided in Chapter Four which includes also discussion of the finding on the implications of the technological choices and how they affect sustainability of the rural water supply projects. Chapter Five is about conclusions and recommendations, which include the proposed approach to improve sustainability through a chosen water supply technology.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

Literature reviews concern what is known on the subject matter. The purpose of literature review is to bring clarity and focus to the research problem, improve methodology and broaden the knowledge base on the subject (Kumar and Casley, 1988).

In order to understand the relationship between sustainability at the global, national and local levels; literature on technology choices and the relationship between them will be presented as they reflect on water projects. Literature on community participation and management of water projects will also be reviewed and the chapter will provide a thorough review of sustainability issues. In the course of examining the existing literature on sustainability of water projects the knowledge gap will also be identified.

2.2 Conceptual Definitions

2.2.1 Sustainability

Sustainability is a multi-phenomenon concept derived from the concept of sustainable development. In this study, sustainability definition has been adopted from WaterAidôs sustainability framework (2010); that states that sustainability is about whether or not WASH services and good hygiene practices continue to work and deliver benefits over time. No time limit is set on those continued services, behavior changes and outcomes. In other words, sustainability in the present context is about lasting benefits achieved through the continued enjoyment of water supply, sanitation services and hygiene practices (WaterAid Sustainability framework, 2010).

2.2.2 Rural Water Supply

The MoW Tanzania regards rural programs as an inclusive approach that comprises rural water supply and sanitation (WSSR 2014). They mainly refer to improvement of the provision of clean and safe water supply and promotion of improved hygiene and sanitation in rural areas through LGAs. The programs are made of two subcomponents namely, management support and investments for water infrastructure (Equity report 2011).

2.2.3 Defining Water Supply Technology

According to WASHtech (2013); technology entails a single component or a combination of technical components, which are used to serve a specific purpose. The WASHtech manual goes on to explain further that technologies might work as standalone technologies or they do compose a system. The term ñtechnologyò is also used for a product, which is the combination of technical and marketing elements.

2.3 Theoretical Review

The study is centered on understanding how communities are involved in the process of sustaining their water supplies through ensured continuity of the service. It will explore the involvement of the targeted beneficiaries in deciding for the water supply technology from among options. It will further assess how a chosen technology influences the sustainability of rural water supply i.e. continuity of the improved service level. In this study, the dependency, modernization and demand-responsiveness theories will be employed.

2.3.1 Dependency Theory

The theory was authored in 1949 by Hans Singer. Theorists view development from a developing world perspective (Kilonzo, 2008). Theorists argue that the state of underdevelopment impacts on structures and agencies within developing areas and communities which in turn may foster or undermine the development process of those areas.

In this sustainability study, project may fail as a result of development interventions failing to acknowledge local or internal knowledge, for example Rondinelli, (2000); shows how development projects fail because of incorrect assumptions about local capabilities and constraints. Kamanzi (2007); argues that on the other hand, a project may fail as a result of internal causes, when local actors become reluctant to take action because they internalize a sense of powerlessness, identifying with their assigned place at the bottom of the social hierarchy.

2.3.2 Demand-Responsiveness Theory

Sara and Katz (1998); conducted a study (Making Rural Water Supply Sustainable) for the World Bank through UNDP under the Water and Sanitation Program (WSP). The study found that employing a demand-responsive approach at the community level significantly increases the likelihood of water system sustainability.

The study found that to be effective, a demand-responsive approach should include procedures for an adequate flow of information to households, provisions for capacity-building at all levels, and a re-orientation of supply agencies to allow consumer demand to guide investment programs. The study also found that the existence of a formal organization to manage the water system and training of household members are significant factors in ensuring water system sustainability.

It is common practice for village water schemes to be managed by a village committee of some sort, the creation of which is intended to enable communities to have a major role in the project, to have a sense of ownership over the scheme and to ensure its ongoing operation and maintenance (Harvey & Reed, 2006). It has been suggested that óbeneficiary participation is the single most important factor contributing to project effectivenessô (Narayan, 1994). It is claimed that without beneficiary participation systems are unlikely to be sustainable even if spare parts and repair technicians are available. Participation can take different forms including the initial expression of the demand for water, the selection of technology and its citing, the provision of labour and local materials, a cash contribution to the project costs, the selection of the management type and even the water tariff (Harvey & Reed, 2006). It is thus the process through which demand-responsiveness is exercised, and empowerment is achieved.

2.3.3 Modernization Theory

Development projects such as community based water projects are set as interventions to the identified development problems. Thus, in explaining why development fails, modernization theory will be examined in detail. Modernization scholars start from the assumption that underdeveloped areas are not experiencing development because indigenous institutions are poorly equipped to take full advantage of the benefits of capitalism (Goldman, 2005).

Criticizing the modernization theorists, Sassen (1999); argued that, the reason for failure of development in the form of modernity lies on the lack of consideration of the fact that the so-called old or traditional cultures can bring some knowledge to the modern world. Building a case from community based water projects, as noted earlier, is the easiest way of channeling development assistance to the underdeveloped areas (Mansuri and Rao, 2003). These forms of assistance are brought as solutions to community water problems without involvement of the communities themselves in choosing the type of interventions needed. Sara and Katz (1998); pointed out that in order to create on environment for sustainability of the projects, end users should be allowed to make choice of the interventions and commit resources of their choices. The process of channeling development assistance without full participation of the end users of the projects is challenged as excluding indigenous institutions and local knowledge. It is difficult for local communities to reject completely their old practices and this makes it difficult for them to participate fully in the project activities, hence the yielding of unsustainable results.

Following the above argument and rationality of the three theories by Goldman (2005); Mansuri and Rao (2003); Rondonelli (2000); Sara and Katz (1998); and Sassen (1999); the theories can be narrowed down to objectively assessing only the implications of the technological choice to the sustainability of community/rural water supplies. The theories will help to determine if the applied type of technology (as the response) was the right choice for meeting the communityôs demand and how the external interventions contributed to poor sustainability when local knowledge was not honored, as referred to by dependency and modernization theorist.

2.3.4 Community Participation

Sustainability of WASH projects is determined by the level of ownership which is realized through effective community participation from the design up to the implementation stage. The National Water Policy of Tanzania (NAWAPO 2002); states categorically that water supply and sanitation facilities provided without the active participation of the beneficiaries in planning and management are often not properly operated and maintained and hence, are unsustainable.

Participation is viewed as a tool for improving the efficiency of a project, with the assumption that where people are involved they are more likely to accept the new project and partake in its operation. It is also seen as a fundamental right that beneficiaries should have a say about interventions that affect their lives (Pretty, 1995). Kumar (1998); asserts that participation is a key instrument in creating self-reliant and empowered communities, stimulating village-level mechanisms for collective action and decision-making. It is also believed to be instrumental in addressing marginalization and inequity, through elucidating the desires, priorities and perspectives of different groups within a project area. Participatory methods now dominate in the implementation of development interventions at the village level, the most common method being Participatory Rural Appraisal (PRA). Participation is also aimed at increasing the sense of ownership over the water supply among community members. A history of top-down service delivery by governments and NGOs frequently leaves a legacy of dependency in the villages on external assistance. Consequently, in the event of a failure of the water supply facility the villagers do not make any attempt at repairs, as it is not perceived to be their responsibility (Haysom, 2006).

Table 2.1: Types of Community Participation in Projects

Type	Characteristics of each type
Passive Participation	Inactive participation of the community, i.e. community members listen and accept to what is going to happen or has already taken place without considering their opinion.
Participation in Information Giving	The community participates by providing information required by other parties
Participation by Consultation	Community participates by being consulted, and external people listen to its views. These external professionals define both problems and solutions, and may modify these in light of peopleȇs responses. Such a consultative process does not concede any share in decision-making, and professionals are under no obligation to take on board peopleȇs views.
Participation for Material Incentives	The community participates in projects by providing resources, for example labour, cash or other material incentives. However, the community has no stake in prolonging activities when the incentives end.
Functional Participation	The community participates by forming groups to meet predetermined objectives related to the project, which can involve the development or promotion of an externally initiated social organization. Such involvement does not tend to occur at the early stages of project cycles or planning, but rather after major decisions have been made. These institutions tend to be dependent on external initiators and facilitators, but may become self-dependent.
Interactive Participation	The community participates in joint analysis which leads to action plans and the formation of new local institutions or the strengthening of existing ones. These institutions take control over local decisions and so people have a stake in maintaining structures or practices
Self Mobilization	The community participates by taking initiatives independent of external institutions to change systems. Such self-initiated mobilization and collective action may or may challenge existing inequitable distributions of wealth and power.

Source: Pretty (1995) and Kumar (2002)

2.3.5 Type of Rural Water Supply Technologies

The Table 2.2 below summarizes the most commonly used rural water supply technologies as adopted from Baumann (2003) and Haysom (2006). Construction and maintenance costs as at the time of the Authorsô publication.

Table 2.2: Technology Options for Rural Water Supply

Technology type	Description	Construction Cost (USD)	Maintenance cost (USD)
Hand dug well	Constructed with simple tools in weathered rock	900-1,500	16 annually
Hand drilled boreholes	Hand-drilled boreholes are constructed with simple hand-operated drilling equipment.	600- 1,200	16 annually
Machine drilled boreholes	Borehole depths vary from about 25 to about 80 metres in basement and sedimentary formations.	6,000-12,000	16 annually
Upgraded family wells	The wells are lined with fired bricks, with well heads surrounded by a concrete apron and water run-off.	Below 100	Nil
Direct action hand pump	*(NIRA AF85 or MALDA) Pump*	900-1,000	16 annually
	Hand pump WALIMI	Not mentioned	Not mentioned
	Hand pump AFRIDEV	900-1,000	36 annually
Mechanized pumps	*Diesel Engine with Mono Pump*	30-40,000	2/ family. annually
	Solar Powered	30-40,000	1.5/ family. annually
	Wind powered	40-50,000	1.5/family. annually
Rainwater harvesting	Rainwater harvesting is a way of collecting rainwater from surfaces that do not allow water to soak or penetrate the soil.	The whole system costs 5,450	Nil
Gravity systems	The main source is spring which delivers water at domestic water point or public kiosk, yard tap, house connection.	100-300,000 for 3,000 persons	500-1,000 annually

Source: Baumann (2003) and Haysom (2006)

2.3.6 Technology Affordability

In order for a technology to be appropriate, the cost of the device and the spare parts should be affordable by the local communities (Ghosh, 1984). Victor (2014); found that affordability of technology had a significant relationship with the sustainability status of the surveyed rural water supply projects. The study showed affordability of the technology by the local actors increases the 13.1 times chances of project sustainability. That implied that for the project to be sustainable the technology should be affordable with easy accessibility of the spare parts (Hysom, 2006).

Although Victor (2014); found the above significant relationship, however, the study was contrast to the global study by Sara and Katz (1997); who could not find any statistical significant relationship between technology and sustainability of the projects. But the study by Victor (2014); emphasized the importance of the local community to afford the technology in terms of easily accessibility of spare parts and technical consultation that are within the capacity of the local actors to afford.

2.3.7 Sustainability Dimensions

According to WASHtech (TAF 2013); WaterAid Sustainability Framework (2010); and WaterAid Water Security Framework (2012); sustainability can be assessed in six (6) dimensions with 18 indicators as summarized in the table 2.3 below;

Table 2.3: Sustainability Dimensions with the Measuring Indicators

Sustainability dimension/actor perspective	**User, buyer**	**Producer, provider**	**Regulator, investor, facilitator**
Social	(1) demand for the technology	(2) the need for promotion and market research	(3) the need for behavior change marketing
Economic	(4) affordability	(5) profitability	(6) supportive financial mechanism
Environment	(7) potential negative impacts for environment or user	(8) potential for local production of product or spares	(9) potential for negative impacts of scaling up
Organizational, institutional, legal	(10) legal structures for management of technology	(11) legal regulation and requirements for registration of producers	(12) alignment with national strategies and procedures
Skills and knowledge	(13) skill set of user or operator to manage technology including O&M	(14) level of technical and business skills	(15) sector capacity for validation, introduction of technologies and follow up
Technology	(16) reliability of technology and user satisfaction	(17) viable supply chains for technology, spares and services	(18) support mechanisms for up scaling technology

Source: WASHtech (2013), WaterAid Sustainability Framework (2010), WaterAid Water Security Framework (2012)

2.3.8 Sustainability against Design Period and Cost Recovery

According to Taylor (2009); Sustainability of water supply project was defined as the period of time for the service to pay back while continuing offering its service after closure, while the Design Period is the time taken till replacement of the installed equipments. It does not mean the that project is over, rather the revenues collected must suffice the maintenance and finally the replacement. The report also defines Cost Recovery as the revenues to pay back the initial total capital cost/investment

(O&M inclusive), that the beneficiary will be required to pay when collecting water at the distribution point.

2.3.9 Policy Review

The National Water Policy (NAWAPO of 2002); suggests that in order to improve ownership, community must contribute in cash 5% to the initial capital cost (enhances maintenance and repair), per capita demand/supply should be 25l/day within 400m walking distance, while a single tap should be accessed by maximum of 250people in the project life time. Each of Tanzaniaȏs districts has a District Water Engineer (DWE) who is responsible for the provision of improved water supplies in the area (WSSA 2009).

2.3.9.1 Sector Direction Guided by the National Water Policy 2002

The sector direction as per the National Water Policy of 2002 is guided by three-pronged sub sector guidance; the IWRM participatory principles for water resources management and development; full cost recovery for provision of water supply and sanitation services in urban areas but with lifeline tariff considerations to the most poor; and beneficiary participation in ensuring sustainable and equitable water supply and sanitation services in rural areas.

2.3.9.2 Rural Water Supply in Tanzania

The overall objective of the component is to improve the provision of clean and safe water supply and promotion of improved hygiene and sanitation in rural areas through LGAs.

2.3.9.3 Management Practices of Community Based Water Projects in Tanzania

The WSSA Number 12 of 2009 and the NAWAPO of 2002 insist that the management of rural water supply projects at community level should be done by the legal Water User Groups (WUGs) instead of traditional village water committees (VWC) as was the case in the previous NAWAPO of 1991. WRMA No. 11 of 2009 insists on sustainable participatory integrated approaches of water resources management and abstraction/development.

The NAWAPO of 2002 further offers 5 more options for management of rural water supplies- WUAs, Board of trustees, companies, cooperative society and cooperation. They all register at MoW except for WUGs (example COWSOs) which are registered at district level to become autonomous legal entity.

2.4 Empirical Literature Review

This section provides empirical evidence that answers what is known or existing knowledge under the study phenomena from different scholars; to be able to draw challenges/knowledge gap from the reviewed studies which will be addressed by the researcher (Magigi, 2015).

2.4.1 Empirical Literature Review Worldwide

According to the World Bank (2014); in its Sector Results Profile on Water and Sanitation, much progress has been made in expanding water and sanitation services in the International Bank for Reconstruction and Development (IBRD) and the International Development Association (IDA) client countries. Nonetheless, 768 million people worldwide are still without access to improved sustainable water sources and 2.5 billion without access to safe sanitation. Only 64% of the worldôs population now has improved sanitation access, a figure projected to increase only to 67% by 2015, well below the 75% aim in the Millennium Development Goals.

However, even people who have access to water supply and sanitation services often have to cope with poor service provision. Improving performance of utilities is crucial to ensure continuous service and lower levels of leakage, which affect both the quality and quantity of water available to end-users, the utilitiesô revenue and their financial sustainability.

Singh *et al* (2005); in a case study of a community water supply program in India qualitatively crystallized the importance of overlapping socio-cultural factors (gender, ethnicity, caste, religion) as critical determinants of exclusion and access to water supply innovations. The study suggested that for water supply management to be sustainable, local people must be encouraged to negotiate, communicate, learn and arrive at joint decisions that reflect community choices and preferences. The study observed that when choice of technology is made by an outside agency, community demands are often not met, even when such demands have been duly assessed.

2.4.2 Empirical Literature Review in Africa

Toyobo and Muili (2013); on the study that was carried out in Ejigbo LGA, a major Yoruba settlement in Osun State in Nigeria on the contributions of community towards sustainability of borehole water schemes found that the commitment of the community is very significant in any successful project performance.

The study stated that, ironically, 56% boreholes were not in good condition and this has affected the community water supply. Government boreholes dug in the area were left at the mercy of the community for repair and maintenance. Oral interview with respondents showed that there were no Water Committees in-charge of repair and maintenances of boreholes in the area. The interview with respondents further showed that, government did not involve community members in the planning and implementation of the boreholes in the area.

WASHtech (2013); on recommendations for the sustainability and scalability of solar powered water pumping for domestic supply in Adjumani and Kanungu districts of Uganda found some challenges on the solar powered water supply schemes technology. A total of four solar schemes were evaluated ï two in Kanungu (Katete and Ishasha villages) and two in Adjumani (Pakele and Ciforo villages). Both schemes (Katete and Ishasha) had suffered major breakdowns in the past. Ishasha scheme of Kanungu district completely broke down some years back; the users were unable to raise the funds to bring it back into operation. The Pakele scheme in Adjumani which was run by private operators was not operating at full capacity at the time of the evaluation.

One of the biggest threats to the scalability of solar technology in Uganda currently is the security of panels, which are very attractive to thieves. The proliferation of poor quality counterfeit components greatly undermines the capacity of schemes to meet user needs. However, the lack of credit institutions willing to lend to scheme operators also hinders ability of the latter to replace or upgrade stolen or damaged components. The study concluded that; technically in Adjumani the schemes viewed scored red (poor) for user un-satisfaction and un-reliability of the chosen technology, and the overall yellow score (moderate) in continual backstopping from the external sources.

Brett *et al* (2007); on analyzing a rural water supply project in three communities in Mali, assessed participation and sustainability of the communities in three communities (Yandianga, Benebourou and Ogodouroukoro in the Koro district). The study examined the impact of stakeholder participation on the management of water sources on the choice-of technology preferences and on water use patterns for domestic and agricultural purposes among stakeholders in the project intervention zone with a view toward its implications for sustainability in rural water supply. Analysis showed that women were the most adamant in demanding alternative water supply technologies, based on their belief that it would be more efficient in reducing the drudgery of drawing water.

The study explained that it was not surprising, given the overwhelming social responsibility placed on women for the provision of water for domestic use. Overall, women based their decisions mainly upon ease of access to water rather than on technological design considerations related to water quality.

A similar study in Nigeria showed that people were three times more likely to use a particular source of poor quality water that was closer to their homes than a good quality water source at a farther distance (Nyong and Kanaroglou, 2001).

2.4.3 Empirical Literature Review in Tanzania

Victor (2014); on his findings about the dynamics of power relations of actors involved in community based water supply projects, pointed out that the powerless group of actors are local actors who are not free to make choices of the project parameters such as the design and type of technology to be used on the project. The findings conformed well to the study by Kaliba (2002); who showed that the majority of respondents in his study about sustainability of rural water supply and sanitation programs were not involved in the choice of technology and choice of water sources; a factor that affected sustainability negatively.

Participation of local actors shows significant relationship with sustainability status of the rural water supplies. Again Victor (2014); showed that effective participation of the local actors increases the chance of sustainability by 5%. Community participation is not only unique in water projects. For example, Paul (1987); in the World Bank review of development projects noted that community participation is a key ingredient to success of the development projects. The results imply that if communities are involved in decision-making it will result in equitable supply of services and creation of a sense of ownership of project activities.

Paul (2011); on the technological analysis of the WSDP Phase 1 found that; the program was formulated on the basis that 48% of the rural water supply schemes would be hand pump schemes. However, analysis of investments planned for the remaining two years of the programme (2010/2012) showed that out of 506 villages, 210 villages (41.5%) had selected gravity schemes, 270 villages (53.4%) had selected pumped schemes, while only 26 villages (5.1%) had selected hand pumped schemes.

This is one of the weaknesses of the WSDP design. Logically surveys should precede the decision on the type of water supply technology, number of villages/projects and budgetary allocation in respect to the technology chosen. The same Technology cannot apply in every location due to differences in topographical nature. For example, the hand pumped technology in semi arid areas like Dodoma and Singida are not reliable, they can work only during the rainy season and become not functional during the dry season.

The study also revealed that out of 70 Wards where the Research was conducted, 62 Wards from the visited projects confirmed that communities were involved in the choice of water technology. They had also been informed about the implications of all options and in most cases communities chose the pumped scheme technology.

When asked whether there could be any other alternative technology to choose given the hydro-geological situation, in most cases it was found that many options would be the hand pumps which were perceived to be temporary and only functional during the rainy season, while other options were not reliable. The findings further indicate that from the visited projects in 70 Wards, only 18 (25.7%) out of 70 confirmed to have alternative technology, while 52 said there were no other reliable water supply technology to choose.

Despite the fact that, most of the communities have chosen the pumped technologies which are more expensive, issues of sustainability should be taken care of by looking at whether communities will be able to meet the operational and maintenance costs. The types of technology used in water projects have impacts on the scheme management and the sustainability of water supply. Reconciling the choice of technology and the level of service with the economic capability of the user groups is one of the pre-requisites for sustainable rural water supply.

On technical skills, Nkongo (2009); on the study of Management and Regulation of Sustainable Water Supply Schemes in Rural Communities noted that while skills some of the communities like Chenene and Chifukulo villages in Dodoma Rural district (now Bahi and Chamwino districts) had people with knowledge, the district did not allow them to repair their water supply facilities; even for very minor maintenance. Instead they were encouraged to use pump and engine maintenance schemes, thus continuing dependency and incurring unnecessary costs which could be avoided. The study also found that equipment and spare parts availability was one of the critical problems. Spare parts were not available at the grassroots level and that the lack threatened functionality and hence sustainability of the schemes.

Haysom (2006); on the study of the Factors Affecting Rural Water Supply in Tanzania, specifically on financial analysis per technology found that flexibility in water service pricing could also serve to encourage the use of clean and safe water during the rainy period, when free alternative sources are often used. For example in Manzase, Dodoma Rural, water was provided for free during the rainy season, a period during which the village water committee operates the system and the running costs are covered directly from the water fund. The system is then managed by a private operator during the six months of the dry season; the period in which the system generates its money.

The study showed that even within a technology type, the breakdown profile varied significantly. For example, the Afridev in Manga village broke down within a year due to a broken riser pipe section, while the Afridev in Matyuku village had no breakdown at all since the 90s. Neither of the hand pumps were locked over night to restrict access simply because the technology was appropriate and affordable to the targeted communities.

Empirical literatures above show factors that have relationship with sustainability of rural water supplies. The studies related projects un- sustainability to lack of community participation, lack of operation and maintenance fund, choice of technology and poor maintenance and operation (O&M). However, sustainability studies partially assess the role and the direct link of the choice of water supply technology with sustainability of the rural water supply projects. Therefore this study aims at bridging the existing information gap.

2.5 Research Gap

According to Taylor (2009); the WSDP was a major step forward for the water sector in Tanzania. It has increased funding for rural water supply from TZS 19bn/- in 2005/6 to TZS 93bn/- budgeted for 2008/9 and made funding available nationwide for the first time. In the JMP (2010); the countryøs water supply coverage was found to be 53%. The WPM (2014); reported that the country functionality rate was at 54%. The WSSR (2014); showed that the current sector budget commitment stood at USD billion 1.4. Despite the fact that there was actorsô high commitment to support the sector, yet sustainability through functionality is relatively low (54%). Therefore, further investment might be of great loss.

Previous researches have responded to sustainability questions and showed the multi-actors relationship with their roles on sustainability. For example, Victor (2014); outlined that if there were no consideration of the powerless local actors in deciding the design and type of technology used for their projects the sustainability of rural water supply in Dodoma (Kongwa and Kondoa districts) would be badly affected. Also, he pointed out the necessity of community involvement in the choice of technology and its effects on project sustainability. However, though the study did not establish the correlation between the choice of technology and sustainability. The study did not cover Bahi or Chamwino districts.

Therefore it is high time to address the issue of water supply technological choice contribution towards rural water supply un-sustainability, so as to fill the information gap and to inform the actors and decision makers on their investments. The focus is to meet the MDG targets of improving health through the improved water supply service level and hence economic livelihoods of the rural communities by half by the year 2015.

2.6 Conceptual framework

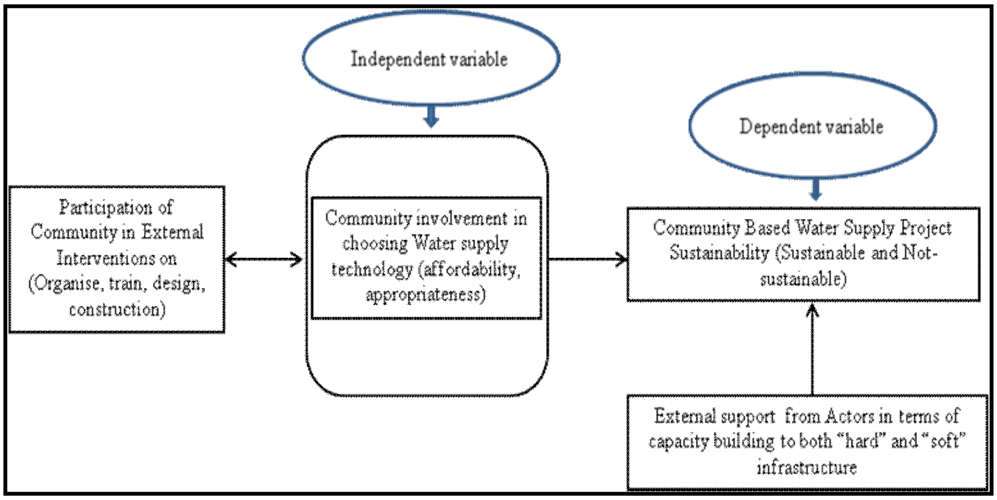

Figure 2.1: Conceptual Framework

Sources: WASHtech (2013) and WaterAid Sustainability Framework (2010)

2.7 Theoretical Framework

A conceptual framework is a narrative outline presentation of variables to be studied and hypothetical relationships between and among the variables. Adopting from WASHtech (2013); sustainability is seen to be a multi-criteria phenomenon measured on six dimensions (Technology, Economy, Social, Environmental, skills and institutions/organizations). These criteria are then broken into factors and sub-factors which are then used at lowest level to explain sustainability under three categories, that is, Sustainable and Not-sustainable; depending on the level of project functionality and continuity of backstopping (continuous capacity building).

There is the relationship between water supply technologies (independent variable) and the sustainability of the same project (dependent variable). However, external support may also influence sustainability when external interventions depict the initiation of the project. Independent variable in this study (technological choice) is hypothesized to be a variable that influences sustainability of the rural water supplies, affordability and appropriateness as the key determinants for technological choice. Technology scalability can be achieved when the project is functional.

The relationship observed in the conceptual framework is not direct; it is a complex causal relationship having both direct and indirect causal links. Generally, it could be said that sustainability (dependent variable) is the function of choice of technology and its interaction with physical project facilities, software facilities and the environment.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents research methods and techniques used to collect and analyze data on the sustainability of community based water projects. The chapter is divided into eight sections. Section One presents the research design. Section Two is on description of the study area and justification for its selection while Section Three describes the population of the study. Section Four is on the sampling design and sample size. Variables and measurements procedures are presented in section Five. Section Six describes methods of data collection and Section Seven presents data processing and analysis.

3.2 Research Design

Research design is the logic structure of the inquiry (De Vaus, 2001). It is argued that research design deals with a logical problem (Yin, 1989). The function of a research design is to ensure that, the evidence obtained enables the researcher to answer the research question as unambiguously as possible (De Vaus, 2001). In order to obtain timely relevant data on the study, cross-sectional research design was used in this research study. This method allows data to be collected at one point in time and establishes relationships between variables for the purpose of testing the hypotheses (Bailey, 1998).

3.3 Research Area

The study was carried out in the central part of Tanzania in Dodoma region. The region was purposively selected to form the study area as it is found in a semi-arid zone which is characterized by dry-land and poor rainfall; hence facing a critical shortage of water. The demand for water in this region is most critical as its shortage impacts heavily on agricultural and several other productive activities, thus contributing to persistent financial poverty and shortages of food in many areas. Failure of water projects might also be attributed by poverty situation in the study area. Currently Dodoma has a functionality rate of 46% (WPM 2012).

To overcome the water shortage problem the government of Tanzania and development partners has been investing broadly in designing and implementing community based water projects in Dodoma. Since there are many community based water projects in the study area, a case study approach will be used. Two districts from Dodoma (Bahi and Chamwino) are purposively sampled for the study. The selection is carefully made in such a way that one of the districts has a high projects functionality rate while the other district has a low functionality rate. Figure 3.1 shows the location of study area.

Dodoma region is situated in central Tanzania. It lies between 4º and 7º South latitudes and between 35º and 37º East longitudes. The region has a total area of 41,310 square kilometers. Administratively, Dodoma is divided into six districts namely; Dodoma Urban, Kongwa, Mpwapwa, Bahi, Chamwino and Kondoa. According to the Population and Housing Census General Report (2012); the estimated population of Dodoma was 2,083,588 people. The main tribes of the region are the Gogo, the Warangi, and the Wasandawe; historically the name Dodoma means "sunken" in the Gogo language. (www.wikipedia.org)

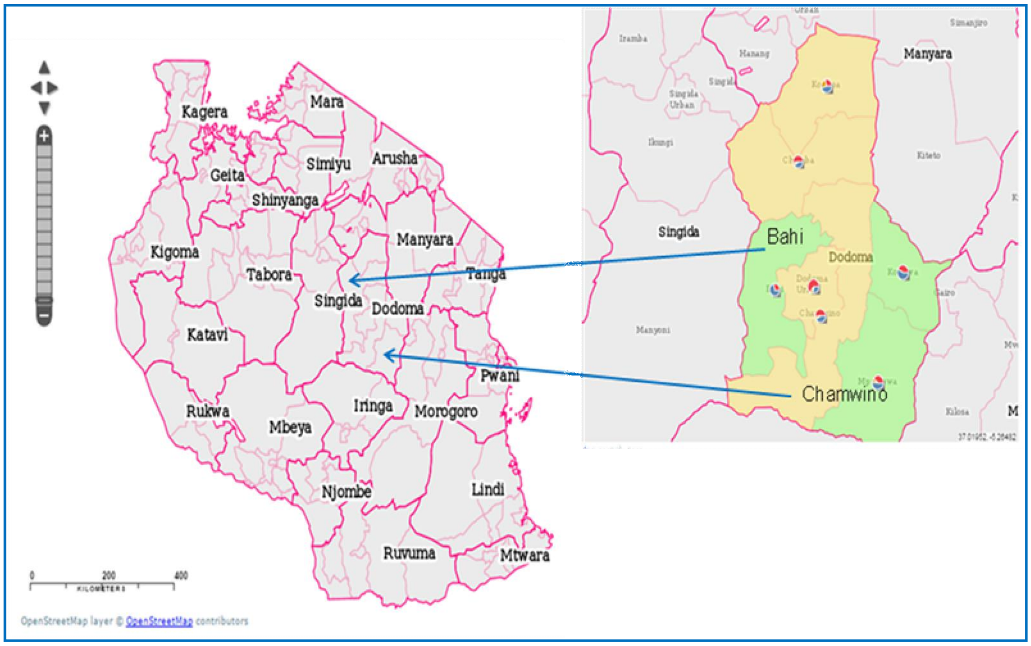

Figure 3.1: Map of Tanzania Showing Location of Dodoma Region, Bahi and Chamwino districts are shown on the right side map.

Source: Ministry of Water, Tanzania

According to Haysom (2006); Dodoma is a dry, basically rural and under-developed region of Tanzania. It remains relatively poor because its economy depends on traditional farming and livestock keeping, both constrained by erratic rainfall and low investment capacity. Most of Dodoma districts have a low water table and thus deeper diesel driven pump schemes are preferred (Victor 2014).

As stated in the [receding pages, the two districts of Dodoma region namely Bahi and Chamwino were chosen purposively on the basis of the functionality rate of their water projects; whereas Bahi has the higher functionality rate (71%) while Chamwino has the lower functionality rate (41%) within the region (WPM 2014).

Chamwino District Council is one of the districts in Dodoma Region which originated from the traditional Dodoma Rural District. The District has a total area of 8,056 square kilometers with a dry Savannah climate and sporadically semi arid. The district is located in the central plateau of Tanzania which extends between Latitude 40º and 80º south and between longitude 35ºand 37º east. The district has five divisions, thirty two wards and seventy eight villages. The district has a total population of 330,543 (National Census 2012).

Like Chamwino, Bahi District Council originated from the Dodoma Rural District. The District has a total area of 5,633 square kilometers, total population of 221,645 (National Census of 2012) with population density of 39.3inhabitants/km^2. The area is of dry Savannah climate and sporadically semi arid. The district is located at 5^0 59ô 0ò South and 35^0 19ô 0ò East. The estimated terrain elevation above sea level is 834 meters.

3.4 Population of the Study

The study covered only a portion of the entire population of the 2 districts. Thirty (30) water supply projects (please refer section 3.5.1 below) were planned to be visited and a total of 184 respondents were expected to be involved. The Tanzania National Water Policy of 2002 stipulates that each water point should serve 250 people. In this context the total representative population in the project areas would be 7,500 people (i.e. 30*250).

3.5 Sampling Design and Sample Size

3.5.1 Sample Size

In 2006, Water Aid Tanzania conducted a survey to map all water points in Central Tanzania. The map served as a sampling frame for the selected districts. Systematic examination of the community based projects for each of the surveyed district of Kongwa, Kondoa, Manyoni and Singida Urban indicated some significant gap. A sampling frame was therefore made by the researcher in collaboration with District Water Engineers (DWEs). From the sampling frame, 30 community based water projects were randomly selected. Bailey (1994); suggested a sample of at least 30 units is statistically significant to present any population. A stratified sample of 15 projects from Bahi and another 15 from Chamwino was taken. Sample size was established using the Sloveneøs formula below;

Sloveneøs formula (as suggested by Magigi, 2015)

$$n = \frac{Z^2 pq}{d^2}$$

Where n = sample size

Z = Standard normal deviate, set at 1.645 corresponding to 90% confidence level

p = proportion in the target population estimate to have a particular characteristic; 10%.

q = 1.0 ï P

q = 0.9

d = degree of accuracy desired, set at .05 or .02. (Chosen 0.0364)

Therefore, using the above formula, the sample size is 184.

The researcher and the DWEs came up with the following types of respondents; 2 households in each village, for the purpose of the views of the people engaging in each of the two main economic activities that the communities were engaged with, i.e. agriculture and cattle keeping. The decision aimed also to get views of 2 most affected community social services institutions from each village i.e. a primary school and a dispensary/health centre at village level. All the individuals in this section were grouped as household respondents summing to 4 household per village. Table 3.1 represents the whole sample distribution of respondents.

Table 3.1: Design of the Proposed Sample Distribution of Respondents

Respondent/ District	**Bahi**	**Chamwino**	**Total**
Households	60	60	120
Water users committees	15	15	30
Village government	15	15	30
Non Governmental organization	1	1	2
District Water Engineerǿs office	1	1	2
Total	**92**	**92**	**184**

3.5.2 Sampling Techniques

The study employed multi stage sampling techniques for selection of the study sample. The method allowed the researcher to employ random sampling after the determination of the groups, and to employ multi-stage sampling indefinitely to break down groups and sub groups into smaller groups, until the researcher reached the desired type or size of groups (Magigi, 2015). The starting point was at the district and ending at the community based water projects that resulted into identification of water users and their committees. The technique was found to be convenient for studying large and diverse populations (Fowler, 1993). The choice of projects was based on the extraction methods that were used. For the purpose of studying different types of projects, the study employed stratification sampling.

Two strata were created basing on the project extraction method: Manual extraction (Hand-Pump) and mechanized/engine extraction (Diesel engine, Electrical pump, Solar system and windmill). The stratification of the projects was based on the discussion that was held with District Water Engineers (DWEs) on the common extraction methods available across the study area.

Challenges that the researcher faced during data collection included lack of the opportunity able to reach out to all the targeted communities owing to various situations, such as unforeseen village auctions (Gulio/Mnada) that led to missing the village leaders and therefore the entire village, some water userôs committees/groups refusing to be interviewed due to serious conflicts and differences with their new village leaders. It should be noted that, data collection was done immediately after the country-wide village leaders elections (LGA- Elections). Table 3.2 below; show the new/actual sample size and distribution that the study managed to survey due to the above mentioned research challenges.

Table 3.2: New Research Sample Composition

Sample composition	Sample- Bahi	Sample- Chamwino	Total
Total Projects Surveyed	10	14	**24**
Water users Interviews (households and social services institutions)	40	56	**96**
Focused group discussion (water userĝs committees/ groups)	8	9	**17**
In-depth interview (LGAs and NGOs)	1 (NGO)	1 (DWE)	**2**
Total	**56**	**80**	**136**

3.5.3 New Population of the Study Area

Section 3.4 entailed on the designed population of the study area. However, with the existing situation, the study found that there was an average of five (5) functional water points in the surveyed water supply schemes. With this, the new population of the study area was 30,000, i.e. (250*24*5).

3.6 Variables and Measurement Procedures

This study had two main variables namely, technology choice as an independent variable and sustainability of the rural water supplies as the dependent variable. Sustainability was measured at two levels which are Sustainable and Not-sustainable.

However, during data collection, the study observed some other factors deemed necessarily influence sustainability. These were community participation at different levels, consideration of other technological options that might have been there prior to decision on the current one, functionality status of the project, institutional capacity to run the project successfully, mode of operation and linkage with external support.

3.7 Methods of Data Collection

The study collected primary data using questionnaires through focused group discussions and interviews, for secondary data an archival review was employed. The use of archival research shed some light on how and why other projects within the study area had succeeded or failed. Five (5) different types of questionnaires were designed and employed in data collection; these were specific for Households, Water Usersô Groups/Committees, Village Governments, Non-Governmental Organizations and for the District Water Engineers. Some questions were repeated in some of the questionnaires to have different views according to the type of respondent/s. Please refer Table 3.2 above for the number of respondents per each method and the used tools.

3.7.1 Data Collection Tools

All the data were collected using different types of questionnaires as entailed in section 3.7 above. Qualitative data was collected through appropriate Focused Group Discussion (FGD) techniques with water user groups/committees guided by the questionnaires. In big part the discussions were guided by multiple choice questions. Also, few open questions were used so as to obtain respondents opinions. Another type of questionnaires were designed to probe for open questions for Structured Interviews with Development Partners (NGOs) and Government Officials (District Water Engineers- DWEs), it provided another qualitative data set that was used to enrich the study; open questioned interviews assisted in obtaining more information since the respondents were as free as possible to provide contextual explanations.

Quantitative data was collected in the survey through interviews with water users at Households and Social Services Institutions. The survey used the closed questioned interviews guided by the specific questionnaires. Furthermore, the research employed archival research by document analysis to complement interviews.

3.7.2 Validity of Data

Data validity refers to the extent to which a measurement does what it is supposed to do. If the result of the study can be reproduced under a similar methodology then the research instrument is considered to be reliable (Magigi, 2015).

To ensure the validity of collected data during the field work, the following strategies were used as adopted from Victor (2014) and Magigi (2015): firstly, the study deployed multiple sources of evidence, namely documentary review, interviews and observation, which provided convergence of facts during the data collection process. Secondly, the study employed a research assistant for data collection who was knowledgeable about the research undertaking and familiar with the study area environment. Thirdly, with the help of village government leaders the study built an understanding with the respondents to make them aware of the research purpose. Lastly, the researcher checked the quality of data through daily meetings that were held with the field assistant to review progress, constraints and the way forward.

To the questionnaires were translated into Kiswahili language and pre-tested to assess their appropriateness. Considering validation of the data was to minimized subjectivity during data collection and analysis (Magigi, 2015).

3.8 Data Processing and Analysis

After the actual field survey, the collected qualitative and quantitative data were processed prior to analysis. Analyzing data collected from mixed methods necessitates the use of multiple processing and analysis techniques (Magigi, 2015).

3.8.1 Qualitative Data Analysis

The information collected during the FGDs and in-depth interviews was subjected to content analysis. The content analysis was important in generating a set of variables that were useful in detailing some characteristics of the research. A detailed analysis of the reviewed documents was done so as to generate information that was used to explain best issues of sustainability of rural water projects.

3.8.2 Quantitative Data Analysis

Quantitative data collected were coded, processed and analyzed using the MS Excel computer program. Descriptive and inferential statistics was used in describing relationship between variables and testing for significance of the findings (Magigi 2015 and Sharma, 2005).

Table 3.3: Objective, Method of Data Collection and Method of Analysis

Objective	Data to be collected	Method of data collection	Method of analysis
To assess if community was involved in reaching the decision of the chosen water supply technology	Community participation in Organising, training, designing and construction process for the project	Interview and Document review	Content analysis
To identify the water supply technology options that were shared for the community to choose	Identified applicable technologies in the area, Analyzed data on community understanding on the options prior decision	FGD, Document review, Interview	Detailed analysis, Statistical analysis
To examine functionality of the project with the current water supply technology	Data to describe whether the project is functional or not functional	In-depth interview FGD, Observation	Detailed analysis, Statistical analysis
To establish the relationship between water supply technology choice and sustainability of the project	Type of technology and functionality rates	In-depth interview and observation	Correlation analysis

CHAPTER FOUR: FINDINGS, RESULTS AND DISCUSSION

4.1 Introduction

In this chapter the findings related to rural water supply project management will be discussed. The main purpose of this chapter is to provide detailed information on the management and sustainability of community managed water supply projects regarding to technology in use in the study area. The chapter is divided into Ten sections. Section One describes the basic demographic characteristics of respondents in the study area and details of projects surveyed. Section Two presents water supply status. Section Three describes community based water projectsô history and community participation in the project stages while Section Four analyses the technological choices and options at community level. Section Five presents project status in terms of project functionality and how the mode of operation meets the O&M costs (tariffs) for project sustainability. Section Six presents the level of accountability at LGA levels; from village leadership to district further explains the applicability and suitability of the technologies in the study area. While section Seven presents the communities legal institutional frameworks and how they operate to meet the communitiesô expectations from the existing abstraction technology. Section Eight presents views from the private sector engagements. While Section Nine is about the correlation analysis for sustainability and the chosen technology and section Ten provides the discussion of the findings.

4.2 Demographic Characteristics

A total of 136 respondents (out of the designed 184) were interviewed during this study covering a total of 24 villages across two districts in Dodoma region. Ten (10) villages were from Bahi district and 14 villages from Chamwino district. The average household size of respondents were found to be 5.65 members, which was slightly higher than the Tanzania Household Budget Survey of 2007 which indicated that, an average household in Tanzania was composed of 4.8 members (URT, 2007). The findings also conform to Caldwell (1987); who shows that most of developing countries had large household sizes as a source of labour for agricultural activities. Large household size could also be linked to the high demand of water in the study area. Table 4.1 provides an overview of the respondentsô socio-economic characteristics. Average age of respondents was 53 years. The survey included 39% males and 61% females.

The majority of respondents (84%) had primary school education. Only 11% of respondents had attended secondary school, while 4% had post secondary education and the remaining group had either attended adult education or not attended formal education at all. The education status of respondents might have been a positive outcome of the improvement of Primary Education Development Program (PEDP). Citing from Victor (2014); the findings on education status concured with the study by Liviga and Mekacha (1998); who found that a majority of their respondents had primary education as compared to only few respondents who had secondary or post secondary education. Low level of education could be as well be linked to low awareness and participation of respondents in project management activities.

Table 4.1: Socio-Economic Status of the Study Area

Type of economic activity	Average annual income Bahi (Million)	Average annual income Chamwino (Million)
Household- agriculture	1.28	1.02
Household- cattle keeper	0.86	1.44
Employed as health personnel (nurses, health officer, laboratory, clinical officer)	3.2	3.8
Employed as a primary school teacher	2.98	3.2

From Table 4.1 above, the daily average income for Bahi was TZS 5,680 (= USD 2.84) and Chamwino was TZS 6,460 (= USD 3.23), both well above the MDG minimum poverty line of USD 1 per day. This may be due to the fact that the 2 districts are located along the Dar es Salaam to Dodoma main road which is a good business and urbanization catalyst. The levels of income imply that the communities can afford to pay for the water supply service so long as they are assured of the service.

4.3 Water Supply Status

The major and reliable water source in the study area were the deep boreholes. The majority of the respondents in Bahi district (76.9%) use piped water from the supply schemes using the Lister Peter Diesel Engine with the Mono pump technology. The same applies to Chamwino District where pumped water users comprise 53.5% of the sample population. Only 41% of respondents in Bahi and 28.6% in Chamwino said that the amount of water supplied sufficed their demand in both quality and quantity. It was perceived that these percentages were in large part influenced by the small number of working distribution points (DPs) in the existing schemes; for example; in Chibelela village (Bahi district) only 4 DPs out of 14 were working, although with frequent breakdowns. In Chinangali 2 village (Chamwino district) there was no DP at the primary school and the scheme was mainly for household connection due to poor management of the public stand posts. The lack of a DP at the primary schools negatively affected implementation of the national primary schools food program, as well as the very performance of primary education. Similarly, the lack of public stand posts was seen as a denial of the service to the poorer in the community who could not afford to have household connections. In both scenarios the community members resorted to alternative sources of water which in most cases were unimproved, unhygienic and unsafe.

During a water supply infrastructure breakdown 84.6% of the respondents in Bahi went back to traditional, unsafe and unprotected shallow wells. The study observed that the remaining represented those who had ability travelled to other villages up to four (4) kilometres to collect water for their domestic use. In Chamwino district; 69.6% of respondents confessed using the traditional ñunsafeò water sources to cater for their daily needs, 10.7% collected safe water from the nearby villages and 19.7% used the water supplied by windmill technology, which they complained that it was saline. The large number of people who alternatively went back to the traditional sources implied the failure of the project different actors to meet supply targets and reduce health risks to the rural communities. Figures 4.1 and 4.2 below represent the distribution of water supply technologies in both Bahi and Chamwino Districts.

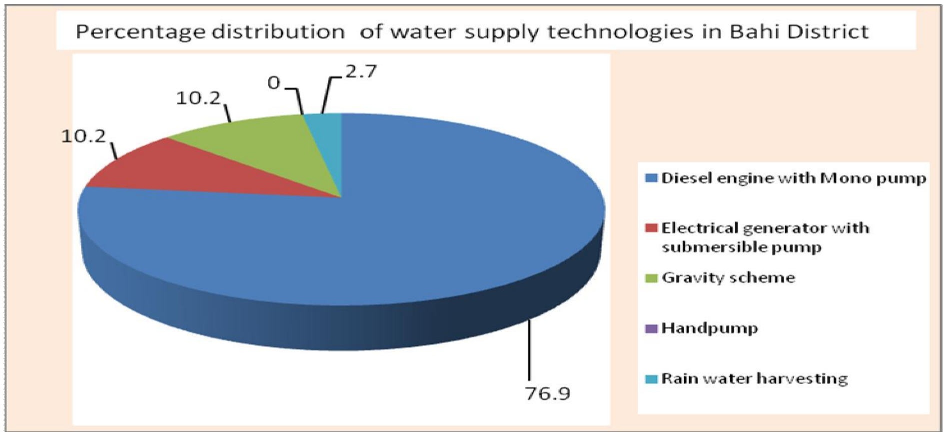

Figure 4.1: Types of Water Supply Technologies in Bahi District

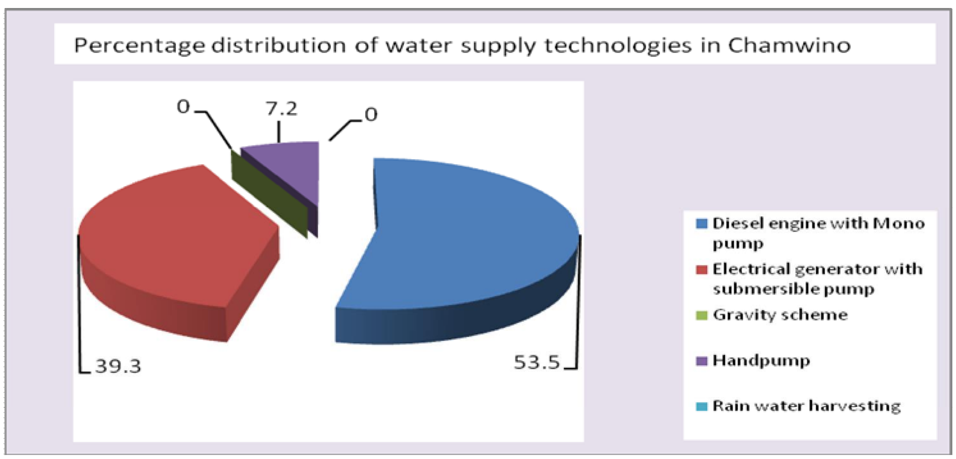

Figure 4.2: Types of Water Supply Technologies in Chamwino District

Figure 4.3 below shows the distances that the community members walk to collect water from improved water supply schemes in Bahi district. It was observed from the respondents that only 17.9% of the community members had access to improved water supply (DP) within 400m. The rest had to go more than 400m to collect water from the improved schemes, which was contrary to the NAWAPO of 2002 which states that each community member should not walk beyond 400m to collect water from the improved sources. It was observed further that majority of DPs were not working due to different reasons in the study area (Chibelela village as an example), that necessitated the community members to walk beyond the standardized walking distance to fetch water for different uses, thus wasting much time that could be used to perform income generating activities.

The situation was much worse in Chamwino district whereby only 5.3% were able to have an access to improved water supply within 400m, 50% could find the DP within 400m to 1Km, 28.5% between 1 to 2Km and 16.2% had to go beyond 2Km to reach the DP. However, the case may be slightly different when considering villages like Ilolo (Chamwino district) and others where the majority of the people voluntarily prefer household water supply connection and the system was 70% functional. Household connection reflects majority been found with 400m walking distance.

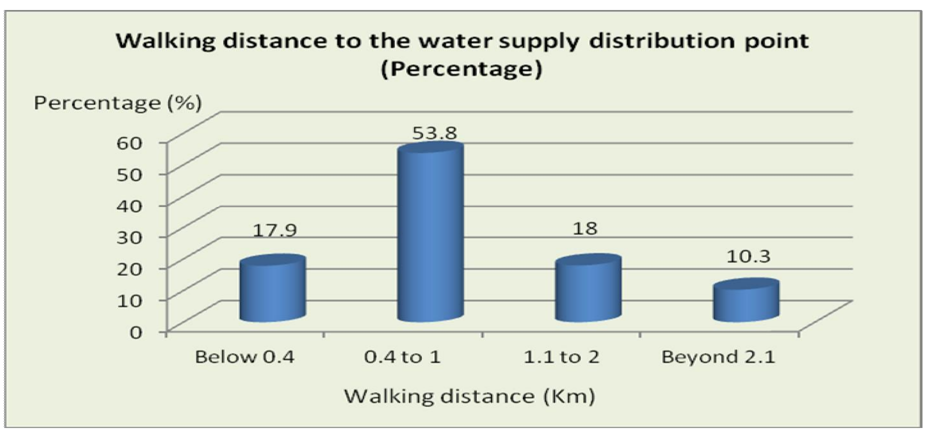

Figure 4.3: Walking Distance to the Nearest DP in Chamwino District

A (Chibelela village)	B (Iringa Mvumi village)	C (Ilolo vilage)

The photos above were taken in some villages during this study; to show the situation when there is water shortage and infrastructure breakdown. Photo A and B show the scooping process along the river and collection of surface water when it happened to rain respectively. Photo C shows a long queue of both residing and nearby villagers who came to collect water at the water distribution point.

4.4 Water Projects History and Community Participation

87.2% of respondents in Bahi district said that the water supply projects established by the desires of donors, 2.6% claimed that the projects were government initiatives and 10.2% admitted that the projects were established as a result of real demand from the community. In Chamwino, 69.6% of the projects were setup by the desires of the donors, 23.2% as the government initiative, while the remaining 7.2% of the water supply projects originated from the community demand. This set of data in both districts shows that private sector/donor side had a great influence on the decision and implementation of the projects. This had a negative implication on ownership and sustainability of the projects. For a rural water supply project to be sustainable the real need and demand should come from the community and that should be seen to take place throughout the project circle. These findings resemble those made by

Toyobo and Muili (2013) that the functionality rate of the DPs was poor because the targeted community did not participate well in the project.

53.8% of the respondents in Bahi said they were not involved in the choice of the type of the project and only 17.9% of those who were involved contributed in terms money. The rest contributed in the form of manpower. However a majority of the respondents (64.1%) declared to have the feelings of ownership of the projects. This could be due to the high demand for improved water supply without alternatives that forced the communities to run the projects. Otherwise the community members would have no choice but to rely on the scheme that was from outside their neighbourhoods.

The Bahi situation was not much different from that obtained in Chamwino, where 82.1% of respondents said they were not involved in the choice of the project and the majority (60.7%) of those who were involved contributed in terms of manpower, while only 30.3% claimed to have a sense of ownership of the projects.

The wider implications of not involving community demands prior to decision making regarding choice of a water supply project had invariably been negatively feelings and views among some communities in the study area. For example, Mlimwa village water supply scheme (Chamwino) stopped working 5 years ago simply because the diesel engine conked out. Since the community did not feel that they owned the project, they abandoned the scheme. The broken pulley for the centrifugal diesel engine (Lister Peter TR2) could cost a total of TZS 2mil and the people of Chamwino had the financial capability to replace it if they had the sense of ownership. An alternative source of water, the traditional wells in the village also exacerbated the peopleøs unwillingness to revive the scheme.

4.5 Water Supply Technological Choices and Options at Community Level

With reference to section 4.3 above, the majority of the communities were found to have schemes that used Mono pumps driven by diesel engines. This section therefore endeavours to analyse and see if this and other technologies were the right choices for the communities.

Table 4.2: Criteria for Water Supply Technology Choice

Criteria	**Respondents (Bahi)**	**Respondents (Chamwino)**	**Total Respondents**
Donor choice	35 (89.7%)	46 (82.2%)	**81**
Community was led to choose	5 (10.3%)	5 (8.9%)	**10**
Direct choice of the community	0 (0%)	5 (8.9%)	**5**
Total	**40**	**56**	**96**

Table 4.2 above represent criteria used in choosing the water supply technologies by the community in the study area. Investigation revealed that in both cases (Bahi and Chamwino) external sources (donors, LGA experts and private sector facilitators) dominated the process of choosing the type of technology. Percentagewise, external influence as confirmed by the communities was 89.7% for Bahi and 82.2% for Chamwino. The real community participation in the choices was on 8.9% in Chamwino and no one at all responded that the scheme technology they were using was of their own choice.

79.5% and 80.3% of respondents in Bahi and Chamwino respectively denied to have been told about the advantages and challenges of the technologies that they are currently using. Also, 100% and 98.2% of respondents in Bahi and Chamwino respectively denied to have been told about any other options of the technologies that would suit their water supply demands.

The criteria and approach used to choose a particular water scheme technology brought about the situation whereby the communities found themselves using the technology without knowing its advantages and disadvantages. Also the limitation of knowledge on the part of the community about any other options through which they could sustainably continue enjoying the services greatly impacted on the sustainability of rural water supply. Taking an example of Mwitikira village in Bahi district, the village water committee owed TZS 2.8mil to the church which they could not settle due lack of funds which in big part resulted from their failure to collect enough funds from the water project; funds which would also be used for running the project. Community members who were supposed to pay for the service demanded to be given water for free and disowned the project. All the DPs were in good working condition but the scheme was running at a loss due to fewer customers who were willing to use and pay for the service. The majority of the community members had gone back to use their unsafe traditional wells.

4.6 Water Supply Project Functionality and Sustainability

This section considers level of functionality of the schemes in the study area and it reflects on sustainability of rural water supply as adopted from WaterAid Sustainability Framework (refer chapter 2, section 2.2.1, 2.2.2 and 2.2.3).

When asked whether the project met their expectations, 53.8% and 39.3% in Bahi and Chamwino respectively responded positively, probably due to the lack of other improved water systems in their area that left the users without an option or comparison. The infrastructures provided by the technology could be used by all the people in Bahi, while only 19.6% in Chamwino could not easily access the water points for the improved water supply services. This fraction represented marginalized and vulnerable groups in the community (people with physical disabilities, elders and children) who were not considered during the design phase of the projects, i.e. equity and inclusion were not considered in their wider spectra.

Only 41% of respondents said they were satisfied with the technology and how it works in Bahi, while only 35.7% agreed to be satisfied by the technology same in Chamwino. From the WASHtech manual (2013); user satisfaction will enhance scalability of the technology and hence more sustained water supply service in rural areas. Regarding these figures, the two study areas were below 50%, meaning less than a half of community members were not satisfied with the services given using the dominating technology.

69.6% of the surveyed schemes in Chamwino were functional, although with frequent repairs, of which 85% were beyond the capacity of the trained village pump attendant (VPA) or local artisans trained at village level. This implied that communities still depended highly on the technical assistance from the DWE office. It was observed that technical support from the DWE office was delayed due to in sufficient resources to offer up timely support by the DWE.

When asked one of the community members in Chamwino said *"the local artisan can only solve minor technical problems like replacement of the broken valves and pipes, but they are not able to solve issues pertaining to the pumps and engines"* Functionality rate for the surveyed projects in Bahi was 89.7%.

64% and 60.7% of respondents in Bahi and Chamwino respectively were using the tariff of TZS 50 per 20liters bucket. This included those who were billed at flat rate at TZS 20,000 to 30,000 per month for household connections. This implied that the majority (beyond 50%) of the community members could afford to pay for the water supply services. However, there was a need to improve the coverage (lower the walking distance by increasing number of DPs) so as to assure the customers of the service. This was also cemented by 71.8% and 67.9% of respondents in Bahi and Chamwino respectively who said the tariff was affordable despite the fact that the choice of technology did come from them as main users. The rest of tariffs are as shown at figure 4.6 and 4.7 below.

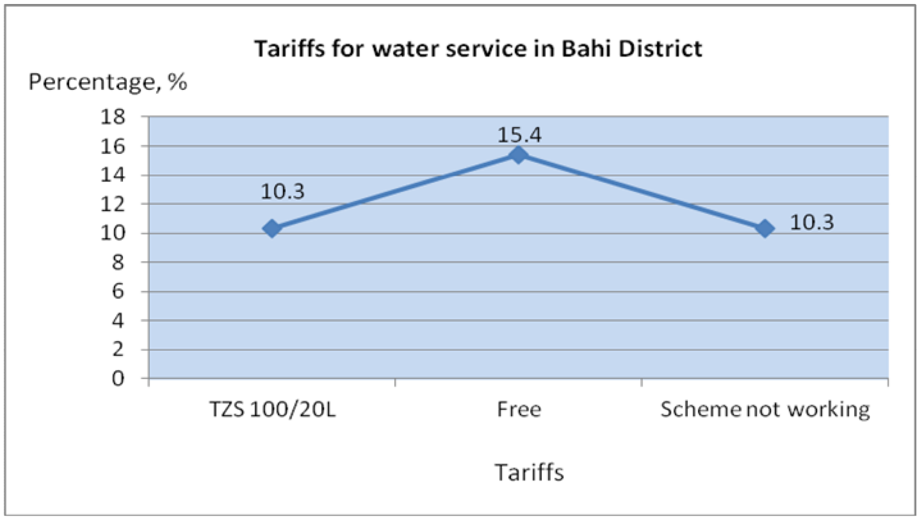

Figure 4.4: Water Tariffs in Bahi District

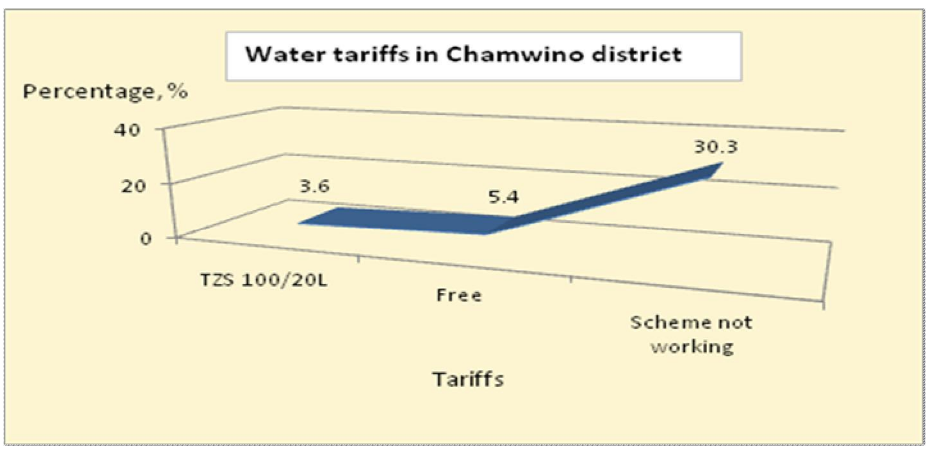

Figure 4.5: Water Tariffs in Chamwino District

The water tariffs varied according to the different points from which consumers collected water. TZS 100/20L bucket applied to those who collected water from their neighbourhoods with household connections. Free water supply applied to the village where there was a gravity scheme (spring as the source of water). According to community members there were no running costs for the gravity scheme. Free water supply was also applicable in few areas for special groups (disabled and the elderly).

It was of the respondentsô opinion in Bahi district that the water project governing institutions (Water Users Groups- WUGs) should provide accountabilities on income and expenditure. However, only 30.8% confirmed that the institutions were issuing the reports while 41% said the associations did not prepare any reports and the remaining respondents (28.2%) stated that projects were not functional. 16.7% of the functional schemes (whose leaders provided financial reports) presented the financial reports on a monthly basis, 58.3% at 3 monthsô intervals and 25% on 6 monthsô intervals. The available platform to disseminate the reports was during the general village meetings; contravening the NAWAPO of 2002 which recommended that financial reports should be shared to the water users as frequently as possible (once every month) to enhance transparency and accountability (good governance). It was also found that in this district a big proportion of the functional schemes (41%) did not provide their financial status to the users, a fact which discouraged and caused users distrust the WUGs. Water users became reluctant to pay for the service, the end result of which would be an increase in the number of non functional schemes beyond the current figure in Bahi (28.2%). Finally, this state of affairs would lead to unsustainable water supply in the district and the resultant incessant morbidity and a relapse to the whole poverty cycle.

Using the same criteria the situation in Chamwino district was much worse. Only 21.4% of the WUGs offered financial reports to the users while 48.2% did not. The non functional schemes were rated at 30.4%. 25% of the functional schemes (where reports were provided) offered reports on the monthly basis, 50% on 3monthsô and 25% on 6monthsô bases. Lack of prompt transparency to the users may contribute to the poor sustainability of the service since the community may hesitate to pay for the service thus rendering the WUGs unable to earn funds for O&M of the schemes.

4.7 Role of Local Government Authorities on Sustainability of Rural Water Supply

This section explains how the LGAs involvement in rural water supply contributes to the trends of the service levels in their communities.

4.7.1 Village Leaders' Involvement in Project Circle

60% of the village leaders in Bahi district who were interviewed said that they participated in all the project stages, while in Chamwino district the response was that 57.1% participated in different phases of their water supply projects. There is a big difference in the figures own representing community membersô participation during the project planning, implementation and its sustainability status. For Bahi and Chamwino community involvement was only 46.2% and 17.9%, respectively. This might be due to the inappropriate entrance strategy/approach that the majority of external actors use in rural water supply sub sector.

The above figures implied that, actors used solely the influence of the village leaders to execute their projects as they believed that the village leaders could fully represent the entire community needs on the type of service and technology that they required. Empirically that was not the right approach. Experience from the local NGO called ñMaji na Maendeleo Dodomaò (MAMADO) shows that many community-managed water supply projects fail to reach their goals because the actors to do not penetrate deep into the communities to come up with the actual demand and desires. This was clearly supported by the levels of community satisfaction on the use of the chosen technology and service level data gathered in this study which was 35.7% in Chamwino and 41% in Bahi district (refer section 4.6). MAMADO had an opinion that community satisfaction was vital to improved functionality rates and hence sustainability of the community managed water supply projects in the study area.

4.7.2 Perception of Village Leaders on Technology Expectations

In Bahi district, 40% of the interviewed village leaders said they were satisfied with how the technology was working leaving more than half (60%), unsatisfied with the workability of chosen water supply technology and how it was helping the targeted communities. In Chamwino the satisfaction level was very low (7.1%). It can be deduced from these data that may be the village leaders were only told on the good side of the appropriateness and affordability of the imposed technology during the introduction of the projects.

On the other hand, in both districts, all the village leaders stated that they had a good working relation with the WUGs in their areas. In one way or another this had impacted positively on the project in the following ways; by providing useful assistance in linking the VPA, WUG and local artisans with the external environment when seeking for technical support upon machines or infrastructure breakdown and for the management of water funds at the banks in case the Village Water Committee was the option in project management model (please refer section 4.8 of this chapter for different management models).

4.7.3 Roles of DWE Office on Sustainability of Rural Water Supply Services

According to the WSSA No. 12 of 2009, the responsibility of the District Water Engineer (DWE) is to ensure all water supply projects in its locality are functional at all the time and the community have access to safe and clean water supply. It was unfortunate that it was not possible to meet with the DWE for Bahi due to his tight schedule.

The Chamwino DWE assured the research team that all the developed water sources do possess water use permits from the Internal Drainage Basin; this was to fulfil the Water Resources Management Act Number 12. One of the challenges in their daily of practice was the little understanding of the village leaders on the new NAWAPO of 2002 which led to some difficulties in management of community water supply projects and their sustainability.

"Majority of villages leaders still think that water supply service is for free while it's not, the policy states that they should contribute 5% of the project initial investment capital, this led to misunderstandings between external supporters and the communities because they do listen to their leaders, hence projects fails to earn funds for O&M, sustainability become difficult. Moreover, the new WSSA number 12 of 2009 is not known at all at community level"

The DWE stressed that even other private actors working with them in this subsector (WaterAid, MAMADO and LVIA) encountered the same obstacles.

To enhance sustainability of the technology and the service, the respondents said that they referred to the technical data as the criteria in selection of the technology, such as pumping test which indicated the discharge capacity of the borehole and actual community demand. Community involvement in training on the usefulness of the technology was claimed to be the best approach prior selection and they involved beneficiaries in deciding on the appropriate technology, while considering other technical parameters as well.

The office also reported to have been using the approach of training the local artisans in the O&M of the technologies applicable in the area. According to the DWE they used to prepare some guidelines for training the communities from planning, designing and construction of the rural water supply projects.

With all the above reported efforts of the DWE office, however, they were not reflected in the real situation on the ground. Still the communities declared to have less satisfaction of the service level due to inappropriate approaches used to arrive at the decision of the chosen water supply technologies, largely attributed by the poor community participation from the project initiation to handing over of the project to the community as highlighted in section 4.6 above. It was clearly observed that the situation was leading to no sustainability since the beneficiaries did not feel to own the projects.

4.7.4 District's Role in the Spare Parts Supply Chain

Table 4.2 below presents the commonly used rural water supply abstraction technologies as presented by DWE office. Nevertheless, the DWE office has failed to invest or create conducive environment to encourage private sector to invest in the spare parts supply chain.

According to VPA at Ibugule village (Chamwino district) there were some unofficial dealers in Dodoma town who could fabricate spare parts using local or second hand materials at relatively cheap prices. But the spare parts did not last longer because they were not genuine. As an alternative, they had to use DWE office to order genuine the parts from Dar es Salaam region (450 kilometres away), a process that took more than one week. Due to this down time delay the communities had to go back to their local unimproved traditional wells to fetch water for domestic use. Victor (2014); established a significant relationship between sustainability and technology on the criteria of affordability, the study emphasized on the importance of the local community to afford the technology in terms of easily accessibility of spare parts and technical consultation that are within the capacity of the local actors to afford.

"If the district could have coordinated the reliable availability of spare parts at Dodoma town(less than 50 kilometres away), it would have helped us in assurance of spare parts and controlled prices, hence improved functionality and sustainability of our services" said the local fundi in Mtitaa village in Bahi district.

Table 4.3: Water Supply Technologies commonly used in Chamwino District

Group	Type	Status	Remarks
Motorized	Mono pumps (powered by diesel engines)	Widely used	Best in rural areas without electricity
	Submersible pumps	Less used	Best in rural areas with electricity
Hand pumps	None	None	Not widely used in Chamwino
Others	Wind mills	Very few	Applicable as an alternative technology to subsidize supply

Source: DWE Chamwino.

Hand pumps and shallow wells had failed in the district due to the fact that the water level in the area drops down in the dry season to the extent that the commonly used hand pumps cannot work and the water shortage problem together with its consequences recur. It should be the common practice in Chamwino to deepen shallow wells and install them with Mono or submersible pumps while considering geo-physical characteristics for investments.

4.7.5 Role of DWE in Continual Support to WUGs at Community Level

According to respondents the office used to provide training to the local artisans so that they could manage to rectify minor technical breakdowns at community level. However, the study found that the skills updating/upgrading mechanism was very weak as none of the VPAs (local artisan) confirmed to have attended any further training after the completion of the project execution. Under this situation, it was of high risk if such a single trained personnel was not available to attend the project for any reasons.

It was of the DWE opinion that the actors should work closely with the communities from the project beginning when they got and came up with a water supply project idea and offer the communities continual support throughout all project implementation steps.

4.8 Rural Water Supply Institutional Framework in the Study Areas

This section describes community associations that are managing water supplies sustainably in the face of challenges pertaining to the chosen technology. In Bahi, it was found that the average age of the projects was 10 years, the youngest was 1 year and the oldest was 43 years. The study managed to interview only 8 WUGs out of the targeted 15 WUGs due to the reasons given under section 3.5.2.

In Chamwino, a total of 9 WUGs were interviewed (out of targeted 15 WUGs) and the average age of the studied schemes was 5.4 years while the youngest was 1 year and oldest scheme was 17 years.

4.8.1 Water Supply Management Models

The dominant management models with the community institutions were through Village Water Committees (VWCs) and Community Owned Water Supply Organizations (COWSOs). According to the new national water policy of 2002, each rural water supply project should have its own water users group called COWSO. It was found that each village surveyed had only one water supply project. The VWC model was the old mode that was inherited from the previous NAWAPO of 1991. The current water policy insists on COWSOs through which the communities have the mandate and autonomy in managing their vested interest in rural water supply projects. Therefore, the current practice recognizes COWSOs to be the legal community institutions.

In Bahi, the distribution was 50% by 50%, meaning there was still presence of VWC to-date, contrary to Chamwino where 100% of the surveyed schemes were still under the VWC mode. According to MAMADOôs experience disadvantage of the VWC was that there was still influence of village governments on operations of the VWCs, especially in financial management that mostly affected service level and caused inconsistency and delays when breakdowns happened. 50% of the total number of VWCs managed their schemes through Water Supply Agencies, also known as Private Operators (PO).

4.8.2 Legal Status of the Associations

50% of the associations in Bahi were registered at district level through the district registrar. These represent all the COWSOs that are recognized by the current water Policy and Act. None of the associations surveyed in Chamwino is registered, due to the fact that they still apply the VWC model which has to change to COWSOs to be legally accepted. Referring to section 4.8.1 above, the sustainability of the rural water supply depends much on its autonomous state without the interference of village governments. Otherwise no sooner than later the functionality rate in these districts may fall.

4.8.3 Technical Challenges Faced and Solutions

62.5% of the associations in Bahi responded that they experienced infrastructure breakdowns on a monthly basis. The remaining fraction said they experienced breakdowns every 6 months. Half of the problems were solved within one week and the remaining half took beyond 1 week. In Chamwino 66.7% of the associations said that they faced breakdowns on a monthly basis and 33.3% on a 6 month basis. 22.2% of the problems took beyond 1 week to be solved and 77.8% were solved within 1 week.

In all the cases when these schemes experienced breakdown the community members went back to use the unprotected traditional wells and scoop water along the river beds. Communicable diseases were inevitable in this situation, livelihood declined and hence a reduced purchasing power of the community. With such want of resources the water supply projects would fail to meet the O&M costs, which would lead to having malfunctioning schemes and consequent unsustainable service.

4.8.4 Capacity Building to Water User Groups

All the water user groups in Bahi denied to have had capacity building after project completion, while in Chamwino only 33.3% confirmed to have attended at least one training to upgrade their management skills in finance and technicalities of the technologies. This implied that there was informal transition of the skills from person to person or water user group to the other during the succession process. Such process can easily result in wrong education leading to mismanage the system, including the infrastructures that the technology was using and negatively affect sustainability.

4.8.5 Financial Capabilities of Water Users Groups

One of the guidelines provided by the Ministry of Water for the formation of COWSOs requires the individual associations to have bank accounts for saving their water funds for future use on operational overheads, expansion and repairs. The research found that historically VWCs used to deposit their water fund saving into the general account on the other hand uses the village government bank account.

"Since the VWC originates from the village governments development committees, we then find ourselves using the village bank account and must consult village leaders for signatories and authority to withdraw funds in case of breakdowns, village government bureaucracy sometimes causes some delays in problem solving hence affects service reliability to the community" said one member of the VWC during focused group discussion in Iringa Mvumi village in Chamwino district. According to the WASHtech (2013); reliability is one of the key indicators to technological adaptation and userĝs satisfaction. Consequently reliability becomes a key determinant for rural water supply service sustainability. The situation exemplified above helps to explain peopleĝs rejection of schemes (technology) due to factors such as delays of repairs, thus affecting negatively the project sustainability.

87.5% of the associations in Bahi confirmed to have bank accounts with an average of TZS 2.3mil in the account in the range of TZS 0mil to TZS 6mil. The remaining 12.5% of the associations did not have bank accounts. In Chamwino 77.8% of the associations had a bank account with an average of TZS 2.5mil in the account, some had no money deposited, while TZS 10mil was the highest amount of money deposited by an association. 22.2% of the association in Chamwino had no bank account but handled cash at hand.

All the surveyed associations in Bahi said that the collected revenues sufficed in case of minor technical problems but not solving problems such as pump or engine replacement (for the schemes older than 10 years). In Chamwino, 66.7% of the associations said that they could meet the costs in solving minor problems, while 33.3% said that they could not meet such cost using the funds collected from water. The above 33.3% failure case in Chamwino threatens functionality and hence sustainability of the projects. The study has found that functionality rate of the surveyed schemes in Chamwino was 69.6% but this could soon be lowered if the above reported failures are not made good.

4.8.6 Capacity of Village Pump Attendants to Solve Technical Challenges

According to the Chamwino DWEös office, Village Pump Attendants (VPA) were among the members of the water usersô groups. They were trained to solve a certain level of machines and water supply infrastructures challenges, beyond which they had to request support directly from DWE or assisted by DWE to access support from private actors.

Generally, majority (87.5%) of the surveyed VPA in Bahi district were capable of solving minor challenges. However the in ability of remaining smaller fraction could impact negatively on their projects, as said that they could not handle the problems due to weak transition of skills from the predecessors. The capability rate was much less in Chamwino, where only 44.4% of respondents said that they could solve technical problems. This was mainly due to application of uncommon technologies like Mitsubishi electrical generators (Idifu village- Chamwino), the DF Chinese engines to run the Mono pumps (Iringa Mvumi and Mungano villages- Chamwino) and TANESCO powered electrical motors (Chalinze and Manchali villages- Chamwino). This shows clearly that Chamwino was piloting new water supply technologies before providing sufficient capacity building to the VPAs and local artisans who had the responsibility for solving technical problems.

"They installed a Mitsubishi generator which is difficult to maintain. It has more frequent breakdowns than the previous technology (Lister Peter TR2 engine with Mono pump) and this requires getting experts from Dar es Salaam town (more than 450Km away) for major repairs" said the Chamwino DWEøs Mechanical Technician.

Conclusively, the introduction of new water supply technologies needed to come with full packages for usersô capacity building and continual support after project completion.

4.9 Private Sector Engagement in Improving Sustainability of Rural Water Supply

The study managed to collect data from an NGO called Maji na Maendeleo Dodoma (MAMADO) which was involved in water and development in Dodoma region, Tanzania. The organizationøs emphasis was on the environment and consideration of community preference regarding the choice and application of appropriate water supply technologies.

4.9.1 Organizational Approaches in Rural Water Supply

The private organizationsô main approach to evolve rural water supply projects involved respecting the real community demands. They worked to complement LGAøs plans in areas which were not easily reachable in rural water sub sector theme. The organization worked hand in hand with the communities so as to maximize their participation.

The main challenge which the organization faced was the conflicting priorities at community level. It was realised that communities still had the hand to mouth attitude and would not contribute to the projects. According to MAMADO, poverty level in the project areas was relatively high such that the people could only sustain their daily lives and regarded improved water services to be the second option.

4.9.2 Private Sector's Role in Enhancing Community Participation for Sustainability

According to MAMADO, many organizations believe that village leaders could make all decisions without involving the societies that they led, which proved to be wrong. On the contrary, actors had to undertake in depths research with involvement of the entire community (feasibility study). A typical example of negative results of exclusion is MAMADOôs experience involving the drilling of boreholes without consultation of the elders during hydro-geological surveys. They ended up having dry wells and the majority of actors incurred big financial losses.

According to MAMADO, many actors were doing their planning wrongly. They set similar time frame for different communities, regardless of the communitiesô dynamics and differences, MAMADO gave an example that when setting project O&M costs and cost recovery through Life Circle Cost Analysis (LCCA- widely used tariff setting tool) a majority of the actors set the same recovery time for all the communities in all localities. One disadvantage is that some communities might not adapt with the technology within the set one year period and this would negatively affects the continuity of the project.

"We take them out of their understanding, we come with new technologies while we would just improve what they have, for example instead of investing on new and complicated physical water supply technologies to maximize water abstraction capacity, one would just change the approach to Water Resources Management (WRM) interventions so as to avoid water scarcity, scarcity leads to complicated water abstraction technologies which are more expensive in investment and O&M and thus less sustainable at community level" said an interviewee.

MAMADO claimed to have been successful in their projects through encouraging participation of all stakeholders (LGA, communities, and community water related institutions) in the areas of capacity for capital costs and the availability of skills for O&M so as to arrive at appropriate technologies to abstract water. Conclusively, MAMADO discourages stakeholders who involve only community representatives rather than reaching the entire community at large via community meetings.

4.9.3 Participation in Spare Parts Supply Chain

The organization did not invest in spare parts supply chain because the market was invaded by fake dealers and fake spare parts. Also the chain was not well coordinated by the LGAs to a have in place control for pricing and standards. They believed that easy access to spare parts by the users would increase chances of sustainability of the projects.

4.9.4 Organization Strategy for Post Implementation Monitoring

The organization did not have a Post Implementation Monitoring and Survey strategy (PIMS) in place but insisted on having strong community institutions (COWSOs) and coordination of support from different stakeholders in case there was a need from the community. MAMADO trained the COWSOs in finance, technical aspects of the technology in use and governance. The WaterAid sustainability strategy insisted on external actors to set aside resources for PIMS, not only to support the communities in case of technological challenges but also to learn from the communityøs perceptions and experience in the use of technologies for sustainability enhancement. The PIMS package should also complement the post project implementation external support for enhanced water supply sustainability (please, refer to figure 2.2- the conceptual framework).

4.10 Correlation Analysis

Correlation analysis measures the relationship between two variables. For this study, these were the independent variable (water supply technology) and dependent variable (sustainability of the water supply project). The resulting value (called the "correlation coefficient") shows that if changes in one variable (a technology) will result in changes in the other variable (sustainability). Sustainability was measured in terms of total functionality of the whole scheme. Functionality indicates that scheme or project is sustainable, meaning the continuity of the service to the beneficiaries.

Adapting from Sharma, A. K (2005); correlation coefficient (r) from a sample (n) which represents the number of projects/schemes surveyed can be calculated using the following formula;

$$r = \frac{n(E_{xy}) \quad - \quad (E_{(x)})(E_{(y)})}{\left\{(nE_{x^2} - (E_x)^2) \quad (nE_{y^2} - (E_y)^2)\right\}^{1/2}}$$

Table 4.4: Coding of Variables

Variables	Indicators	Code number
Independent variable: Technology group (Y)	Motorized	1
	Manual	2
Dependent variable: Sustainability (X)	Functional	2
	Non functional	1

Table 4.5: Data for Calculation of Correlation Coefficient, r

Sample, n (coded projects)	X	Y	XY	X^2	Y^2
1	2	1	2	4	1
2	2	1	2	4	1
3	2	1	2	4	1
4	2	1	2	4	1
5	2	1	2	4	1
6	2	1	2	4	1
7	2	1	2	4	1
8	2	1	2	4	1
9	2	1	2	4	1
10	1	1	1	1	1
11	2	1	2	4	1
12	1	1	1	1	1
13	1	1	1	1	1
14	2	1	2	4	1
15	2	2	2	4	4
16	2	1	2	4	1
17	2	1	2	4	1
18	1	1	1	1	1
19	2	1	2	4	1
20	2	1	2	4	1
21	2	1	2	4	1
22	2	1	2	4	1
23	2	1	2	4	1
24	1	1	1	1	1
Total (E)	**43**	**25**	**43**	**81**	**27**

Calculation using the above formula and using the data in Table 4.4 (of values of E_x= 43, E_y= 25, E_{xy} = 43, E_x^2= 81 and E_y^2= 27) for the total surveyed projects (n) which summed to 24, Correlation Coefficient, r, was -0.9199 (= -91.99%). This implies that there was very strong correlation between technology and sustainability but it was a high negative coefficient, which meant that the relationship was in the opposite direction.

Analytically, the strong negative correlation of 91.99% shows that there was a very strong dependence of sustainability from the chosen water supply technology. A change in any of the technologies (indicator) might affect the sustainability trend. On the basis of based on this strong correlation coefficient, even poor functionality of the rural water supply projects caused by inappropriate water abstraction technology would have an effect on the sustainability of the project.

4.11 Discussion of the Findings

The quantity and quality of water was found not sufficing the communitiesô needs in the study area (sufficiency levels of 41% for Bahi and 28.6% for Chamwino). The response was largely attributed to fewer working distribution points (DPs) in the existing schemes. The responses conform to Singh *et al* (2005); Singh as well as (this study) insists that the local people should negotiate, communicate, learn and arrive at joint decision that reflects community choices and preferences to achieve sustainability.

As already indicated in the preceding sections, 30.4% and 10.3% of the water supply projects in Chamwino and Bahi were not working at the time of this study. Although the above percentages look to be relatively small compared to those which were functional they do represent the communities that missed the service and had no alternative water sources in the vicinity. By reflecting these figures in the Toyobo and Muili (2013); it can be deduced that non functional water points reflect the incorrect entry points to the communities by the donor/facilitators, which ultimately affects management and sustainability of the rural water supply projects.

More than half of the respondents were not satisfied with the technology (59% Bahi, 64.3% Chamwino). WASHtech (2013); found the same scenario in Uganda. In order for technology to be scalable user satisfaction has to be observed.

82.1% of the community members in Bahi and 94.7% in Chamwino had to walk beyond the NAWAPO 2002 recommended walking distance of 400m to get water. This scenario is similar to the findings in the study done by Brett *et al* (2007). The longer the walking distances the more the displeasures and increase in the burden on women who bear the yoke of having to fetch water for their families in the rural areas. Livelihood is negatively affected by the wasted time and energy.

Only 10.2% of surveyed projects in Bahi and 7.2% in Chamwino were direct community choices. This represents the smallest fraction in the study area and reflects neglect of the powerless stakeholders in the community. This situation renders inactive decision on the project choices and leads to poor sustainability of the projects, also pointed out by Victor (2014).

The study observed that the types of water supply technology were pre-defined and not shared to the communities. External sources such as donors, LGA experts and private sector facilitators dominated over the community instead of observing the communityôs preferences. The percentages of external sources technology choices were 89.7% for Bahi and 82.2% for Chamwino, with these percentages it was clear that the community had less inputs to the technology choices. There was a resemblance of this scenario with Paulôs (2011); revelation the WSDP phase 1 pre-decided for the type of rural water supply technologies. The outcome was the communitiesô rejection of the projects as the members went back to their original traditional water sources and the external actors could not achieve their targets of reducing health effects caused by unsafe/unclean water usage.

It was found that the most common technology used in the study area was the pumped and piped supply option using the Lister Peter Diesel Engine with the Mono pump technology (Bahi 76.9% and Chamwino 53.5%). One of the manifestations of the dominance by external sources was the imposition projects on the communities, applying the same technology everywhere and treating different communities in the same way. The implication was that the type of technology applied was of the donor group interest. Haysom (2006); observed that this type of scenario was not suitable for the sustainability of rural water supply and that external actors should observe community dynamics while considering technological options. In the case of this study it was not necessary to apply one technology all over the districts because the communities were not the same and thus the adaptation capacities differed. This was also noted from MAMADOôs experience in the study area and the non-functioning projects that were found in this study (30.4% in Bahi and 10.3% in Chamwino) can be taken as proof for scenario.

CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The major aim of this study was to analyze sustainability of selected rural water supply projects in two districts of Dodoma region, central of Tanzania. Specifically the study dwelt much on analyzing the implications of technology choices in the context of sustainability. Factors that influence sustainability were also determined and discussed in this study with the aim of generating information on water supply technologies with regards to sustainability of rural water supply projects.

Furthermore, the study intended to inform policy makers and project planners on how to plan and design sustainable rural water supply projects. All this information has been presented in the previous chapters. This chapter therefore, provides a succinct conclusion on the specific study objectives and the implications of the study findings.

5.2 Summary of the Main Findings

Specific objective number One was to assess if community was involved in reaching to the decision of the chosen water supply technology. The study has found that there was very limited involvement of the beneficiaries in the decision of the type of affordable and appropriate water supply technologies. 0% in Bahi district and only 8.9% in Chamwino district water supply technologies were of the communitiesô choice, while the remaining choice percentage was done by donors and a very small fraction by the communities which were led to choose a particular technology. The discussion in this submission has linked this scenario with prospect of more failures of the current functional projects that would add up to the existing non-functioning projects and increased un-sustainability of the projects.

Specific objective number Two was to identify the water supply technology options that were shared for the community to choose. The study found that 100% of Bahi and 98.2% of Chamwino communities (nearly all the respondents) denied to have shared knowledge of other water supply technologies options that would suit their needs. This means that the communities were limited and constrained by donor requirements and had to submit to donor and external expertsô choices of technologies. This state of affairs was found to lower levels of satisfaction and ownership on the part of communities and threatened sustainability of the projects.

Specific objective number Three was to examine functionality of the project with the current water supply technology. The majority of the surveyed projects were found to be functional. However, the remaining small fraction 10.3% and 30.4% in Bahi and Chamwino respectively signified that there were some communities that did not have access to safe water supply due to technical challenges brought about by the chosen water supply technologies.

The Fourth specific objective was to establish the relationship between water supply technology choice and sustainability of the project. The study established a very strong negative correlation coefficient of the technology (independent variable) and sustainability (dependent variable). The coefficient, r, of -0.9199 (-91.99%) implied that there was strong relationship between the type of water supply technologies and sustainability of the rural water supply projects. The figure implied that a change in the independent variable (water supply technology) would affect the dependent variable (sustainability) and the study calls on external actors/facilitators to consider community demands, take them throughout the project and decide with them on how to enhance the chosen water supply technology. It is considered that this should improve the functionality of the projects and hence the sustainability goals.

5.3 Implications of the Findings

5.3.1 Policy Implications

The majority of the community institutions governing rural water supply projects were the VWC, half of which engaged the services of Private Operators (PO). The study found that all the Agencies (PO) were directly accountable to the village governments. This was due to the weaknesses of VWCs which was caused by the village governments for their operations. This implied that more than half of these community institutions were not conforming to the new NAWAPO of 2002.

The new NAWAPO encourages the Public-Private-Partnership (PPP) in enhancing water project sustainability. Victor (2014); found a significant correlation between private operated projects and sustainability status. However this study encourages dominance of the management of project by COWSOs so as to detach the projects from the village governments. This should promote project autonomy and also transparent accountability to the end users for the enhancement of project sustainability.

5.3.2 Development Theories Implications

The dependency theory elaborated in this study and related to real situation on the ground. Some of the water supply projects in this study were proved to have failed because of incorrect assumptions about the local capabilities. Although the rates were relatively low (10.3% and 30.4% in Bahi and Chamwino respectively) they represented the communities that were deprived of the crucial social service in their real life.

The demand-responsiveness theory was also proved in this study. Donor/experts influences and decisions for rural water supply projects were remarkable in the study areas, where 89.7% and 82.2% of the technology choice decisions in Bahi and Chamwino respectively, were done by donors instead of from the targeted beneficiaries. Consequently, the sense of ownership of the projects among the communities dropped significantly i.e. in Chamwino (30.3%); it is feared that in the near future this tendency will thwart the beneficiariesôzeal to own the project, e.g. in Bahi that sense of ownership was 6.4%.

This situation reflected that the consumer demand was not considered and this endangers sustainability of these projects. The established correlation coefficient showed that there was very strong relationship between technology choice and sustainability. If projects do not result from community demand then there is a big likelihood of the projects to fail and thus become unsustainable.

The modernization theory was also proved in this study. As suggested by Sara and Katz (1998); on this theory, that in order to create an environment for sustainability of the project end users should be allowed to make a choice of the interventions and commit resources of their choices. However, this was not the case in this study, as the majority of the projects were the choices of the donors (87.2% in Bahi and 69.6% in Chamwino). In these situations the majority of community members were denied the opportunity to contribute to these projects and that diminished the chances for the projects to be sustainable.

5.3.3 Data and Methodology Implications

Although the data used in this study are subjected to some limitations, the study was able to answer all the four research questions that were posed initially. The study managed to answer the research question on the management practice of the projects in the study area.

The first question was on the community involvement in reaching the decision to opt for a certain technology. The study answered this question when it found that there was a very limited/minimal community involvement in the selection of the appropriate and affordable technologies for their projects. The second research question was to assess if the process exhausted all the existing water supply technological options applicable in their areas and the study answered this question by providing quantitative evidence that technologies were pre-determined or pre-defined by the external actors such as donors, CSOs and the government.

Third question on the community sense of ownership and the capacity to meet O&M costs with the current technology was also answered. Communities were found to have low sense of ownership. However, they had no option but to pay for the unsatisfactory water supply service, in the few cases where the projects met the O&M requirements. Finally, the study provided responses with regard to the relationship between technology choice and sustainability of the projects by establishing a very strong correlation coefficient that was in the opposite direction.

5.3.4 Conceptual Framework Implications

The conceptual framework was well tested in this study; firstly, there was weak participation of the community in organizing, training, designing and construction of the project while considering the chosen technology. Secondly, the failure of the projects in the study area had a relationship with insufficient community involvement in decision making in the water supply projects in which they had vast interests. Thirdly, it was found that there was no continual external support from actors in capacity building. The communities and water supply management institutions were only trained during the project execution but no further capacity building in software and hardware was given to the community institutions and no PIMS was done in any of the surveyed projects. Therefore, the indicated few projects failures might have been due to weak relationship between the community, external sources of interventions and the external support for capacity building as shown in the conceptual framework, hence the reduced level of sustainability of the water supply projects in Bahi and Chamwino districts.

5.4 Conclusion

Sustainability was mainly measured in terms of functionality status, as well as other factors such as beneficiaries participation in all the project phases, capacity of community institutions to meet O&M costs, mode of project operation and linkage between the community water management institutions and the external support, community sense of ownership and level of satisfaction and affordability of service due to the applied technology and its appropriateness to all groups of users that collectively attributed total functionality of project. All these factors contributed to the levels of functionality of the projects as relating to the chosen water supply technology. In the final analysis these factors were used for developing a correlation between sustainability status and the type of water supply technology. The study can conclude by stating that there is a very strong correlation between the type water supply technology choice and sustainability of the projects and that weak community participation in the choice of the particular technologies became a key determinant to poor functionality of the projects and hence their un-sustainability.

5.5 Recommendations

The study wishes to objectively recommend the following to be done so as to improve community participation and sustainability of the rural water supply projects;

5.5.1 Objective Recommendations

Specific Objective Number One:

1. Deep researches should be done prior to project design. This will help investors to know the real community demand and how to mobilize the community resources for project optimization
2. Projects should consider strong community participation according to the community ability through application of the interactive participation approach (please refer Table 2.1)
3. In order to form strong community institutions as the management model the NAWAPO of 2002 should be observed. The policy insist on COWSOs to replace VWCs and that COWSOs should be registered at the LGAs and work

autonomously. On their composition, COWSOs should have representatives from different community groups that have stakes in the project.

Specific Objective Number Two:

1. External actor should work closely with local actors (communities) for thorough assessment of different applicable water supply technologies prior to applying them on the ground.

Specific Objective Number Three:

1. Apart from forming strong community institutions, it is recommended that there should be continual capacity building to them from the external actors after project completion.
2. Application of PIMS is highly encouraged as a tool for gathering the lessons and challenges prior to scaling up of the technologies to other areas. Capacity gaps at community level on the use of the technology should also be observed.
3. The NAWAPO of 2002 insist on Private Sector Engagement in promoting rural water supply sustainability. The study therefore recommends that the government at district level should create conducive environment for private sector to invest in spare parts supply chain to simplify accessibility of spare parts immediately when needed and promote improved functionality and sustainability of the rural water supply services.

Specific Objective Number Four:

The study established a very strong correlation between water supply technology and service sustainability. It is therefore recommended to the external actor side that transparency should be well observed through the sharing with the beneficiaries on all the technological options, their advantages and disadvantages and when possible to respect technologies which communities have experience with for the following advantages: it will be much cheaper to improve on the communities knowledge and experiences; it will build a sense of ownership, increase level of satisfaction and hence sustainability of their projects.

5.3.2 Technological Recommendations and Approaches

On technological implications, the study recommends the following;

1. Rural water supply external actors should be coordinated to share experiences on success and challenges of the rural water supply technologies so as to build a good understanding of the community perceptions.
2. Investment in studies/researches on the communities to understand their dynamics so as to have new and better approaches that can fit in well modern communities.
3. Involvement of traditional leaders in all project stages to avoid vandalism of the project infrastructures and inculcate willingness to care for the structures. The study observed that the traditional leaders had high influencing powers on the local community than the political leaders.
4. External facilitators should exercise sensitivity during community group capacity building, e.g. members of the community could be grouped according to age or gender, instead of grouping them all in the same group.
5. External Actors should invest in cultivating political willingness to accept projects so as to avoid vandalism and resistance or rejection of the project.

6. There should be motivation for trained community members who are expected to disseminate the knowledge and skills to the other members of the community (even verbal appreciations can do), for easy of transition of the right skills from one generation to the other.
7. According to the MAMADO experience, Solar energy can work more efficiently than the current commonly used water supply technology (diesel engines with mono pumps or electrically powered pumping systems). Solar systems require less investment costs and are relatively cheaper to run throughout their life time on O&M. MAMADO have applied this technology in Chololo village in Dodoma municipality where the communities confirmed that they never experienced any technical problem with the system. The service was reliable. Please refer the annex 3 for more technical data on this.
8. DWE office to assist the communities in contractual engagement with the Private Operators so as to safeguard the communityǒs interests. Also, the contract management should be closely managed and monitored by the DWE office.
9. Section 4.6 explained on the different water tariffs used in the study area, it was observed that household connections were flat rate billed; this was the major source of non revenue to the WUGs. It is therefore recommended that external actor/donors to come up with new innovations such as prepaid metering systems through which users will be obliged to pay according to the amount of water s/he is using. This will avoid non revenues in water (funds wasted by unaccounted loss of water) and hence increase revenues to the

WUGs for improvements, expansions or scaling up their rural water supply projects.

5.6 Study Limitations and Delimitations

Sustainability is a contradictory phenomenon with different interpretations and meanings to different actors depending on the context and motives of use of technology by the actors. This study adopted the sustainability indicators matrix for measuring sustainability and selected the water supply technology which was later assessed in terms of project functionality to determine sustainability.

Water is vital for human development. As such conducting a study in water projects is associated with many expectations from end users of water projects. One has to take care so as to avoid providing inaccurate answers. For this matter, the researcher had to provide a brief explanation and purpose of the study.

Studying community based water projects in a diversified geographic location poses a very big challenge to the researcher. In order to study in detail different types of projects available in the study area, multi-stage sampling techniques were employed whereby strata of different projects were created. Furthermore simple random sampling was adopted to select the study projects.

5.7 Suggested Area for Further Study

The researcher hereby wishes to suggest further studies in assessing the other sustainability indicators such as Environmental implications; Skills of the community water supply institutions; Economic implications from the unsustainable water supply services. There are several other indicators, such as social impacts of the services and how effectively external support can improve the capacity of the legal community organizations in enhancing rural water supply sustainability. The researches should come up with recommendations that can inform the rural water supply sub sector for effective investments.

REFERENCES

Arvidson, M. and Nordström, M. (2006). Water sector Policy overview paper. *Stockholm Environment Institute.*

Bailey, D. K. (1998). *Methods of social science research*. The Free Press Collier Macmillan Publisher, London.

Baumann, E. (2003). *Technology Options in Rural Water Supply*. Skat_Foundation. Rural Water Supply and Sanitation Network.

Baumann, E. (2005). Common RWSN context. Discussion Paper. *St. Gallen, SKAT/RWSN.*

Bossert, T. J. (1989). *Sustainability In Africa*. A.I.D. Health Projects in Zolre, Senegal and Tanzania. Washington, D.C.: U.S. Agency for International Development.

Brett A. Gleitsmann, Margaret M. Kroma and Tammo Steenhuis, (2007). Analysis of a rural water supply project in three communities in Mali: *Participation and sustainability*. Natural Resources Forum 31 (2007) 142ï 150

Carter R. C., Tyrrel S. F., Howsam P. (1999). Impact and Sustainability of Community Water Supply And Sanitation Programmes In Developing Countries. *Journal of the Chartered Institution of Water and Environmental Management*. Vol.13, No.2, 292-296.

De Vaus, D. A. (2001). *Research design in social research*. SAGE Publications, Inc. London.

Flyvbjerg, B. (2006). Qualitative Inquiry. Vol 12, No. 2, 219-245. [http://qix.sagepub.com] site visited on 16th April 2015.

Fowler, F. J. (1993). *Survey Research Methods*. Second Edition. SAGE Publications, Inc. California.

Goldman, M. (2005). *Imperial Nature.* Yale University Press, New Heaven and London.

Harvey, A. and Reed, R. (February 10, 2006). Community-managed water supplies in Africa: sustainable or dispensable? *Community Development Journal Advance Access* 10.1093/cdj/bs1001.

Harvey, P. A and Reed, R. A. (2004). Rural Water Supply in Africa*: Building Blocks for International Conference on Water and Environment* (Dublin, 1992). The Dublin Statement on Water and Sustainable Development.

Haysom, A. (2006). *A Study of the Factors Affecting Sustainability of Rural Water Supplies in Tanzania*. Unpublished Masters Dissertation, Cranfield University.

Hodgkin (1994). The sustainability of donor-assisted rural water supply. *WASH Technical Report No. 94.* Arlington, Va.: Water and Sanitation for Health Project.

Howitt, D. And Cramer, D. (2003). An introduction to statistics in psychology. *A complete guide for students (revised 2nd ed.)*. Hemel Hempstead: Prentice Hall.

Jakobsen, G. T. (2013). Theory of Science. *What is Positivism*. Published in February 15th 2013. Cited through http://www.popularsocialscience.com/2013/02/15/theory-of-science-what-is-positivism/ on the 18th March 2015.

JMP, (2010). Joint Monitoring Report: Coordinated by the Ministry of Water Tanzania.URT (2010).

Kamanzi, A. (2007). Our *way to Responding to the Dutch aid in the District Rural Development Program of Bukoba*, *Tanzania*. Leiden: ASC.

Kilonzo, R. (2008). *Land Conflict in Sub-Saharan Africa: Development and Evictions along the Morogoro Highway, Tanzania*. Unpublished PhD thesis, University of Minnesota, USA.

Kumar, K. and Casley, D. J. (1988). *The collection Analysis and Use of Monitoring and Evaluation Data*. The International Bank for Reconstruction and Development. Washington.

Magigi, W. (2015). Research Proposal Development and Report Writing*. A pathway for success in higher learning Institutions*. Safi Publishers and trading Co. ltd.

Mansuri, G. and Rao, V. (2004). Community-Based and ï Driven Development. A Critical Review. *World Bank Policy Research Working Paper 3209.*

Moon, S. (2006). Private Operation in the Rural Water Supply in Central Tanzania: *Quick fixes and slow transitions.*

Narayan, D. (1994). Contribution of people's participation: evidence from 121 rural water supply projects. *Environmentally sustainable development occasional paper series, No 1*. World Bank, Washington, D.C.

Nkongo, D. (2009). *Management and Regulation for Sustainable Water Supply Schemes for Rural Communities*. WaterAid Tanzania.

Nyong, A., Kanaroglou, P. S. (2001). A survey of household domestic water-use patterns in rural semi-arid Nigeria. *Journal of Arid Environments*, 49: 387ï 400.

Paul, F. (2011). Equity Report: Does the WSDP benefit the underserved? *Learning from the first phase of WSDP to inform the second phase*. WaterAid Tanzania.

Pretty, J. N. (1995). *Participatory learning for sustainable agriculture*. World Development Vol. 23 No 8: 1247-1263

Sara, J. and Katz, T. (1998). Making Rural Water Supply Sustainable. *Report on the Impact of Project Rules.* World Bank. Discussion Paper No. 24. Washington, D.C. : U.S. Agency for International Development.

Sassen, S. (1999). Whose City Is It? *Globalization and the Formation of New Claims. From Globalization and its Discontents* (NewYork: New Press). Excerpt the Globalization Reader, edited by Frank Lechner and John Boli, 70-76.

Sharma, A. K. (2005). *Text book of Correlation and Regression*. Discovery Publishing House Mathematics Series, DPH, New Delhi, India.

Singh, N., Jacks, G., Bhattacharya, P. (2005). *Women and community water supply programmes*. An analysis from a socio-cultural perspective. Natural Resources Forum, 29: 213ï 223.

Taylor, B. (2009). Management for Sustainability. *Practical lessons from three studies on the Management of rural water supply schemes,* WaterAid Tanzania.

Toyobo, A. E. and Muili, A. B. (2013). *Sustainability of Borehole Water Schemes Through Community Participation in Ejigbo, Osun State.* Department of Urban and Regional Planning Ladoke Akintola University of Technology, PMB 4000, Ogbomoso, Oyo State, Nigeria. Vol.4, No.9, 2013-Special Issue - 2nd International Conference on Engineering and Technology Research.

UNICEF and WHO (2000). *Joint Monitoring Programme Definitions of Indicators*. http://www.unicef.org/wes/mdgreport/definition.php (accessed: 18th May 2015).

Victor, G. (2014). *Sustainability of Community Water Projects in Central Tanzania*. Unpublished PhD thesis. University of Dodoma, Tanzania.

WASHtech (2013). *Technology Applicability Framework Manual*. Skat_Foundation publication.

WASHtech (2013). *Recommendations for the sustainability and scalability of solar powered water pumping for domestic supply in Adjumani and Kanungu districts of Uganda*. NETWAS and WaterAid, Uganda.

WaterAid (2012). *Water Security Framework*. WaterAid Global Forum.

WaterAid (2010). *Sustainability Framework*. WaterAid Global Forum, April 11, 2014.

WPM (2014). *Water Point Mapping Report*. Ministry of Water Tanzania. URT (2014)

World Bank (2014). *Water Supply and Sanitation Sector Results Profile*. Foundations for Ending Poverty. Providing Sustainable Water and Sanitation Services (http://www.worldbank.org/en/results/2013/04/12/water-sanitation-results-profile). Accessed April, 2015.

World Bank (2002). *Water, Sanitation and Gender Equality*. Gender and Development Briefing Notes, Gender and Development Group. Washington, DC: World Bank.

World Bank (1998). Making Rural Water Supply Sustainable. *Recommendations from a Global Study.*

WSSR (2014). Water Sector Status Report: *Marking the end of WSDP phase One*. The Ministry of Water, Tanzania. URT (2014).

Yin, R. K. (2003). *Case study research, Design and methods.* (3rd ed.). Thousand Oaks, CA: Sage Publications.

Yin, R. K. (2009). *Case study research, Design and methods.* (4th ed. Vol. 5). Thousand Oaks, CA: Sage Publications.

ANNEXES

Annex 1: List of villages surveyed per district

Bahi	Remarks	Chamwino	Remarks
1. CHIBELELA	Surveyed	CHALINZE	Surveyed
2. MWITIKIRA	Surveyed	CHILOMWA	Surveyed
3. MPHANGWE	Not surveyed	MLIMWA	Surveyed
4. MTITAA	Surveyed	CHINANGALI 2	Surveyed
5. NCHINILA	Not surveyed	DABALO	Surveyed
6. IBUGULE	Surveyed	HANDALI	Surveyed
7. NKHOME	Surveyed	NDEBWE	Surveyed
8. NHOLI	Surveyed	MANCHALI	Surveyed
9. MPALANGA	Not surveyed	IRINGA MVUMI	Surveyed
10. CHIDILO	Surveyed	MUUNGANO	Surveyed
11. ZANKA	Surveyed	ILOLO	Surveyed
12. MAYAMAYA	Not surveyed	MZULA	Surveyed
13. MKONDAI	Surveyed	IDIFU	Surveyed
14. ASANJE	Surveyed	MAJELEKO	Not surveyed
15. BABAYU	Not surveyed	MLOWA	Surveyed
TOTAL	**10**		**14**

Annex 2: List of WUGs surveyed per district

Bahi	Remarks	Chamwino	Remarks
1. CHIBELELA	Surveyed	CHALINZE	Surveyed
2. MWITIKIR.	Surveyed	CHILOMWA	Not surveyed
3. MPHANGWE	Not surveyed	MLIMWA	Surveyed
4. MTITAA	Surveyed	CHINANGALI 2	Not surveyed
5. NCHINILA	Not surveyed	DABALO	Surveyed
6. IBUGULE	Surveyed	HANDALI	Not surveyed
7. NKHOME	Surveyed	NDEBWE	Not surveyed
8. NHOLI	Surveyed	MANCHALI	Surveyed
9. MPALANGA	Not surveyed	IRINGA MVUMI	Surveyed
10. CHIDILO	Surveyed	MUUNGANO	Surveyed
11. ZANKA	Surveyed	ILOLO	Surveyed
12. MAYAMAYA	Not surveyed	MZULA	Surveyed
13. MKONDAI	Not surveyed	IDIFU	Surveyed
14. ASANJE	Not surveyed	MAJELEKO	Not surveyed
15. BABAYU	Not surveyed	MLOWA	Not surveyed
TOTAL	**8**		**9**

Annex 3: Comparison of the solar powered system against diesel engine powered supply system

Criteria	Solar system	Lister peter system
Specifications	10horsepower, 120meters pumping head, 67,000L/8hours	10horse power, 120meters pumping head, 67,000L/8hours
Initial cost (capital investment)	TZS 45 Mil	TZS 31 Mil
Components	Panels with equivalent power and all components all bought together	Engine and other parts bought separately
Warranty	2years for the pump, 10year for the panels	2years for the whole system
Running cost	No cost in the first and second year of the pump no cost in the first 10 years of the solar panels, guarantee replaces it	-1st day diesel of 6L/5hrs to give same power output -approximately TZS 8.64mil/2yrs - monthly heavy duty oil 4L @ TZS 40,000 with oil filter @ TZS 15,000 -2 months diesel filter @ TZS 15,000, -air cleaner and associates @TZS 50,000. Other parts like rods, pulley requires more funds and can delay the system to work for more than a week because the spare parts are coming from Dares salaam mostly
Working hours	8 sunny hrs, flexible with sunny hours	Recommended 6hrs
Maintenance	Requires any person to clean the panels and security, requires experts to clean boreholes in every 10years	Trained fundi for maintenance, requires VPA for operations, requires experts to clean boreholes in every 10yrs
Availability and recommended manufactures	India for pump, Australia for panels-best quality. Chinese for other specifications and costs but they use battery	Engine and pump can be from Australia

Annex 4: List of questionnaires

Research on community participation in designing, implementation and management of rural water supply projects in Dodoma region

Questionnaire for the selected households

Put a tick in the right place/fill in the blank spaces

Name of intervieweré é é é é é é é é é é é é é . Date ..é é é é é é é é é .

Village é é é é é .é é é é é é é é .. Ward .é é é é é é é é é é é é é é

Division é é é é é é é é ..é é é é . Districté é é é é é .
Regioné é é é é ..

Starting timeé é é é é é é é . Name of interviewee/phone numberé é é é é .

Personal information

1. Sex of respondent
(a) Male ( )
(b) Female ( )

2. Age of the respondent
   (a) 15-20 years ( )
   (b) 21-35 years ( )
   (c) 36-45 years ( )
   (d) 46-60 years ( )
   (e) 60 years and above ( )

3. What activities do you do to support your life?
   (a) Agriculture ( )
   (b) Cattle keeping ( )
   (c) Employed ( )
   (d) Business ( )
   (e) Others
   é é é ..é é

   What is your householdôs annual income? é .é é é é é é é é é é é é .

4. How many people live in your house/family?é é é é é é é é é é é é .

Water for domestic uses

5. Where do you get water for domestic uses?
   (a) Tap water ( )
   (b) River ( )
   (c) Deep wells ( )
   (d) Shallow wells ( )
   (e) Damn ( )
   (f) Wet areas ( )
   (g) Constructed spring ( )
   (h) Traditional spring ( )
   (i) Streams ( )
   (j) Others é ...

6. Is the water enough to meet your household demands?
(a) Yes ( )
(b) No ( )

7. Where do you get water when the main source is not working?
é é é é é é é é é é é é ..é é é é é é ....

8. Howfar is the water source from the place you live?
(a) Below 400m ( )
(b) 400 to 1Km ( )
(c) 1 to 2 Km ( )
(d) Beyond 2Km ( )

History of the project

9. How did you get the project
   (a) Pressure/desires from the donors ( )
   (b) From the government ( )
   (c) The need came from you ( )
   (d) Others,
      é .é
      é

10. How did you ñpersonallyò get involved in the decision of the choice of this project?
      é
      é é é é é ..é é

11. How did you/your household participate in the construction of the project infrastructure?
    (a) Funds ( )
    (b) Man power ( )
    (c) We did not participate at all ( )
    If not participated, why? é é é ....
    What was done to make the project accomplished? é é é é é é é é é

12. Do feel like you own this project anyhow?
    (a) Yes ( )
    (b) No ( )
    If NO, why? é é é é é é é é é é é é é é é é é é ..
    é

Technology choice and sustainability of the project

13. What was the criterion in choosing for this technology?
    (a) Choice of the experts/facilitators ( )
    (b) Community was led to choose ( )
    (c) Choice of the community ( )
    (d) We donøt know ( )
    Can you name the type of technology you are currently using
    é é é é é é é é .é é é é é é é é é é é é . é é é é é é é é é é .
14. Were you told on the advantages and disadvantages of the chosen technology?
    (a) Yes ( )
    (b) No ( )

15. Were you told on the other applicable technological options to suit your need?
    (a) Yes ( )
    (b) No ( )
    If yes, please mention them é .é é é é é é é é é é é é é é é é é é ..

Project progress

16. Does the project meet your expectation?
    (a) Yes ( )
    (b) No ( )
    If NO, why é .é ....é é é é é é é é é é é é é é é é é é é ..

17. Can the technology be used by everyone in your house?

(a) Yes ( )
(b) No ( )
If NO, which group is not able to use the technology? How do they get water
é é é .é é

18. How do you get water in case of infrastructures breakdown?
é é é é é é ...é é é ..é ..
é é

19. Are you satisfied with this technology the way it works?
(a) Yes ( )
(b) No ( )
If NO, why?
é .é é é é é é é é é é é é é é é é é é é .é é é é ..é ..

20. Is the project functional to-date?
Yes ( )
No ( )

Payment for water

21. How do you pay for water service?
é é é é é é é é é é é é é é é é é é é .é é

Are you able to pay that amount of money?
(a) Yes ( )
(b) No ( )

22. Does the group leadership report to you on income and expenditure?
(a) Yes ( )
(b) No ( )
If YES, how often? é ..

23. Uses of water

Source	Uses

Finish time: é é é é é é é é é é é

Research on community participation in designing, implementation and management of rural water supply projects in Dodoma region

Questionnaire for Community Owned Water Supply Organization- COWSO

Put a tick in the right place/fill in the blank spaces

Name of intervieweré é é é é é é é é é Dateé é é é é é é é é é é é é .

Name of COWSOé é é é é é é é . Villageé é é é é é é é .
Wardé é é é é é é é .. Divisioné é é é é é é é ..é é é é .
Districté é é .é é é . Region.é é é é é ..

Starting time é é é é é é é é ..

Group information

1. List group members as shown in the table below

#	Number	Males	Females	Disabled	
				Male	Female

2. What is the management option
   é
3. How old is the projecté é .
   é ..
4. Type of the project
   (a) Mechanized scheme (electrical/ diesel engine) ( )
   é é é é é ..é é é é é é é é ..
   (b) Hand pump ( ) mention the type of the pump
   é é é é é é é é é é é é é é é ..

5. Is the group registered at the LGA?
   (a) Yes ( )
   (b) No ( )

Uses of water

6. What is the main use of water in this project?

   (a) Domestic ( )
   (b) Agriculture ( )
   (c) Cattle keeping ( )

(i) Othersé é é ...., ...

7. Is the water for domestic purpose adequate in quantity?
   (a) Yes ( ), how much é
   (b) No ( )
   If NO, how do you get water to satisfy your needs?
   é ..

History of the project

8. How did you get the project
   (e) Pressure/desires from the donors ( )
   (f) From the government ( )
   (g) The need came from you ( )
   (h) Others, é .é é .
   é

9. Did the community participate in the decision on the type of the project?
   (a) Yes ( )
   (b) No ( )
   If YES, explain how community participated
   é
10. How did the community participate in the initiation and construction of the project
    (a) Funds ( )
    (b) Man power ( )
    (c) Did not participate at all ( )
    If No, what was the reason? é é é ....

    What was done to achieve the project completion?
    é é é é é é é é é é é .é é é é é é é é é é é é é é é é é é é é

Choice of technology and its sustainability

11. What was the criterion in choosing for this technology?
    (e) Choice of the experts/facilitators ( )
    (f) Community was led to choose ( )
    (g) Choice of the community ( )
    (h) We donõt know ( )
    Can you name the type of technology you are currently usingé é é é .é é

12. Were you told on the advantages and disadvantages of the chosen technology?
    (c) Yes ( )
    (d) No ( )

13. Were you told on the other applicable technological options to suit your need?
    (a) Yes ( )
    (b) No ( )
    If yes, please mention them, é é é é é é é é é é é é é é é é é é é .

14. How do you solve for technical challenges arising from the chosen technology?
é é

Project progress

15. Does the project meet your expectation?
    (c) Yes ( )
    (d) No ( )
    If NO, why é ....é é é é é é é é é é é é é é é é é é é ..

16. How often do you experience breakdowns?
    (a) Daily ( )
    (b) Monthly ( )
    (c) Others, é ..

17. How long do you take to resolve the problem?
    (a) Within a week ( )
    (b) More than a week ( )
    Why does it take more than a week? é é é é é é é é é é é é é é é ..

18. Where do you get water when there is project breakdown
    é

19. Can the technology be used by every group member?
    (c) Yes ( )
    (d) No ( )
    If NO, which group is not able to use the technology? How do they get water .é é

20. Is there any arrangement for capacity building from anyone for your group on how to manage your project?
    (a) Yes ( )
    (b) No ( )

21. Is the project functional to-date?
    (a) Yes ( )
    (b) No ( )

Capacity to manage the project (revenue collection and expenditures)

22. How does the community pay for water?
    é

23. Do you have a bank account?
    (a) Yes ( )
    (b) No ( )
    If YES, how much is in the account?
    é é é é é é é é é é é é é é é é é .
    If NO, how do you keep the funds collected from water bills?
    ..é .
24. How is the response from the community when it comes for payment of water?
    (a) Self motivated/willing to pay ( )
    (b) By pushing them to pay ( )
    If by pushing, why is that so? é ..é é .é é é é é é é é é é é é é é é é .
25. Does the collected revenues enough to solve technical problems in your project?
    (a) Yes ( )
    (b) No ( )
    If NO, how do you solve the problems? é é é é é é é é é é é é é .

26. Do you experience any interactions from the village government/district officials on how you should spend your revenues?
    (a) Yes ( )
    (b) No ( )

27. Do you share the income and expenditure report with the group members?
    (c) Yes ( )
    (d) No ( )
    If Yes, how often? é é é é é é ..é é é é é é é é é é é é é é é é ..

28. Is the line/pump attendant capable of solving technical challenges in your project?
    (a) Yes ( )
    (b) No ( )

Name of the respondents with their communications

S/N	Name/title	Sex	Phone numbers
1			
2			
3			
4			
5			

Finish time:é é é é é é é é é é é

Research on community participation in designing, implementation and management of rural water supply projects in Dodoma region

Questionnaire for Civil Society Organization- CSOs/NGO

Put a tick in the right place/fill in the blank spaces

Name of intervieweré é é é é é é é é Dateé é é é é é é é

Districté é é é é é ..Regioné .é ..é é é é é Name of CSOé ..é .é é é é é
Interviewee/Titleé é é é é é é é é é é é Contactsé é é é ..é é é é é .é ..

Start time é é é é é é é é é é é é é ...

Information about the Organization

1. What is the core business of your organization?
é é
2. Do you coordinate water supply project in your core business?
(a) Yes ( )
(b) No ( )

3. Which kind of water supply technology do you insist in your strategies? é

Implementation of rural water projects

4. How do you position yourself in rural water sector?
(a) Facilitators ( )
(b) Donors ( )
(c) Capacity building to the communities ( )
(d) Others, é é é é é é é é é é é .. é é é é é é é é é é é é é é .

5. Which approaches do you use to identify the communities in need of your services? é

Implementation approaches

6. Which community participatory approaches do you use in implementing your projects? é

7. What is the main challenge do you encounter with your participatory approach in identifying and implementing the rural water supply projects in your areas? é

8. Where do you see other actors make mistakes in enhancing community participation in the project circle? é é é é é é é é é é é é é é é é é

Technology choice

9. How do you arrive to the decision of a certain water supply technology choice for the communities in your projects?
é é

10. There has been some evidence showing poor community participation in deciding the type of water supply technology; this has hindered these projects to meet the sustainability expectations. What is your opinion on this?
é é
é é

Capacity building after project implementation

11. How does your organization participate in spare parts supply chain? é

12. Do you have a strategy in your organization of setting aside resources for post implementation monitoring and surveys? é é é é é é é ...é é é é ..
If yes, how do you implement the process?
é é é é é é é é é é é é é é é é é é ..é é é é é é é é é é é é

Sustainability of rural water supply projects

13. Which strategies do you use in enhancing sustainability of your rural water projects?
é .é ..é é

Contribution of CSO in technical support

14. Do you have arrangements in your project of linking the trained community line/pump attendants with experts of the technology that the community is using?
(a) Yes ( )
(b) No ( )
If YES, how? é é é é ..é é é é é é é é é é é é é é é é é é é ..
é é

15. Kindly, share your opinions on poor participation of the rural water supply beneficiaries and how it hinders sustainability of the services.
é é

Finish time: é é é é é é é é é é é

Research on community participation in designing, implementation and management of rural water supply projects in Dodoma region

Questionnaire for District Water Engineer

Put a tick in the right place/fill in the blank spaces

Name of interviewer é é é é é é é é é Dateé é é é é .é é é ..é é é é é

District é é é é é é é .. é é é é é Region é .é ..é é é é é é .é .é é é é

Interviewee name: é é é é é é é é ..Title é é é é é é é é é é é é é é é ..

Contacts .é é é é ..é é é é é é é ..start time é é é é é é é é é é é é é ...

Information at DWE's office

1. What is the role of your office in implementation of rural water supply projects?
   é

2. Do the water projects in your area use water sources with the water use permits?
   (a) Yes ( )
   (b) No ( )
   If YES, briefly explain the type of permits which are mostly used:
   é

   Implementation of the National Water Policy and Water Supply and Sanitation Act

3. What challenges does you office face in the implementation of the National water policy?
   Policy (of 2002): é ...
   Act (of 2009):é é

4. Are there any CSOs/Private Actors involved in rural water supply services?
   (a) Yes ( )
   (b) No ( )

If YES, kindly mention them as per the following table

S/N	CSO	Theme

Applicable technologies in the district

5. What type of water supply technologies are mostly used in your district, please fill the table below:

Group	Type	Current statuses	Remarks
Motorized			
Hand pumps			

6. a) Which type of technologies has been successful in your area? Please fill the table below;

Technology	Reason

b) What is your opinion for the successful technologies?
é é

7. Which type technologies have failed in your area? Please fill the table below:

Technology	Reason

Opinion é

Choice of technology

8. Which criteria do you use in the choice of water supply technology in your area?
é é

9. Which ways/approaches do you use in educating the beneficiaries on the process of choosing appropriate and affordable technology?
é .
.

10. How the targeted communities get involved towards reaching to the final decision of the water supply technology in your district?
é é
é

11. How do you participate in solving the technological challenges at community level? é

Roles/responsibilities of the DWE office in water supply projects

12. In the setup for community water supply projects, how do the communities participate in planning, training, designing and construction of their projects?
é é

13. Does the LGA invested or created a conducive environment for private sector to invest on spare parts supply chain for rural water supply projects?

(a) Yes ( )

(b) No ( )

If YES, how do you prove that this setup has improved sustainability of the projects?

é é é é .é é

14. How does your office provide continual support to the COWSOs on technical issues pertaining the chosen water supply technology?

é .é é é é .é é

15. As the main stakeholder in provision water supply services to the rural communities, what opinion do you have in improving community/beneficiary participation in all the project steps (including right choice of water supply technology) so that to achieve sustainability of the rural water supply project?

é é
.é .é é é é .é é

Finish time: é é é é é é é é é é é

Research on community participation in designing, implementation and management of rural water supply projects in Dodoma region

Questionnaire for village leadership

Put a tick in the right place/fill in the blank spaces

Name of intervieweré é é é é é é é é é Date é é é é ..é é é é é é é é .

Village é é é é é .é é é é é Ward é é é é é é é é é é é é é é é é é é

Division é é é é é ..é é é é . Districté é é é é é . Region é ..é é é é é ..

Starting timeé é é é é é é é .

Information of the village

1. Village population

Number of people	Males	Females	Children		Disabled	
			Male	Females	Males	Females

2. Please list the types of water sources used in your village.
é é é é é ..é é
é é
é é

History of water projects

3. How did you get the project
   (a) Pressure/desires from the donors ( )
   (b) From the government ( )
   (c) The need came from you ( )
   (d) Others,
   é .é é .
4. Did the community participate in deciding for the type of water supply in the village?
   (a) Yes ( )
   (b) No ( )
   If YES, how?
   é é é é é ...é é é é é .é ..é é é é é é é é é é é é

Choice of the technology

5. How did the whole community participate in deciding for the type of water supply technology to be used? é é é é é é é é é é é é é é ..
é .é ..é ...é é é é

6. As village leaders, how were you involved in identifying and deciding for the appropriate and affordable technology for water supply?
é é

7. Does the technology meet the expectations?
é ..é é

Project progress

8. What is your opinion on the functionality of the water projects you have in your village? é .é é ..é

9. Do the projects able to collect revenues that meet operational and maintenance needs?
(a) Yes ( )
(b) No ( )
If NO, how does the village government supports when project experience break downs?
é é
10. How is the relationship between the village government and the COWSO?
é é

Names of respondents

S/N	Name	Title	Sex	Contact
1.				
2.				
3.				
4.				
5.				

Finish time:é é é é é é é é é é é