

**DETERMINANTS OF RURAL WATER PROJECT SUSTAINABILITY: A CASE
OF RUFJI DISTRICT, PWANI REGION, TANZANIA**

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**A DISSERTATION SUBMITTED IN PART FULLFILMENT OF THE
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ABSTRACT

The study was conducted to assess the determinants for rural water project sustainability in Rufiji district, Tanzania. A household questionnaire to 180 respondents in six villages was used in data collection. This was supplemented by discussions with ordinary water users and water attendants. Descriptive statistical methods such as percentages and cross tabulations were used as qualitative analytical techniques. Quantitative methods included Pearson Chi square and Logistic regression model. The collected data were analysed using SPSS software. In order to determine the main factors for rural water project sustainability the Logistic regression model was applied and the results show that cox and snell (R^2) was 0.470 and Nagelkerke (R^2) was 0.670, this indicates that the model was fit to explain the change in the dependent variable as a result of change in the independent variable. From the results it show that only two independent variable which are number of maintenance done and number of spare parts replaced were found significant at $p \leq 0.000$ and $p \leq 0.004$, respectively. The findings implies that the positive signs attached to the estimated coefficients of such variables indicate that the greater the values of these variables the higher the tendency to maintain sustainability of rural water supply. The negative signs of price of water and time for collecting water, indicate that the greater the value of the variable the lower the probability to maintain sustainability of rural water projects. The study concludes that functionality of rural water project depends on multiple factors such as maintenance, availability of spareparts, community participation, and short distances from the sources, reasonable water prices and good management of water funds.

DECLARATION

I, Alistidia William Kyamani, do hereby declare to neither the Senate of Sokoine University of Agriculture, that this dissertation is my original work and that it has neither been submitted nor being concurrently submitted for degree award in any other institution.

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Date

The above declaration is confirmed by:

Supervisor: Dr. Mbwambo J. S
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Date

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DEDICATION

I dedicate this work to Almighty God, my parents, William John Kyamani and Agness Thadeo Mashulano who laid the foundation for my education.

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LIST OF ACRONYMS

SPSS	-	Statistical package for social science
SUA	-	Sokoine University of Agriculture
BTC	-	Belgium Technical Cooperation
UNESCO	-	United Nations for Education, Scientific and Cultural Organizations
NAWAPO	-	National water policy
URT	-	United republic of Tanzania
RDC	-	Rufiji District Council
NSGRP	-	National strategy for Growth and Reduction of Poverty
UNFPA	-	United Nations Population Fund
RWSSP	-	Rural water supply and sanitation programme
FGDs	-	Focus Group Discussions
WHO	-	World Health Organization
UNCEF	-	United Nations Children's Fund
UNDP	-	United Nations Development Programme
WUG	-	Water user Group
VWC	-	Village water Committee

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background information

In order to fight poverty and diseases as well as boosting production in both industry and agriculture availability of water services has been given a special consideration (Gleitsmann *et al.*, 2007). Improved access to safe and clean water in rural and urban areas is essential in improving health of the people, increasing production, and other related aspects linked to development of a nation as a whole. However, studies (UNESCO-WWAP, cited by Gleitsmann *et al.*, 2007) reveal that rural people in many African countries have the least access to clean water and sanitation facilities

In Tanzania recent data shows that about 47% people have no access to safe and clean water (World Bank, 2006), this contributed to low level of access to improved sanitation as indicated by Joint Monitoring Programme (2010), that access to improved sanitation is still as low as 23 per cent and 27 per cent in rural and urban areas respectively. A study by Mdende (2009) reveals that women and men spend an average of 150 and 25 minutes respectively per day in dry season for fetching water; and in the water scarce villages about 508 and 375 minutes are spent for collecting water during dry season. In 1965 the government abolished user fee for construction and later opted for the cessation of operational and maintenance of rural water supply schemes. In 1991 the Government of Tanzania adopted a new National Water Policy (NAWAPO) which emphasized on community participation, use of appropriate technology, decentralization, and cost

sharing for rural water supply (URT, 2002). The main objectives of all water policies that have been implemented since Independence have been to improve water services and make water projects sustainable. However, evidence from the field shows that most of the projects are either non-functional or perform below the expected outputs (Water Aid, 2005; Jimenez and Perez, 2008; Kanyala, 2009). In order to address some of the challenges, the Government of Tanzania launched the National Rural Water Supply and Sanitation program in 2002. The programme combined two small projects one being the rural water supply project and the sanitation and hygiene project. This programme aimed at improving demand driven approaches, community ownership and water management, access to safe and clean water supply within a distance of 400 meters from households and having each point serve about 250 people (World Bank, 2006).

This programme was first piloted in Rufiji, Kilosa, and Mpwapwa whereby 10 villages were initially covered in each district. The programme was initially aimed at serving about 250 villages and benefits 500,000 people by constructing more than 1,300 water points (URT, 2007b). In Rufiji the programme worked in 15 villages and was expected to serve about 55.3% of the total population at the total cost of US\$ 571,000 (URT, 2007b). Despite that the programme has constructed 15 schemes, only 8 schemes are still working and about 50% of the population has no access to clean water (URT, 2010a). Studies (Jimenez and Perez, 2008; Kanyala, 2009) indicate that most of the initiated government water projects have failed to provide the intended services to the people; there is however, limited empirical evidence on the factors that influence sustainability of water projects in Rufiji District.

1.2 Problem statement

Despite the Government efforts since Independence of ensuring a sustainable supply of water services in the country a sustainable water supply still remains problematic in Tanzania and in Rufiji district in particular (World Bank, 2006). Tanzania population is estimated to be 37 million at present and about 80% of this population lives in the rural areas; but only 53% of the rural population has access to reliable water supply services (World Bank, 2006). According to Water Aid report (2005), there are a number of rural water supply projects, which are in poor condition and about 30% of all constructed projects are not functioning properly. In order to address some of the challenges, the government of Tanzania launched the National Rural Water Supply and Sanitation program in 2002. The main goal of the program was to achieve a universal access to clean and safe water through the construction of water points often supported by the local communities. Rufiji district managed to construct about 15 water projects at the cost of US\$ 571,000. These water projects were expected to serve about 55.3% of the total population (URT, 2007b).

Despite all the efforts by the Government and donors, the situation in Rufiji is getting worse as about 53% of the water projects are not functioning properly (URT, 2010a). Studies by Jimenez and Perez (2008) and Sanders and Jennifer (2011), show that sustainability of rural water projects is highly affected by availability of spare parts, the choice of technology and availability of trained local technicians. A study by Kanyala (2009) reveals that lack of community participation has a negative impact on sustainability especially after the withdrawal of donors' support. However, Jimenez and

Perez (2008), Kanyala (2009) and Sanders and Jennifer (2011) do not provide evidence of all the determinants on the sustainability of rural water project in Tanzania. Therefore the aim of this study was to assess the other determinants for rural water project sustainability in Rufiji District.

1.3 Significance of the study

Water is regarded as a main ingredient in poverty reduction through ensuring food security and self-sufficiency among other things (URT, 2002). Improved health and poverty alleviation of the rural population through enhanced access to adequate, safe and clean water” is the ultimate objective of the rural water supply sector (URT, 2007a). Similarly, the objective of the current study is in line with the National strategy for Growth and Reduction of Poverty (NSGRP) as stipulated in cluster II. The cluster referred to herein calls for an increase in the proportion of the rural population with access to clean and safe water from 53% in 2003 to 65% in 2009/2010 within 30 minutes of the time spent in collection of water, and within a distance of not more than 400 meters from the household to the water source (URT, 2005).

Moreover, the current study is important because the establishment of rural water supply and sanitation projects still is in progress, and more water projects are expected to be established in future. Thus, if the establishment of the current and future water projects is done without considering the factors which influence sustainability of such projects, the government will continue to spend more money without achieving the expected outcomes of improving the quality of life and social well-being of the people.

This research therefore is worth undertaking so as to have the determinants for rural water project sustainability empirically determined.

The findings from this study are anticipated to enable the Rufiji District, the Government and Donors have informed decisions in the establishment of water supply projects and thus adopt suitable strategies and plans in order to achieve sustainable rural water supply which will enable the rural population to have sustainable access to sanitation and adequate, safe and clean water.

1.4 Research Objectives

1.4.1 General objective

The overall objective was to assess the determinants of sustainability of rural water projects in Rufiji District.

1.4.2 Specific Objectives

- i) To determine community perception on functionality of the project
- ii) To identify alternative sources of water before and after the project
- iii) To assess the value of water projects against other sources
- iv) To assess the factors for sustainable rural water projects
- v) To assess the sanitation and hygiene practices

1.5 Research questions

- 1) What are the community perceptions on functionality of the project?
- 2) What are sources of water before and after the project?
- 3) What is the value of water projects against other sources?
- 4) What are the factors for sustainability of rural water projects?

In putting the study in a proper context, the following different research questions were developed; the first question attempted to gauge the altitudinal status of respondents towards attributes of project functionality through altitudinal scales (likert scale).

The second question based on what are sources of water before and after the project. The aim of this question was to identify natural sources of water in the study area and to know if are still existing and used by people to get water for domestic purposes this enabled the researcher to link between the existence of natural sources of water and the sustainability of rural water projects.

The third question based on what is the value of water projects against other sources. The purpose of this question was to compare the value of water which based on accessibility, affordability and availability of water in both natural sources and the projects. The accessibility of water measured by using distance from the household to the source while affordability and availability measured by price set to get water and time spent for water collection respectively, from both sources.

Fourth question based on what are factors for successful and failed projects. The question was designed to make the respondent identify and mention both factors which are likely to make their projects function well and those which they think are likely to affect their projects and hence not function well.

The fifth question based on the sanitation and hygiene aspects of the rural water supply. The question aimed to make situational analysis of the sanitation and hygiene interventions done in the study area so as to come with a clear picture on how rural water supply facilitated the sanitation and hygiene practices.

1.6 Conceptual Framework

The conceptual frame work used in the study is as shown in Figure 1, based on the Functionalism theory (Talcot, 1975), the study assumes that sustainability of water projects depends on effective management of the system which considers such aspects as operations and maintenance, as key instruments for project functionality. Thus, sustainability was measured using functionality of the system as an indicator for sustainable rural water supply. The conceptual framework shows that sustainability of rural water projects depend on both community participation and effective management of the system which includes: Operation and maintenance, setting of water charges and effective use of water funds.

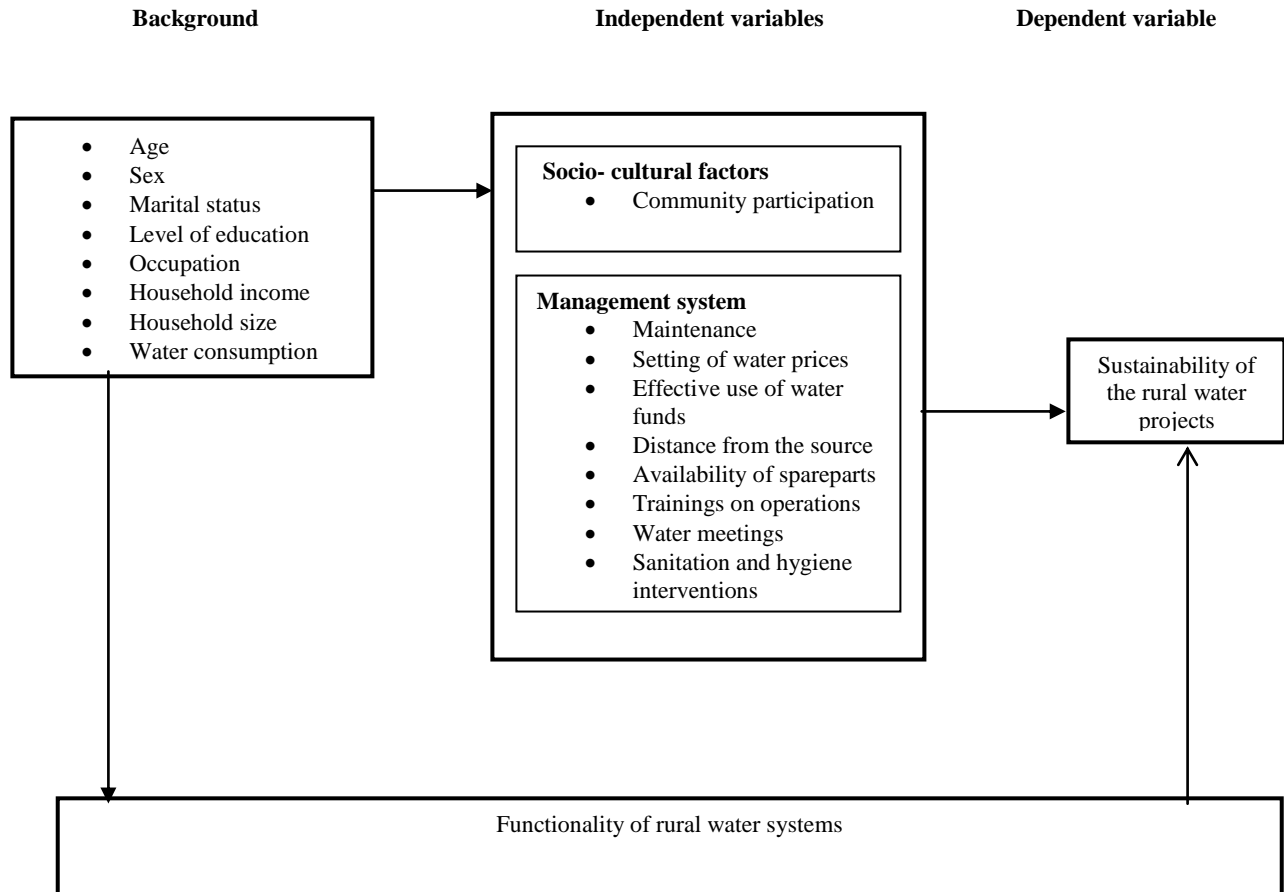


Figure 1: Conceptual framework

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Definition of key concepts

2.1.1 Sustainability

Sustainability refers to a situation where the termination of a particular source of funding does not lead to the collapse of a project (UNFPA, 2002: Cited by Kanyala (2009). Sustainability of the water project therefore is the continued service of water supply project over time, after the termination of the source of funding. However, this study adopted and used the term sustainability as defined by Harvey and Reed (2007), which holds thus, water sources are not over-exploited, facilities are maintained in a condition which ensures a reliable and adequate water supply, and that the benefits of the supply continue to be realized by all users over a prolonged period of time, and the service delivery process demonstrates a cost-effective use of resources that can be replicated.

2.1.2 Community participation

Community is defined as a group of people who live together in a specified geographical area such as a village and sharing some common values; they may face similar problems and sometimes share the same facilities though they may have different background, experience and skills (Bray, 1996). The term participation is widely used especially in theory and practice of developmental programmes. Participatory and community-driven approaches are claimed to give improved equity, sustainability and effectiveness in development activities (Toner *et al*, 2005). Participation is defined as ‘a process, through

which stakeholder's influence and share control over development initiatives, decision and resource which affect them (World Bank, 1994). According to Cohen *et al.*, (1980, cited by Kanyala, 2009) participation includes people's involvement in decision making process, implementation, evaluation, and sharing of the benefits of developmental programmes.

2.2 Typology of Participation and Sustainability of Rural Water Supply Projects

According to Pretty *et al.*, (1995) and Hawlett *et al.* (2001), participation is categorized into seven types namely: passive participation, manipulative participation, and participation by consultation, participation for material incentives, functional participation, interactive participation and self mobilization.

- (i) Passive participation is the type of participation where people participate by being told what should be done or what has already been done.
- (ii) Manipulative participation is the one in which people tend to be presented by official boards but are not elected and have no power on final decisions concerning the project.
- (iii) Participation by consultation involves consulting people, for example people may be involved in answering some questions and giving clarifications on some issues concerning the project.
- (iv) Participation by material incentives; under this type of participation people are requested to contribute materials which may be needed to accomplish the project.

- (v) Functional participation; this occurs after major decisions have already been made by external agencies. Here people are involved in achieving external project goals at each stage of the project cycle.
- (vi) Interactive participation this is the type of participation where people are actively involved in the whole process of project identification, analysis, planning, implementation, monitoring and evaluation stages to ensure that community needs and objectives are included in the wide goals of the project, it is therefore the type of participation which is recommended in order for the project to achieve sustainability
- (vii) Self-mobilization is where the people themselves take the initiative without external pressure with the aim of changing their lives through resources and technical advice they need. Sustainable development initiative is a challenging process which needs integration of different institutions with a new pattern of decision making by making sure those individuals are included in the process of decision making and in taking actions towards achieving sustainable development of the projects (Pretty *et al.*, 1995). It is recommended that people should be involved in the planning and implementation of rural water projects as stipulated in the 2002 National Water Policy (URT, 2002). Therefore the typology of participation employed during the planning and implementation of specific projects, especially the rural development projects such as water and education projects has an implication on the sustainability of the project concerned.

2.3 Sustainability of rural water projects

Sustainability depends on multiple aspects of a rural water supply, with institutional, social, technical, environmental and financial dimensions (WELL, 1998). The fact is that sustainability as a concept is context specific in how it is understood and measured. In the Tanzanian context, many projects have been established on sustainability basis whereby the concept of community participation has been regarded as a key instrument to enhance sustainability in many projects especially in the projects focusing on poverty alleviation, environmental conservation and social service provision (URT, 2002). The water policy of 2002 wanted the government, communities and other stakeholders to aim at sustainable rural water supply and management of water through participation of all stakeholders in order to achieve sustainable access, efficient and, equitable use as well adequate protection and conservation of water sources (URT, 2002). It has been suggested that ‘beneficiary participation is the single most important factor to project effectiveness, in the sense that community participation enables the people to play a major role in the project, have a sense of ownership over the scheme and to ensure its continued operation and maintenance (Harvey & Reed, 2006). Systems are unlikely to be sustainable where there is no community participation, availability of spare parts and repair technicians notwithstanding (Narayan 1995). However, the recent study in Tanzania by Kanyala (2009) shows that for donor funded projects sustainability of rural water supply is largely influenced by community participation.

2.3.1 Indicators for Rural Water Project Sustainability

According to Kaliba (2000), there are seven indicators that can make a project remain functional for a long period and continues to deliver the services to people: (i) reliability of the system which depends on the availability of spare parts and skilled people, especially at local level, who can facilitate the maintenance process of the system in order to make the system functional at all times. These people also need capacity building and frequent training to enable system operations: (ii) availability of local institution structure which is flexible in implementing necessary remedial measures:(iii) prevalence of cost recovery for operations and maintenance of the system; here community members need to contribute resources which are within their capacity in order to facilitate the operations so as to achieve sustainability; (iv) interactive collaboration between community, government, private sectors, research institutes and NGOs in the implementation of community based water projects; lack of interactive collaboration can have a negative impact on sustainability: (v) to have the projects replicable, which implies the process of scaling up the same project or to start a new project in other areas; (vi) to have effective and efficient use of community based water projects throughout their economic lives; this influences project sustainability in terms of ability to handle seasonal fluctuations of water availability.

2.4 Factors affecting rural water project sustainability in Tanzania

The sustainability of the water project especially those managed by communities depend on multiple factors which includes maintenance, cost recovery, community participation, spare parts replacements, fund management and training as commented by Howsam

(2006), that sustainability pertains to multiple aspects of a rural water supply, with institutional, social, technical, environmental and financial dimensions.

Widespread failures in water supplies have been attributed to a number of problems. For instance, the study by Haysom. A (2006) shows that water costs were too high for the community to handle; thus this situation affected the project negatively as majority of the people decided to collect water from unprotected sources, and this does not have any cost implication. Kaliba and Norman (2004) also did a study which revealed that the water pricing negatively influence sustainability of water projects. In villages where the price of water was high people reported to have failed to pay the cost of water services; while in villages where the price of water was low, people also reported to have failed to handle the operational and management costs as the price of lubricants and spare parts fluctuates every now and then.

Another factor influencing project sustainability is lack of training concerning operational and maintenance of the project. A study by (Carter *et al*, 1999) indicates that education programmes are too short and trained members of the community go away or loses interest. Training in many water projects is done at the inception stage just to complete the formalities of project cycle but these trainings are not continuous in the real sense so as to equip the people with proper knowledge of undertaking maintenance and repairs of their water systems, therefore this trend negatively affect water project sustainability.

Other factors that contribute to undermining sustainability of water projects include the on-going use of traditional sources of water, poor systems of cost recovery and long distance from the improved source (Parry-Jones *et al*, 2001). In Tanzania most of the people in rural areas cover a distance of about 500 meters and above to reach the improved water sources (Mdende, 2009); the situation therefore contributes to the preference of other natural sources of water which are unsafe and unprotected. Moreover, community participation contributes to water project sustainability; as Harvey and Reed's (2006) study reveals, lack of ownership of the project which results from lack of participation results into a neglect of maintenance and repairs of the water project, this therefore negatively affect rural water project sustainability.

2.5 The national water policy

Since 1961 the national water policies of Tanzania were to improve water services to its people in order to achieve improved standard of living. During this time, the policy enhanced participation of beneficiaries through contributing of 25% of the water scheme capital investment costs while local governments contributed 75% of the total costs. During the policy reform in 1965, the government adopted *Ujamaa* policy whereupon the water service was provided for free to the people; it was during this time water user fees were abolished leading to the cessation of operation and maintenance of rural water supply projects. In the 1991, the government of Tanzania adopted the NAWAPO which put much emphasis on community participation, decentralization of management, use of appropriate technologies and the cost sharing for rural water supply which was later replaced by National water policy of 2002, URT (2002).

The new water policy of 2002 also put much emphasis on cost recovery, economic efficiency, and integrated water management (World Bank, 2006). Tanzania like other developing countries focused on poverty alleviation by adopting various strategies, one being the RWSSP (Rural water supply and sanitation program). The program emphasizes on demand driven approaches, community ownership and management of water supply facilities, universal access to clean and safe water supply within reach of 400 meters from each household and with each point serving about 250 people (URT, 2002; World Bank, 2006).

2.6 Situational Analysis of Access to Water

About 84% of the global population has access to piped water supply through house connections to an improved water source through other means than house, including standpipes, protected springs and protected wells (Joint Monitoring, 2010). However, about 14% does not have access to an improved water source and have to use unprotected wells or springs, canals, lakes or rivers for their water needs, (Joint Monitoring, 2010).

Although access to water supply and sanitation in Africa has improved, the region lags behind all other developing regions: access to safe drinking water has increased to 60% in 2008, while at the same time access to improved sanitation has only risen to 31% (Joint Monitoring, 2010). There are large disparities among countries in the Sub-Saharan region. Access to safe drinking water varies from 38% in Ethiopia to 91% in South

Africa, while access to improved sanitation ranges from 11% in Burkina Faso to 77% in South Africa (Joint Monitoring, 2010).

Access to water and sanitation remains low in Tanzania (World Bank, 2006). About a half of the population is estimated to have access to an improved water source with stark differences between urban areas (81%) and rural areas (46%). According to the data from the Household Budget Survey (URT, 2007c), access to water and sanitation in Tanzania mainland was 52% in 2007. Rufiji district has many water sources, which include Rufiji River and its tributaries. There are 35 water supply schemes. But out of these only 8 are working properly (URT, 2010a). It is estimated that about 57% of the total district population in Rufiji is served with clean water. As per the National water policy, domestic water demand is 25l/c/day per capita. In Rufiji district the total projected population in 2006 is 219,139. Therefore this population needs 5,478.5 metre cubes. But currently, the actual coverage in the district is a 3,396.7 metre cube which is equivalent to 62% of the actual demand (URT, 2010a).

2.7 Water shortage and livelihoods in Rufiji basin

Rufiji River basin extends over most of southern Tanzania. The River drains an area of about 170,000 km² before it enters the Indian Ocean, (Meena and Raphael, 2008). The basin collects water from numerous tributaries originating from the southern Uporoto Mountains and Udzungwa mountain forests block of the Eastern Arc Mountains. The estimated maximum water flow in the basin is 14,000 m³/sec during the wet season and the minimum flow is 50m³/sec in the lower catchments.

About 3.2 million people obtain water for various uses from the basin including hydropower generation, irrigation, domestic and industrial uses, livestock and commercial uses, as well use for wildlife in areas with tourism related activities. Out of these uses, hydropower generation is the main non-consumptive user of water at 2.1 million m³/day and irrigation is the largest consumptive water user at 7.5 million m³/day. Irrigation is mainly found in the Great Ruaha and the Kilombero Sub-basins (Sokile S., *et al* 2003). There is a big potential for irrigation in this basin, the major irrigation schemes include crop farming of rice, sugarcane, maize, tomatoes, onions, vegetables, bananas and beans in Mbeya, Iringa and Morogoro regions. There are also commercial uses of water in such aspects as fishing, which is done in almost all rivers, and navigation using ferries and boats which mainly occurs in the Great Ruaha, Kilombero and the lower parts of the Rufiji river, (Meena and Raphael, 2008). Water shortage in the basin started to be experienced when new opportunities to consume water at large quantity emerged and these include irrigated agriculture and hydropower generation, this coupled with the long dry season and several years of less than average rainfall has led to water scarcity resulting into conflicts.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes the methodology employed during the research work which includes the description of the study area, research design, sampling procedures and statistical procedures used to analyze the collected data.

3.2 Catchment areas

The research was conducted in Rufiji District and involved six villages namely; (Mtawanya, Bungu, Jaribu mpakani, Kimbuga, Utunge and Chumbi) of Rufiji District in Pwani Region (Figure 2 map). Rufiji District was chosen for this study because the District is among three districts in Tanzania where pilot implementation of rural water supply and sanitation projects was done, and where access to clean water is still low. About 50% of the people in the District have no access to safe and clean water (URT, 2010a).

The study included six villages which participated in the rural water supply and sanitation project in Rufiji District. The villages included were in two categories (a) Schemes that were functioning (b) Schemes that were not functioning. Rufiji District is among six administrative districts which comprise the Coast Region. The district is made up of six divisions, nineteen wards and ninety eight registered villages. The district is situated in the Southern part of the Region and share borders with Kilwa

district in the south, Mafia district in the east, Mkuranga district in the north and Liwale district in the south-west (URT, 2010a). The district covers an area of 13,339 km² out of which 4,824.3 km² (36.2%) is arable land, 1,656.62km²(12.4%) is covered by registered forest reserves, 6258km²(46.9%) is covered by Selous Game reserve and 600km²(4.5%) is covered by water bodies, including rivers, swamps, Lakes and the Indian Ocean (URT, 2010a). The map of the study area is presented in Figure 2.

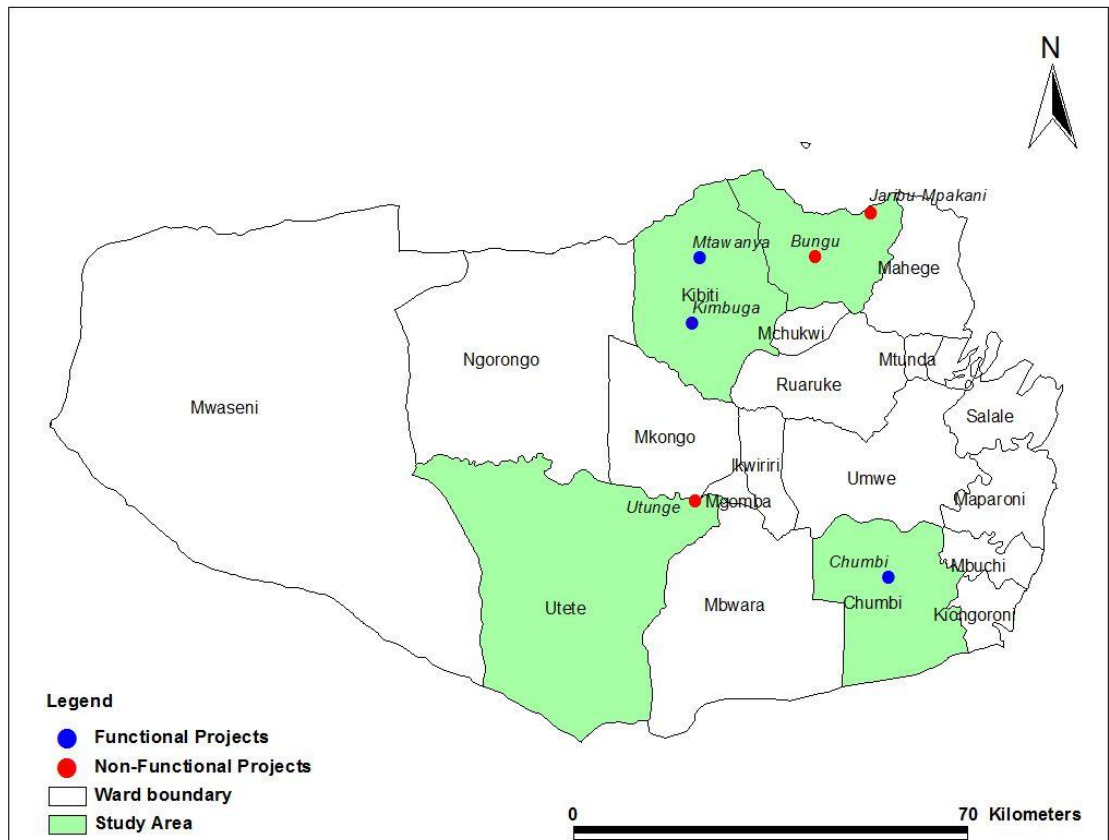


Figure 2: Map showing area of study in Rufiji District, Pwani region, Tanzania

3.3 Research design and its justification

The study adopted cross sectional type of design whereby data were collected at a single point in time, this enables a researcher to collect a body of quantitative and qualitative data of about two or more variables which are then examined to detect patterns of association. The design is mostly used in descriptive research studies, which are appropriate to research in social sciences. Cross sectional design is considered to save time, and resources; therefore the data collected are eventually used to determine the relationship between variables (Babbie, 1973; Balley, 1978; Bernard, 1994; Kothari, 2004).

3.4 Unit of analysis

The study used households and water attendants as units of analysis. A household is defined as one person or a group of people who are accommodated under the same roof and share at least one meal per day.

3.5 Sampling strategies for unit of analysis

The study used purposive sampling technique to select wards and villages based on evidence of community involvement on rural water supply and sanitation project in Rufiji District. Also simple random sampling was used to select respondents from the village register; thus a sample of 180 households was selected from six selected villages (30 respondents from each village). Also six key informants that included village leaders and water association leaders were selected purposively. Purposive sampling was used to select six villages three out of which have functional projects and the remaining three

have non functional projects. The process ensured that only members with the desirable characteristics were included in the sample (Benard, 1994: Kothari, 2004).

3. 6 Methods of data collection

3. 6.1 Data collection for qualitative variables

Six focus group discussions were conducted in this study, whereby a total of 60 participants comprising ordinary water users basing on gender and age were involved; the purpose was to obtain more clarification and details of the collected data from the respondents. Also the researcher visited water sources to see a real situation of water projects. The researcher observed long queues at several water points and destruction of water infrastructures in some of the study villages. Also under qualitative data a checklist was used to guide the discussions with key informants as per the specific study objectives.

3.6.2 Data collection for quantitative variables

The structured interview was conducted in the study area guided by a questionnaire. The researcher collected data with the help of two enumerators from Rufiji District council. A total of 180 household heads were interviewed. A questionnaire with both open ended and closed ended questions was designed and covered all specific objectives of the study.

3.7 Methods of data analysis

3.7.1 Data analysis for qualitative variables

Data from FGDs and field observations were analyzed using content analysis. Information obtained from key informants and FGDs using semi structured interview was broken down into smallest meaningful units. This enabled the researcher to ascertain values and altitude of the respondents (Bernard, 1994).

3.7.1.1 Likert scale

The scale used to measure perception toward functionality of water projects among respondents under objective number one, and the scale had 16 statements. Every respondent was asked to indicate whether he/she strongly disagreed (1), disagreed (2), was undecided (3), agreed (4) or strongly agree (5) with each item of the scale. The responses were grouped into three categories to reduce repetition of words, strongly agree and agree were regrouped into agree; strongly disagree and disagree were regrouped into disagree while undecided was treated as a separate entity.

3.7.2 Data analysis for quantitative variables

Descriptive statistics such as frequencies and percentages were used to determine distributions and magnitudes of variables among the respondents for objectives number two and three. Also logistic regression model was used to determine the factors for successful and failed projects for objective number four. The model was necessary to explain the prediction of the presence or absence of an outcome variable which is based on values of a set of predictors and for this case, the dependent variable (functionality of

the project) was dichotomous with two values, 1 was for if the project is functioning and 0 was for otherwise, Hosmer *at el*, (1989). The model is presented in the following equation:

$$Z_i = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon$$

Whereby;

1 if the projects function

$$Z_i = \{$$

0 if the project does not function

β_i = coefficients for the independent variables

X_1 =maintenance

X_2 =community participation

X_3 =spare parts

X_4 =Price setting

X_5 = Trainings

X_6 = Time for water collection

ε = error term

Table 1: Variable definition

Variable name	Indicators
Dependent variable	
Functionality of the project	If the project is functioning or not (1,0)
Independent variables	
Household size	Total household residents related or not related
Education	Number of years spent in school
Household income	Total household income in Tanzania shillings
Water consumption	Total water consumed by household members in litres
Price of water	Amount of money set to pay for water service per container
Number of maintenance performed	Total number of maintenance work performed at a project
Number of spareparts replaced	Total number of spareparts replaced in the system
Time spent in water collection	Total time spent in water collection in minutes
Number of trainings conducted	Total number of trainings conducted concerning operation of the water system
Community participation	Total number of meetings conducted on water project annually

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Demographic and socioeconomic characteristics of the respondents

This section presents the demographic and socioeconomic characteristics of 180 households which were selected randomly from the study population in six villages of Rufiji district namely: Mtawanya, Bungu, Jaribu mpakani, Kimbuga, Utunge, and Chumbi. The respondents who participated in the study were 16.7% from each village. Therefore, all villages had equal representation of the sample population with the same sample size of 30 respondents from each village as per Bailey (1996) suggestion that at least 30 respondents are required for statistical analysis. Other demographic and socioeconomic characteristic of the respondents are presented in Table 2. These socioeconomic and demographic factors have notable differences across villages as detailed in the next sections.

4.1.1 Sex of the respondents

Majority of the respondents interviewed during the study were males (52.8%) while the remaining 47.2% were females as shown in Table 2. Given the random sampling done at village level, percentages on gender representation reflects the male dominance especially in development processes such as planning and management of developmental projects. Since women are lowly represented in decision making especially in matters concerning with water developmental projects, then the whole process of establishing, planning, management, and operations of water projects are

mainly controlled by men. At household level, women are the ones responsible for fetching water; this is attributed to the fact that most of the domestic activities such as washing, gardening, cooking just to mention few and which are carried out by women depend on the availability of water; therefore if water is not available near these women's homes, most of them would suffer a great deal and they may sometimes spend hours on end and even a whole day searching for water instead of doing other productive activities. Moreover, the study results show that 51.1% of adult women as opposed to 26% of adult men are responsible for fetching water in the household in the study area. This trend reflects the fact that was observed by Mdende (2009) who reveals that women spend an average of 508 to 375 minutes while men spend about 150 to 25 minutes per day during dry season for fetching water. However, Chi square results show no significant difference according to sex of the respondents across villages.

Table 2: Distribution of respondents by sex category (n= 180)

Sex	Frequency	%
Male	95	52.8
Female	85	47.2
Total	180	100

$\chi^2=0.813$

4.1.2 Age of the respondents

Age is an important variable as it determines both inter-household and intra-household characteristics which include ownership and control of resources such as land and

household assets (Mbwambo, 2007). According to (URT-UNFPA, 2003), statistical information on age and sex are used for a wide range of planning and administrative purposes such as determining the segments of population qualifies for voting in decision making processes, labour force age group and so forth. In the study area, an average mean age was 40 years and the standard deviation for age was 12.03 with the minimum and maximum age of 18 and 64 respectively. Majority of the respondents interviewed were between the ages of 31-51years representing 55.2% of the whole population. Table 3 summarizes age of the respondents under the study.

Table 3: Distribution of the respondents by age (n=180)

Age categories in years	Frequency	%
18- 30	46	24
31- 51	99	56
52- 65	35	20
Total	180	100

This finding therefore implies that the labour force in the study area is big; this is because people in the age group of between 18 - 50 years are considered to be more active in any social and economic initiatives (URT-UNFPA, 2003; cited by Kanyala, 2009).

4.1.3 Education

As URT (2003 cited by Mbwambo 2007) notes, that education in developing countries is the most important tool for enhancing people's ability to fight poverty and build awareness on various interventions including agricultural extension, water supply, education and health. Also it has become a survival strategy in which few educated members of the family may be formally employed or self employed and hence they may become able to help other family members in terms of remittances. The levels of education as categorized in Table 4 reflect the picture that generally rural areas of Tanzania are inhabited by people with low education. About 40% of the study population spent about 7 years in primary schools, and about 37.2% of the population spent none years in education while the rest spent about 13 and 16 years in colleges and other higher learning institutions with 12.3% of the study population. This observation indicates that literacy rate of majority (62.9%) of the respondents is high. The high literacy rate implies that most of the respondents know how to read and write (URT, 2003).

Table 4: Distribution of respondents by years of education (n=180)

Number of years in school	Frequency	%
0	67	37.2
7	72	40
11	19	10.6
13	19	10.6
16 and above	3	1.7
Total	180	100

4.1.4 Main Occupation of respondents

As for the main occupations of the respondents the study found that about 80% of the respondents, which is the majority in the study area, are peasants. According to (Mbwambo, 2007) about 80% of the people in Tanzania are living in the rural areas and their main income generation activities include small scale agriculture or peasantry. As a study by Mbwambo (2007) reveals, nearly two third of the population work as farmers and the rest combine farm and off-farm activities including petty trade and carpentry just to mention few. The results in Table 6 also show that 1.1% of the population comprises workers and 18.9% of the population comprises business men and women.

Table 5: Distribution of respondents by occupation (n=180)

Occupation	Frequency	%
Business	34	18.9
Worker	2	1.1
Peasant	144	80.0
Total	180	100

$\chi^2 = 0.582$

The results reflects a general trend in Tanzania where people in the formal sector and those in business are believed to have more stable income than peasants who normally depend on their crops and livestock for gaining income; but the risks are high with agricultural sector; since as in developing countries, the sector depends much on rain fed agriculture. The household income is the determinant of access to social services;

therefore in this respect the households with low income are likely not able to access social services including water, education, and health just to mention few.

4.1.5 Source of income for households

The results in Table 6 present the main sources of income for households in the study area. The findings show that 62.2 percent of the respondents are engaged in small farming as a source of income for household, 22.2% are involved in business 6.7% are involved in small scale livestock keeping, those in salaried employment accounted for 5.6% and those engaged in large scale farming accounts for 2.2% of the respondents.

Table 6: Distribution of respondents by source of income (n=180)

Income source	Frequency	%
Small livestock	12	6.7
Small farming	112	62.2
Large farming	4	2.2
Small business	40	22.2
Fishing	2	1.1
Worker	10	5.6
Total	180	100

$\chi^2 = 0.094$

Moreover, when the respondents were asked about their monthly household income, most of them gave estimations of what they sold including crops and livestock to get money for household expenditure. The findings imply that majority of the people in the study area depend on small scale farming for income generation. Therefore, from the findings it is clear that in the study area majority of the people belong to low income

bracket. However the Chi square reading shows no significant differences at ($p \leq 0.094$) in occupation of the respondents across villages.

4.2 Community perception

A total of sixteen (16) statements were formulated and used in collecting information on the frequency of perception towards functionality of rural water projects. Table 7 shows that with exception of the responses of six, eight, nine, ten, eleven, twelve and fourteen statements the rest of the statements number one, two, three, four, five, seven, thirteen, fifteen and sixteen agreed with almost all the statements that sought to measure their attitude towards project functionality. For instance, the statement number one, two, three, four, five, seven, thirteen, fifteen and sixteen as presented in Table 6 shows that the functionality of the water project is facilitated by maintenance, community participation, availability of spare parts, good management of funds, setting of water charges, and short distance from the main source. This finding implies that the functionality of a specific water project depends on multiple factors such as maintenance, availability of spare parts, community participation, and short distances from the sources, reasonable water prices and good management of water funds.

Therefore, there is a need to take into considerations for the mentioned aspects in order to achieve water project sustainability in rural areas especially those managed by communities.

Table 7: Community perception on water project functionality

Attitudinal Statements	Disagree %	Undecided %	Agree %
Maintenance is potential for functionality	9.5	1.1	89.4
Community participation is important for sustainability	8.9	Nil	91.1
Availability of spare parts contributes for functionality	20.6	1.7	77.8
Setting of water charges facilitate operations	41.7	5.0	53.4
Good fund management facilitate functionality	45.0	6.7	48.3
Frequent trainings of water attendants facilitate operations	50.6	3.9	45.5
Distance from household to project facilitate preference	38.9	3.9	57.2
Effectiveness of water association contributes to functionality	54.4	4.4	41.1
Maintenance of water project is not necessary for functionality	81.6	2.8	15.6
Community participation is not necessary for project sustainability	81.7	NIL	18.3
Lack of spare parts does not affect project functionality	76.7	1.7	21.6
High project water charges makes people opt for local sources	51.7	2.2	46.1
Bad fund management affects operation and maintenance of project	45.5	1.7	52.8
Frequent trainings does not facilitate operations of project	63.3	3.3	33.3
Long distance from household to project makes people opt for other sources	40.6	0.6	58.9
Weakness of water association affect functionality	19.4	2.2	78.3

Source: Survey data

However, the water user association seems not to facilitate functionality of the water project as the statement number eight scored 54.4% negative attitude towards project functionality.

4.3 Sources of water in Rufiji District

This section addresses specific objective number two by giving detailed account of the sources of water before and after the project. The section begins by giving an account of,

among others; the payments for the services are explained and discussed. Also the section presents aspects of existence of local sources of water in the study area it ends with the distance from the source.

4.3.1 Sources of water prior to the project

The study identified several sources of water prior to the launching of the project as shown in Table 8. Prior to coming of the project majority of the people depended on local sources such as rivers, streams, ponds, lakes, and dams which accounted for 24.4% of the total amount of water available in the study area. In Mtawanya village about 63.3% of the respondents reported to collect water for domestic purposes from bore holes, and similar results were reported by about 93.3% of the respondents in Bungu, Jaribu and Kimbuga villages.

Table 8: Sources of water before the project

	Name of the Village (n-30)					
	Mtawanya	Bungu	Kimbuga	Jaribu	Utunge	Chumbi
Bore holes	63.3%	93.3%	93.3%	93.3%	26.7%	16.7%
Un protected dug well	26.7%	6.7%	.0%	6.7%	3.3%	3.3%
Rivers, streams, ponds, lakes and dams	10%	.0%	6.6%	.0%	70%	80%

$\chi^2 = 0.000$

Also the findings show that 26.7% of the respondents in Mtawanya village reported to be collecting water for domestic purposes from unprotected dug wells. Other villages that depend on the similar source of water include Utunge and Bungu villages. The findings show that other respondents (73.3% in Chumbi and 66.7% in Utunge villages) depended much on rivers, streams, ponds, lakes, and dams as sources of drinking water.

These findings imply that prior to the coming of the water project in the study area, people were very much at risk of contracting water borne diseases as the majority 64.4% and 7.8% of the respondents were using water from bore holes and un protected dug wells respectively. Similar findings were obtained from Joint Monitoring Report (2010) which indicates that about 14% of the people in developing countries did not have access to an improved water source and had to use unprotected wells or springs, canals, lakes or rivers for their water needs. Moreover in some of the villages in the current study, the respondents reported to have used piped water as the source of drinking water prior to the coming of the project. This is possible as there were some old projects which people still kept referring to as their source of water. However, Chi- square analysis indicated significant difference at ($p \leq 0.000$) in sources of water prior to the project across villages.

4.3.2 Source of water after the project

When respondents were asked to mention where they prefer to fetch water after the project the respondents gave varying responses across villages. About 15% of the people in Mtawanya and Kimbuga villages preferred to fetch water from the project (piped

water). About 11.1% of the respondents in Bungu and 5% of the respondents in Jaribu preferred fetching water from the project.

Table 9: Sources of water after the project

	Name of the Village (n=30)					
	Mtawanya	Bungu	Kimbuga	Jaribu Mpakani	Utunge	Chumbi
Piped water	15.0%	11.1%	15.0%	5.0%	.0%	1.7%
Bore holes	.6%	3.9%	1.1%	11.1%	3.9%	1.7%
Unprotected dug well	.6%	1.1%	.0%	.6%	.6%	.0%
Hand pump	.6%	.6%	.6%	.0%	2.2%	13.3%
Rivers, streams, ponds, lake and dams	.0%	.0%	.0%	.0%	10.0%	.0%

$\chi^2 = 0.000$

The findings imply that water projects at Mtawanya and Kimbuga villages are functioning well, and that is why people still depend on piped water. However, water at Bungu, Jaribu and Utunge are either not functioning or poorly functioning. For the case of Chumbi, the study observed that the project used hand pump for drinking water and the project is still functioning. Moreover, bore holes were reported by some respondents in Jaribu, Utunge and Bungu villages as the main source of water even after the coming of the project. These findings reflect the fact that villages such Mtawanya, Kimbuga and Chumbi, which have low preference in bore holes have their water projects still

functioning while villages Utunge, Jaribu and Bungu, which have high preference in bore holes have their water projects not or poorly functioning. However, the Chi square results show that there was a significant difference at ($p \leq 0.000$) on the sources of water after the coming of the project across villages.

4.3.3 Payments for water services from other sources

When the respondents were asked if they were paying for the water services from local sources the response was negative at 77.2% from all the villages in the study; this implies that in the study area no payments was required in order to collect water from local sources. Table 10 summarizes the results.

Table 10: Payments for water services from other sources

	Name of the Village (n=30)					
	Mtawanya	Bungu	Kimbuga	Jaribu Mpakani	Utunge	Chumbi
Yes	23.3%	36.7%	26.7%	26.7%	13.3%	10.0%
No	76.7%	63.3%	73.3%	73.3%	86.7%	90.0%

$\chi^2 = 0.150$

Therefore, the finding indicate that the existence of local sources were likely to influence the performance of water projects in a negative way because in the water project people are obliged to pay for the water services and these payments are necessary in order to obtain money for meeting operations and management costs.

Therefore, if the number of people who collect water from the project is lower than that of people collecting water from other local sources, the situation is likely to affect the water project functionality. However, the Chi square reading indicates that there was no significant difference at ($p \leq 0.150$) in payments of water services from local sources across villages.

4.3.4 The existence of local water sources after the starting of the project

The previous section shows that local water sources still exist despite the starting of the new water project. When respondents were asked if they still fetch water for domestic use from these sources they responded positively at 91.7% in all villages in the study.

Table 11: Existence of local water sources after the project

	Name of the Village (n=30)					
	Mtawanya	Bungu	Kimbuga	Jaribu Mpakani	Utunge	Chumbi
Yes	86.7%	93.3%	90.0%	96.7%	93.3%	90.0%
No	13.3%	6.7%	10.0%	3.3%	6.7%	10.0%

$X^2= 0.791$

The findings imply that majority were still using water from local sources as alternative sources for domestic use; therefore this situation is likely to affect the performance of new water projects in a negative way if the price of water in the project is high and the economic situation of these people is unstable. As explained in the previous sections, majority of people in the study area are peasants with no stable incomes.

4.4 The Value of Water from the Project against other sources

This section presents the findings for objective number three, it give a detailed picture of the value of water from the project against that from other sources of water. Accessibility and affordability of water from both sources are also analyzed and discussed. According to the Global Water supply and sanitation Assessment 2000 Report by WHO/ UNICEF, the terms access to improved water supply and sanitation are defined basing on the types of technology and levels of services afforded (WHO and UNICEF, 2000). Moreover for water, reasonable access has been broadly defined as the availability of at least 20 liters of water per person per day from a source within one kilometer from the household (WHO/UNICEF, 2000). Accessibility to water sources can be measured by time spent on collecting the water (WHO/UNICEF, 2000).

4.4.1 Time spent for fetching water

The time for fetching water was measured in minutes used by the respondents to walk from home to the source as a reference point and which also included the time used to fill the container. There were variations across villages in terms of time spent. For instance, it was observed that the shortest distance which was estimated to take about 30 up to 60 minutes scored about an average of 47.2% of the total time spent in collecting water while the time between 90 and 120 minutes was categorized to be longest distance and takes an average of 52.8% of the total time spent across all the villages.

Table 12: Time spent for fetching water

	Name of the Village (n=30)					
	Mtawanya	Bungu	Kimbuga	Jaribu Mpakani	Utunge	Chumbi
30minutes	6.1%	3.9%	5.6%	1.1%	2.2%	6.1%
60minutes	5.6%	2.2%	2.2%	2.8%	2.8%	6.7%
90minutes	1.1%	4.4%	1.7%	2.2%	6.1%	2.2%
120 minutes and above	3.9%	6.1%	7.2%	10.6%	5.6%	1.7%
$\chi^2 = 0.000$						

Therefore, from the findings it can be said that majority of the respondents in the study area walked long distances to reach their main water sources. These findings conform to the findings of earlier results (Table 11) about the distance from the household to the main source of water. The findings are supported by the findings in the study conducted in Malawi which indicate that if water supply is improved, women and girls as the major responsible group for fetching water would spend only one hour per day for collecting water; women and girls could use the time saved either for income generating activities or for domestic, social, and other developmental activities (Mulwafu, 2003). However, the Chi square reading indicates that there was a significant difference at ($p \leq 0.000$) in time spent for water collection across villages.

4.5 Main Factors for successful and failed projects

4.5.1 Logistic regression model

Logistic regression model was used in order to predict the presence or absence of an outcome variable based on values of a set of predictor variables. For this case, the dependent variable (If the water project is functioning) is dichotomous because it has

two values which are 1 and 0 values. The 1 value stands for ‘if the water project is functioning’ and 0 value stands for ‘otherwise.’ A logistic model in this case was developed and a number of factors (maintenance, spare parts, distance, training and participation) were modeled against the dependent variable (if the water project is functioning). The data in Table 13 define and provide the descriptive statistics of the variables used in the Logistic regression model. Also the mean and standard deviation of all variables at higher levels are presented.

Table 13: Variable definition

Dependent variable	Description	Mean	SD
Functionality of the project	Number of days when water was available at the project	7.2	2.13
Independent variables			
Household size	Total household residents related or not related	7.64	2.52
Education	Number of years spent in school	8.2	2.02
Household income	Total household income in Tanzania shillings	8.08	2.09
Water consumption	Total water consumed by household members in litres	8.76	1.99
Price of water	Amount of money set to pay for water service per container	4.29	1.31
Number of maintenance done	Total number of maintenance work performed at a project	5.31	1.29
Number of spareparts replaced	Total number of spare parts replaced in the system	5.63	1.62
Time spent in water collection	Total time spent in water collection in minutes	6.09	1.90
Number of trainings conducted	Total number of trainings conducted concerning operation of the water system	5.68	1.48
Participation	Total number of meetings conducted on water project annually	7.60	2.46

In this analysis, the dependent variable (Functionality of the project) was modeled against independent variables indicated in Table 13. To test the strength of the model

Logistic regression model was estimated using (R^2), the results show that cox and snell (R^2) was 0.470 and Nagelkerke (R^2) was 0.670, the results therefore show that the model was fit to explain the change in the dependent variable as a result of the change in the independent variable.

Table 14: Logistic regression results for factors responsible for sustainability of Rural water projects

Variable	Coefficient estimate	Std error	Sig.
Wtepric (x_1)	-.112	.260	.668
Nofmadon (x_2)	1.560	.298	.000
Nuosrepl (x_3)	.605	.268	.004
Timutgwm (x_4)	-.092	.187	.623
Trcondom (x_5)	.065	.297	.827
Hmmecywp (x_6)	.174	.159	.275
Constant	-4.342	1.314	.001

-2 log likelihood =134.989; Cox & Snell R2 = 0.470; Nagelkerke R2 = 0.670;

Furthermore, the 'F- value' was used to check whether it was significant. The results show that only two independent variables which are the number of maintenance carried out (nofmadon) and the number of spare parts replaced (nuosrepl) were found to be significant at $p \leq 0.000$ and $p \leq 0.004$, respectively. The findings imply that the positive signs attached to the estimated coefficients of the variables (nofmadon) and (nuosrepl), indicate that the greater the values of these variables the higher the tendency to maintain sustainability of rural water supply.

The negative signs of the price of water and time for collecting water indicate that the greater the value of the variable the lower the probability of maintaining sustainability of the rural water supply. Therefore, from the regression analysis, it is concluded that sustainability of the rural water projects is influenced by frequent maintenance and availability of spare parts.

4.6 Other factors for successful and failed projects

Apart from the main factors which are likely to affect the water projects directly, the findings show that some other factors were also likely to affect water projects indirectly; these factors include: water prices, quality of service delivery, absence of payment receipt for the service, immediate problem solving mechanism, annual meetings conducted, water distribution schedule, inspection of project facilities, and sanitation and hygiene aspects.

4.6.1 The Setting of Water Prices

Setting of water prices is the responsibility of the whole community through general meeting where all community members decide on the proper price that should be used (URT, 2002). According to water policy of 2002, Community members are responsible for making decisions on the price of the water for community based water projects through general meetings. Also the price should be within the capacity of the people in the specific community but which should consider the current socio economic situations of operations and maintenance of the project (URT, 2002). When the respondents were asked whether or not the price of water was reasonable, the response varied across the

villages. The findings reveal that 40% of the respondents thought that the price was reasonable while the rest of respondents about 54.4% thought that the price was not reasonable. Table 15 summarizes the findings.

Table 15: The price of water being reasonable

	Name of villages (n=30)					
	Mtawanya	Bungu	Kimbuga	Jaribu Mpakani	Utunge	Chumbi
Yes	7.8%	3.3%	13.3%	2.8%	.6%	12.8%
No	8.9%	13.3%	3.3%	11.1%	14.4%	3.3%
Don't Know	0	0	0	2.8%	1.7%	.6%

$\chi^2 = 0.000$

During discussions with key informants in Kimbuga village, one village council member explain that,

“ Bei ya maji ya mradi imekuwa ndogo kiasi cha kushindwa kununua mafuta na Vifaa vya mashine hivyo endapo mradi utaharibika hatutaweza kutengeneza kwa hii Pesa kidogo iliyopo.”

The statement meant that the price was low because one bucket of 20 litres was reported to be sold at 25 Tanzanian Shillings. Thus, they wished to have the prices of water reviewed to have them meet operational costs of the project, especially in the purchase of lubricants and fuels. . These finding indicate that the setting of water prices directly influence the project performance as in some villages, the prices were very low and in

other villages the prices were very high. However, the question as to whether the prices were reasonable or not also had varied response in accordance with the type of services delivered. However, the Chi square reading shows that there was significant difference at $p \leq 0.000$ in prices of water between villages.

4.6.2 Quality of Water Service Delivery

Under this section, the water service delivery is based on the number of days per month people get the water from their project. The service is put into several categories as follows, very good (30) days, good (20-29) days, moderate (4-19) days, bad (2-3) days and very bad, where the project was no longer functioning.

Table 16: Quality of water service delivery

	Mtawanya	Bungu	Kimbuga	Jaribu Mpakani	Utunge	Chumbi
2 Up To 3 Days	.6%	.6%	0	0	0	0
4 Up To 19 Days	3.9%	3.9%	9.4%	.6%	.6%	1.1%
20 Up To 29 Days	7.2%	1.1%	3.9%	0	.6%	0
30 Days	3.9%	3.3%	3.3%	1.1%	2.2%	15.6%
Not At All	1.1%	7.8%	0	15.0%	13.3%	0
Total	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%

$\chi^2 = 0.000$

When the respondents were required to indicate the number of days they get water services from the project 37.2% reported that their project were no longer functioning, while about 29.4 percent reported to be getting the water for thirty (30) days and the rest (19.4%) reported to be getting the water for 4-19 days, 12.8% (20-29) and 1.1% (2-3)

days. These findings imply that the water service delivery was very bad as majority of the respondents 37.2% reported not to be getting any water at all in their projects, except in few cases where some respondents about 29.4% reported that the water service was very good in all 30 days. However, the Chi square results indicated a significant difference at ($p \leq 0.000$) in water service delivery across the villages.

4.6.3 Payment receipts for the service

Payment receipts are very important in any business or service; receipts are used to show that a payment has been made and generally specifying the purpose of the payment. In the current study, when respondents were asked if they receive any receipt when the pay for water service the response was negative with 87.2% of the respondents admitting that receipts were not being issued for payments made, while 12.8% of the respondents in all the villages of the study admitting that receipts were being issued for payments made.

Table 17: Payment receipts for the services

	Mtawanya	Bungu	Kimbuga	Jaribu Mpakani	Utunge	Chumbi
Yes	2.8%	6.1%	.6%	1.7%	0	1.7%
No	13.9%	10.6%	16.1%	15.0%	16.7%	15.0%

$X^2 = 0.000$

The findings indicate that the water services are given to people without receipts which verify the payments made. In these water projects the main collectors of the water funds

are water attendants who always receive money from people and submit the same to the project management. Thus, therefore without receipts water attendants are likely to misuse water funds as the auditing of the real expenditures will be difficult without payment vouchers or receipt concerning project funds.

4.6.4 Immediate problem solving mechanism

The problem solving mechanism is an important aspect in water projects, the researcher wanted to know how people in the study villages solve their problems concerning project breakdown. When the respondents were asked to indicate the person to whom they report to when problems occur, especially concerning minor maintenance arise in the water project, majority 35.6 of the respondents said that they consult the maintenance worker from outside the community; and about 31% of the respondents reported to be consulting the local government while 16.7% of the respondents reported to be consulting the project technician and 11.7% of the respondents were not aware as to whom they should consult in case of the emergence of the problem in the project machinery. Also about 5% of the respondents reported to be consulting the water user association in case of problems in the projects.

Table 18: Immediate problem solving mechanism

	Mtawanya	Bungu	Kimbuga	Jaribu Mpakani	Utunge	Chumbi
Water User Association	.6%	1.7%	1.1%	0	1.1%	.6%
Project Technician	5.6%	1.7%	2.8%	1.1%	1.7%	3.9%
Local Government	3.9%	7.2%	2.8%	6.7%	5.6%	5.0%
Worker From Outside	5.0%	5.6%	10.0%	4.4%	4.4%	6.1%
Not Aware	1.7%	.6%	0	4.4%	3.9%	1.1%

$X^2 = 0.005$

The finding indicate that even minor maintenance of the water projects depend on hired technician or consultants who probably need a lot of money to carry out maintenance tasks. This is contrary to what has been given as a guideline to the management of rural water projects as stipulated in the National water policy of 2002 that, the community is responsible for undertaking minor maintenance of their water projects through local trained technicians (URT, 2002).

4.6.5 Annual water meetings

Through water meetings different stakeholders discuss water matters which are likely to strengthen the project and maintain sustainability of the water project. When the respondents were asked about the number of meetings which are conducted annually concerning water project, the responses varied across villages. Some respondents representing 30% of all the respondents with high percentage concentration in Chumbi village (6.7%) and low percentage in Mtawanya and Kimbuga villages (3.3%), reported

to be conducting one meeting per year. Moreover some other respondents about 23% with high percentage in Bungu village (7.2%) and low percentage in Jaribu mpakani villages (2.2%) reported to be conducting two meetings per annum. Other respondents representing 15% reported to be conducting three meeting per annum, while about 18% of the respondents reported to be conducting four meetings and above per annum.

Table 19: Annual water meetings

	Mtawanya	Bungu	Kimbuga	Jaribu Mpakani	Utunge	Chumbi
One Meeting	3.3%	5.6%	3.3%	6.1%	5.6%	6.7%
Two Meetings	5.6%	7.2%	2.8%	2.2%	2.8%	2.8%
Three Meetings	.6%	2.8%	6.7%	1.1%	2.8%	1.7%
Four And Above	5.6%	.6%	3.3%	3.3%	2.2%	3.3%
Don't Know	1.7%	.6%	.6%	3.9%	3.3%	2.2%

$X^2=0.001$

The findings provides evidence that in many water projects in the study area, people conduct water meeting once per annum and this is likely to affect the project because people lack opportunity to discuss water matters; and probably in these villages, project management organize water meetings when there is a problem already. However, there was significant difference at ($p \leq 0.001$) in water meetings done annually across villages.

4.7 Sanitation and hygiene aspects of the rural water supply project

Rural water supply and sanitation programme included two projects which were conducted at the same time namely: (i) Rural water supply projects and (ii) Sanitation

and hygiene projects. The programme is one of the government strategies of alleviating poverty through community ownership and management of water supply facilities, universal access to clean and safe water supply within 400 meters (URT, 2002; World Bank, 2006). Under this section several sanitation and hygiene aspects are analyzed and discussed as presented in the following section.

4.7.1 Preparation and storage of drinking water in the household

The current study findings in Table 20 reveal that 81.1% of the respondents were storing water for drinking while the rest of the respondents about 18.9% were not storing water for drinking. This implies that minority were not isolating drinking water from the water for other domestic purposes such as cooking, washing, gardening just to mention few. The results are presented in Table 20.

Table 20: Preparation and storage of drinking water

		Mtawanya	Bungu	Kimbuga	Jaribu Mpakani	Utunge	Chumbi
Do you store drinking water	Yes	14.4%	13.3%	14.4%	12.2%	11.7%	15.0%
	No	2.2%	3.3%	2.2%	4.4%	5.0%	1.7%
Do You Cover Container	Yes	9.4%	9.4%	15.0%	11.1%	9.4%	12.2%
	No	7.2%	7.2%	1.7%	5.6%	7.2%	4.4%

$\chi^2 = 0.271$ and $\chi^2 = 0.035$

Moreover the study aimed at finding out if drinking water containers were covered to protect them from contamination. When respondents in the study area were asked to state whether or they covered their water containers used in storing drinking water,

66.7% of the respondents gave a positive response; while 33.3% of the respondents gave a negative response. These findings imply that majority of the respondents are aware of the need for preparing and storing the drinking water especially in the villages with functioning projects namely Mtawanya 14.4%, Kimbuga 14.4% and Chumbi 15%.

4.7.2 The responsibility of drawing water for drinking from the container

The act of drawing water for drinking from container was a threat to people's health in the study area as people were dipping containers in order to draw water for drinking from the storage container. About 67.8% of the respondents reported that everyone was responsible for drawing drinking water as from the storage container in accordance with one's water needs. This implies that the water is not safe as everyone is likely to use her/his container which may not be thoroughly cleaned.

Table 21: Taking of water for drinking from the container

	Mtawanya	Bungu	Kimbuga	Jaribu Mpakani	Utunge	Chumbi
Adults	.6%	1.7%	1.7%	3.9%	2.8%	2.2%
School Age Children	4.4%	5.0%	2.8%	1.7%	3.3%	1.7%
Children Under Five	0	.6% (1)	0	0	0	0
Any One In Need	11.7%	9.4%	12.2%	11.1%	10.6%	12.8%

$\chi^2 = 0.312$

4.7.3 Treatment of drinking water

When the respondents were asked as to how they treat their drinking water, the results showed differences in the means of treating the water across the villages. Majority of the

respondents (34.4%) with high percent in Mtawanya village (7.8%) and low percentage in Bungu village (3.9%).reported not to be treating their drinking water at all.

Table 22: Treatment of drinking water

	Mtawanya	Bungu	Kimbuga	Jaribu Mpakani	Utunge	Chumbi
Boil	1.7%	7.2%	2.8%	6.1%	6.1%	7.2%
Add Chlorine	3.3%	2.2%	3.9%	2.8%	1.7%	3.3%
Water Filter	1.1%	2.2%	.6%	0	1.1%	.6%
Sedimentation	2.8%	1.1%	5.0%	1.1%	.6%	1.1%
Not At All	7.8%	3.9%	4.4%	6.7%	7.2%	4.4%

$\chi^2= 0.021$

Furthermore, other respondents accounted for 31% of the total respondents reported to be boiling water as a means of treatment prior to drinking; while 17.2%, 11.7% and 5.6% of the total respondents reported to be using chlorine, sedimentation and filtration respectively as water treatment mechanism. The findings indicate further that people in the study area are exposed to water borne diseases such as diarrhea. , These results are indicated in Table 8 that shows that some people still fetch the water from rivers, ponds and unprotected wells. Therefore drinking untreated water is likely to cause diseases and even deaths.

4.7.4 Kind of toilet facility used by household

The study identified several types of toilet facilities which were used by people in the study area. When the respondents were asked to mention the types of toilet facility used by household members, majority (41.7%) of the respondents with high percentage in

Kimbuga (7.8%) and Chumbi (7.8%) villages and low percentage in Bungu (5%) village reported to be using pit latrine with no floor or slab.

Table 23: Kind of toilet facility used by household

	Name of villages (n=30)					
	Mtawanya	Bungu	Kimbuga	Jaribu Mpakani	Utunge	Chumbi
VIP With Floor Or Slab	4.4%	6.1%	1.7%	3.9%	4.4%	1.7%
Pour Flush To Pit	.6%	.6%	.6%	.6%	.6%	1.1%
Flush To Septic System	2.2%	1.7%	2.8%	1.7%	1.1%	3.3%
Pit With No Floor Or Slab	7.2%	5.0%	7.8%	6.7%	7.2%	7.8%
No Facility Or Bush	2.2%	3.3%	3.9%	3.9%	3.3%	2.8%

$\chi^2 = 0.854$

Furthermore, other respondents accounting for 22.2% of the total respondents with high percent in Bungu (6.1%) and low percent in Kimbuga and Chumbi villages (1.7%) reported to be using VIP with floor or slabs. Other toilet facilities used by household members included pour flush to pit which accounted for 3.9% of the total population using these facilities, flush to septic system which accounted for 12.8% and still some respondents, accounting for 19.4% of the total respondents reported to be using bushes.

The findings imply that the variations in the use of toilet facility are likely to be attributed to the nature of the villages, sanitation interventions carried out in a specific village or the status of water project in the specific village. Starting with the nature of the village, the findings indicate that those villages which are near the town centers such as Bungu and Jaribu mpakani have low percentage (ranging from 5% to 6.7%) of the people who use pit latrines with no floor or slabs as opposed to remote villages such as

Mtawanya (7.2%), Kimbuga (7.8) and Chumbi 7.8%. Moreover, the status of water project in specific villages attributes to the type of toilet facility used. For example, in the villages where water projects are still functioning, the percentage of people using flush to septic system was high accounting for 2.2% in Mtawanya village, 2.8% in Kimbuga and 3.3% in Chumbi village; this is in contrast with village with non functioning projects such as Bungu, Jaribu mpakani and Utunge which had 1.7%, 1.7% 1.1% of the respondents respectively reporting to be using flush to septic system. The sanitation interventions was also carried out in phases; some villages, such as Bungu, Utunge and Mtawanya received more training on sanitation matters than was the case for other villages, thus in Mtawanya, Bungu and Utunge villages people are much aware of the sanitation issues than is the case in other villages.

4.7.5 Cleanness of the toilet facility

Cleanness of the toilet facility in the study area was observed to be facilitated by the availability of water. In the villages with functioning projects, the cleanliness rate of toilets was high compared to the villages with non functioning projects. It was observed, for example that in Kimbuga village about 13.3% of the respondents reported to be cleaning their toilets. Likewise in Mtawanya and Chumbi villages about 10.6% and 10% of the respondents respectively reported to be cleaning their toilets while in villages with non functioning projects, the rate of clearing toilets was low. It was observed that in Bungu, Jaribu mpakani and Utunge about 8.9 %, 9.4% and 8.9% of the respondents respectively reported to be cleaning their toilets. The findings indicate that availability of

water especially in the rural areas facilitate sanitation and hygiene practices as the process of cleaning toilets, washing and flushing needs enough and sufficient water.

Table 24: Cleanliness of the toilet facility

	Mtawanya	Bungu	Kimbuga	Jaribu Mpakani	Utunge	Chumbi
Yes	10.6%	8.9%	13.3%	9.4%	8.9%	10.0%
No	6.1%	7.8%	3.3%	7.2%	7.8%	6.7%

$\chi^2 = 0.273$

The findings indicate further that in villages with non functioning projects, such as Bungu, Utunge and Jaribu mpakani villages, people are likely to be affected by water borne diseases such as cholera

4.7.6 Hand washing facilities

Hand washing practices in the study area was also observed. When the respondents were asked to mention whether or not there was for a hand washing place at household, 80.6% of all the respondents responded negatively with variations across villages; while in Mtawanya village, about 15% of the respondents reported to have no hand washing places, the percentage for Bungu, Kimbuga, Jaribu mpakani, Utunge and Chumbi the rate were 13.9%, 10%, 15%, 14.4% and 12.2% respectively.

Table 25: Places for hand washing in the household

		Mtawanya	Bungu	Kimbuga	Jaribu Mpakani	Utunge	Chumbi
Is There A Place For Hand Washing	Yes	1.7%	2.8%	6.7%	1.7%	2.2%	4.4%
	No	15.0%	13.9%	10.0%	15.0%	14.4%	12.2%
Are These Items present/used	Water						
	From Tape	4.4%	1.7%	2.8%	1.7%	.6%	2.2%
	Soap Or Detergent	3.3%	7.2%	2.2%	3.9%	5.6%	3.3%
	Ash	0	0	0	0	.6%	0
	Basin Or Sink	0	0	1.7%	0	0	0
	None Of The Above	8.9%	7.8%	10.0%	11.1%	10.0%	11.1%

$\chi^2 = 0.020$ and $\chi^2 = 0.018$

The findings indicate that majority of the respondents do not have places for hand washing, not having hand washing places may be attributed to the cultural tradition of people in the east coastal zone whereby all members in the household wash their hands in the same container with each one dipping his/her hands one after another, beginning with the household head (father) followed by the wife or the mother, other adults and finally children. The tendency of washing hands in the same container is likely to facilitate the spread of water borne diseases such as cholera, diarrhea and worms.

4.8 Division of labour in domestic water collection

The respondents were asked to indicate the person responsible for fetching water for household use from among the household members. Adult women accounting for about 51% of all the respondents were reported to be the main collectors of water while for Adult Men only 26% of all the respondents were reported to be the main collectors of water for domestic use. Furthermore, about 16.6 % of respondents indicated that the

responsibility of fetching water was under the school age female and male children in the study villages. Table 26 summarizes the findings.

Table 26: Who collects water for household?

	Female	Male
Adult Women	22.8%	28.3%
School Age Female Children	7.2%	5.0%
Adult Men	11.7%	14.4%
School Age Male Children	2.2%	2.2%
Don't Know	3.3%	2.8%

$X^2 = 0.002$

The findings imply that the responsibility of fetching water for the household is still under adult women. In developing countries particularly in rural areas, water scarcity mostly affects women and girls who often bear the burden of hauling water for domestic purposes (UNESCO, 2002). A study by UNDP shows that, women and girl- children are primarily the ones who bear the daily burden of carrying heavy buckets of water and walk long distances to and from water sources to meet water domestic needs for their families (UNDP, 2006). The burden of fetching water is time consuming and physically debilitating; it also reduces the time available for productive activities; for girls it limits their school attendance (UNDP, 2004). In some parts of Africa, women and children spent eight hours per day in collecting water (UN-Water, 2007).

4.9 Community participation in planning cycle of water projects

The planning of any project cycle needs community participation which brings a sense of ownership and commitment which may generate collective views, aspirations and efforts of all the people in all the stages. According to URT, (2006), the local and central governments have a role to play in ensuring that people at the lowest levels and government leaders are all involved in the participatory planning cycle of the water projects. During the study the respondents were asked to indicate whether or not they were involved in planning cycle of water project at different stages. Accordingly, the following sub sections present the participation levels in the water project cycle:

4.9.1 Involvement of users in making water plan

When the respondents were asked to indicate whether or not they were involved in the formulation of the water distribution plan, the results in Table 27 show that 70% of the respondents reported that there were no plans in place, and about 23.9% of the respondents reported that were not involved in the formulation of the water distribution plan of the project. The rest of the respondents of about 6% reported to be involved in the preparation of water distribution plan through attending meetings. Therefore these findings imply that there was no water distribution plan for the project thus people in the study area were not generally involved in the project planning cycle. The situation is likely to affect the project negatively because the community members have no full ownership of these projects.

Table 27: Involvement in making the water distribution plan

	Mtawanya	Bungu	Kimbuga	Jaribu Mpakani	Utunge	Chumbi
Were Not Involved	6.1%	6.7%	6.7%	1.7%	1.1%	1.7%
No Plan In Place	9.4%	8.3%	8.3%	15.0%	15.0%	13.9%
Through Meeting	1.1%	1.7%	1.7%	0	.6%	1.1%

$\chi^2 = 0.169$

4.9.2 Participation in the inspection of the project facilities

The whole community has the responsibility of protecting the project against any damage or destruction which is likely to affect the project. Through the inspection of the project facilities, the community is able to identify any damage on the project machinery and which might affect the proper functioning of specific project. Therefore, when the respondents were asked to indicate the person responsible in participating in the inspection of the project facilities, the results in Table 28 show that about 29.4% of the respondents mentioned district water technicians as having the responsibility of inspecting the project facilities.

Furthermore, about 28.3% of the respondents were not aware of who was responsible for inspecting the project facilities, while about 18.3% of the respondents indicated water user association leaders, 11% of the respondents indicated village council, 8.9 % of the respondents indicated the whole community and 3.9 % of the respondents indicated water attendants as responsible for inspecting project facilities.

Table 28: Participation in the inspection of project facilities

	Mtawanya	Bungu	Kimbuga	Jaribu Mpakani	Utunge	Chumbi
District						
Water Technician	6.7%	3.9%	5.0%	3.9%	5.0%	5.0%
The Whole Community	.6%	2.8%	1.1%	1.7%	2.2%	.6%
Water Attendants	1.1%	1.7%	.6%	0	.6%	0
Water User Association	2.8%	5.6%	8.3%	0	0	1.7%
Village Council	1.1%	1.7%	.6%	2.2%	3.3%	2.2%
I Don't Know	4.4%	1.1%	1.1%	8.9%	5.6%	7.2%

$\chi^2 = 0.000$

The findings reflect the fact that communities are not involved in doing inspection of the project facilities and this in one way or another affects the water project. In the discussion with FGDs members one woman said that:

“Mradi wa maji unaharibiwa na watu wanoiba mabomba makusudi ili waweze kuuza maji yao wanayochota visimani”.

The comment meant that some people steal project facilities and other people sabotage the project by destructing water pipes purposely, Therefore this affect rural water projects sustainability.

4.10 Women representation in the water user association

Women representation in the water user association should be equal to men as was stipulated in the water policy of 2002 which provides the guidelines on the formation and registration of water user associations (URT, 2002). When the respondents were

asked to mention the number of women belonging to water user associations, about 30% of the respondents reported that there were no women representations in the water user association while 26% and 14% of the respondents mentioned to have two women and six women representation respectively.

Table 29: Women representation in the water user association

	Mtawanya	Bungu	Kimbuga	Jaribu Mpakani	Utunge	Chumbi
Two	3.9%	3.3%	5.6%	3.9%	6.1%	3.9%
Four	1.1%	2.2%	1.7%	1.1%	1.1%	1.1%
Six	5.6%	2.8%	.6%	3.9%	0	1.7%
More Than Half	.6%	1.7%	2.8%	0	0	0
Not At All	4.4%	5.6%	5.0%	3.9%	6.1%	5.6%
Don't Know	1.1%	1.1%	1.1%	3.9%	3.3%	4.4%

$\chi^2 = 0.009$

Furthermore, some other for 8.3% of respondents indicated representation of four women in the water user association and 15% of the respondents said they were not aware of the number of women involved in the water user association. The results indicate that in the study area, men are the ones who manage and operate the water projects, while women are left behind. The situation is likely to affect the water project because it is probable that women's ideas and decision are not included in the whole process of planning and management of the water projects.

4.10.1 Women decision making in water meetings

When the respondents were required to say whether or not women have a chance to speak or contribute ideas concerning water matters in the meetings, the findings show that 20% of female respondents admitted to speaking and making decisions in the meetings concerning water projects. The rest 27.2% of female respondents reported not to be speaking in the meetings, while about 13.3% of male respondents reported to be speaking in the meeting and about 39.4 % reported not to be speaking in the meeting concerning water projects.

Therefore from this finding it is evident that women are the main decision makers in the water related matters; this is probably possible because women are the main collectors of domestic water, as their main household activities such as washing, cooking, and gardening depend on water. The overall findings are summarized in Table 30.

Table 30: Women decision making in water meetings

		Female	Male
Do You Speak In The Meeting	Yes	20.0%	13.3%
	No	27.2%	39.4%

$X^2 = 0.019$

These results are supported by Koda (1990), who observes that women are usually responsible for domestic activities such as collecting water and firewood, cooking and providing food and other household services. According to URT, (2002), the National water policy of 2002 emphasized equal involvement of women and men in the planning and management of the rural water projects especially community based water projects.

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of the Major Findings

The study was carried out to assess the determinants of rural water project sustainability in Rufiji District in the Coast region. Six villages namely, Mtawanya, Bungu, Kimbuga, Utunge, Chumbi and Jaribu mpakani were studied. Several factors which affect rural water projects sustainability were identified and variations of the level of sustainability across the villages were discussed. Generally, the findings show that in Mtawanya, Kimbuga and Chumbi villages, water projects were still functioning while in Bungu, Jaribu mpakani and Utunge villages water project were not functioning.

However, the study reveals that there are direct and indirect factors which affect the functioning of rural water projects especially in the study area. For instance, the direct factors affecting the rural water projects include lack of project maintenance and lack of spare parts, while the indirect factors include lack of water meetings, lack of women representation in the water project management, weakness of water user association group and poor implementation of sanitation and hygiene strategies.

5.2 Conclusions

Based on specific objectives and a summary of major findings, the study presents the following conclusions:

- i) In the study area there was an observable general pattern of increasing failure of rural water projects which resulted into continuation of fetching water from rivers, lakes, unprotected dug wells and ponds for domestic water purposes. For instance, it was observed that about 91% of the respondents in the study area fetch drinking water from local sources; this situation is attributed to high prices of the water from the project and non-functioning of the water projects in the specific villages.

- ii) The target of ensuring access to drinking water within 400 Meters to domestic water resources by the majority of population is yet to be achieved in Rufiji District. In Rufiji District, majority 46% walked about 500 Meters and beyond to reach the main sources of water. The NSGPR target is to increase the proportion of rural population with access to clean and safe water from 53% in 2003 to 65% in 2009/2010 within a distance of not more than 400 Meters. Therefore this goal in Rufiji District was not achieved until 2011 when the study was done.

- iii) One of the limitations towards smooth functioning of rural water projects was observed to be the misuse of water funds and lack of community participation in the whole process of project planning and management as well as irregular maintenance of water projects.

- iv) The setting of water prices has a direct link to the smooth operation of the project. For instance in the study villages, the general trend shows that in some villages water prices were high and limiting some people from getting the water from the project.

On the other hand, in some villages the prices were very much low which also negatively affected the operations and maintenance processes.

- v) In the study area, there was an observable general pattern of poor sanitation and hygiene practices. About 34.4% of the respondents were not treating drinking water, therefore majority of the people are exposed to water borne diseases such as cholera and diarrhea.
- vi) In the study area about 41.7% of the respondents use pit latrine with no floor or slabs. This is attributed to lack of training on sanitation and hygiene practices in the study area. Also the situation may be attributed to lack of enough and sufficient water.
- vii) Poor management of water funds was another big factor for the failure of rural water projects. The purpose of collecting funds from selling water is to handle operations and management costs, therefore funds mismanagement in the villages such as Utunge, Bungu and Jaribu mpakani may have contributed to non functioning of water projects.

5.3 Recommendations

From the study findings and conclusion made above, the following recommendations are drawn:

- i) The increasing rate of water project failure especially in the rural areas should be addressed in order to achieve reliable supply of safe and clean water to the rural populations. Local governments, donors and communities should make sure that both technical aspects and regular follow-ups, capacity buildings to the community and water user association members become a sustainable process for the attainment of rural water project sustainability.

- ii) The target of ensuring access to drinking water within 400 Meters to domestic water resources by majority of the population is yet to be achieved in Rufiji District. In order to increase the access in rural areas rain water harvesting and proper storage should be introduced. At the community and Local government levels, it is recommended that the rain water harvesting technologies should be included into the Village and District strategic plan. Extension officers and water committees should be involved in creating awareness and promoting the rain water harvesting technologies.

- iii) In order to enhance transparency among WUG and VWC towards management of water funds, there should be good and timely quarterly progress reports on expenditures and incomes accrued from water services which should be submitted

in the village assemblies so that immediate measures can be taken in cases where operational problems emerge.

- iv) Community participation is a useful means for achieving sustainable development in rural areas. In order to achieve sustainable development, interactive and self mobilization types of participation are recommended whereby people are actively involved in all stages of project identification, planning, implementation, monitoring and evaluation for sustainable development.
- v) Regular maintenance of rural water projects is very important in achieving sustainability. Regular maintenance is facilitated by regular training of the WUGs and village technicians. Therefore, it is recommended that WUG and village technicians should be trained on how to handle minor and major maintenance instead of depending on maintenance workers from outside.
- vi) The setting of water prices should consider the community capacity and the economic situations whereby the price set should handle operations and maintenance costs and at the same time be affordable by majority of the people. As is stipulated in the National water policy of 2002, the price of water should be within the people's capacity to pay and communities are responsible for setting these prices and the review them accordingly as it is deemed fit.

vii) Local governments, donors and extension officers are recommended to promote and create awareness on sanitation and hygiene practices. For instance in the study area, sanitation and hygiene practices can be promoted through formation of sanitation and environmental clubs at schools and community levels.

5.3.1 Recommendations for future research

Based on the main findings the study managed to understand different determinants for rural water project sustainability. However, while results lead to conclusion made earlier, the study did not analyze the influence of technology in its broader sense. The study therefore recommends for another study in the following areas:

- i) Water quality and quantity from the source
- ii) Type and quality of technology used by contractors in building water projects
- iii) Type of equipments and qualification of technicians

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APPENDICES

Appendix 1: Questionnaire for households

My Name is ALISTIDIA WILLIAM KYAMANI, a student at Sokoine University of Agriculture. I am working on a research project titled, Determinants for sustainability of rural water projects in Rufiji District. The aim of this project is to identify all factors which affect the sustainability of water projects in Rufiji District. I am going to ask you a number of questions on operation and maintenance of the water projects. Information provided by you will be valued and treated confidential, at the end the project will contribute on the knowledge for the factors which affect sustainability of water projects.

1. BASIC RESPONDENT'S INFORMATION

DATE OF INTERVIEW	VILLAGE NAME	DIVISION
HOUSEHOLD SIZE	NAME OF RESPONDENT	RESPONDENT'S AGE
1= LESS THAN FOUR 2= 4-6 3=7-9 4=10-12 5=13 AND ABOVE		
RESPONDEN'S GENDER	RESPONDENT'S MARITAL STATUS	ORIGINAL OF HHH
1= Male 2= Female	1= Married 3= Divorced 2= Single 4= Widow	1= Native 2= Immigrant

1.2 MEMBERS OF HOUSEHOLD CURRENTLY RESIDENT AND WHO ARE PERMANENTLY AWAY

(Write the correct number in the right side boxes)

Name	Age (years)	Sex put M or F	Relationship	Education	Occupation	Resident/Away	If sends money home	Estimated amount last season
1.			1= Head	1= None	1= Child	1= Resident	1= Yes	
2.			2= Wife	2= std IV	2= Student	2= Away	2= No	
3.			3=Husband	3= std VII	3= Farmer			
4.			4= Child	4=Secondary	4=C/servant			
5.			5= Other	5= Higher ed	5= Business			
6.			relative					
7.			6= None					
8.			relative					
9.								
10.								
Total of HH members								Total amount

2. HOUSEHOLD ASSETS ACQUISITION AND LIVELIHOOD

DIVERSIFICATION

NO	QUESTIONS	CODING CATEGORY (circle the correct number)
2.	Does your household own the following items?	CAR/TRUCK.....1 MOTORCYCLE.....2 BICYCLE.....3 BOAT.....4 RADIO.....5 RADIO WITH TAPE.....6 TELEVISION.....7 REFRIGERATOR.....8 SEWING MASHINE.....9 KEROSINE COOKER.....10 KEROSINE LAMP.....11 LARGE LIVESTOCK.....12 SMALL LIVESTOCK.....13 LAND FOR SUBSISTANCE FARMING.....14 LAND FOR CASH CROPS.....15 SHELVES.....16 CHAIRS OF WOODS.....17 TABLES OF WOOD.....18 CHAIRS OF PLASTICS OR METAL.....19 TABLES OF PLASTICS OR METALS20 GENERATOR OR SOLAR PANEL.....21
3.	Do you own a dwelling including the land?	YES.....1 NO.....2
4.	If not how likely that you could be evicted from this dwelling?	VERY LIKELY.....1

		SOMEWHAT LIKELY.....2 NOT AT LIKELY.....3
5.	What are the activities for gaining a living in this household?	SMALL LIVESTOCK.....1 SMALL FARMING.....2 LARGE FARMING.....3 SMALL BUSINESS.....4 FISHING.....5 OTHERS.....6
6	What is the monthly household income	50,000-150,000 tzsh.....1 160,000-250,000 tzsh.....2 260,000-350,000 tzsh.....3 360,000-450,000 tzsh.....4 500,000 tzsh and above.....5

3. WATER SUPPLY BEFORE AND DURING THE PROJECT

NO	QUESTIONS	CODING CATEGORY (circle the correct number)
7.	Have you heard about rural water supply and sanitation project in this village?	YES.....1 NO.....2
8.	If yes, what were the sources of water before that project?	PIPED WATER.....1 BORE HOLES2 UNPROTECTED DUG WELL.....3 HAND PUMP.....4 RIVERS, STREAMS, PONDS, LAKE AND D.....5
9.	Are those sources (mentioned above) still existing?	YES.....1 NO.....2
10.	What is daily household water consumptions	LESS THAN 20 LITERS.....1 20-40 LITERS.....2

		41-60 LITERS.....3 61-90 LITERS.....4 91- 150 LITERS.....5 151 LITERSAND ABOVE.....6
11.	Are you contributing any thing in order to get water from the source mentioned?	YES.....1 NO.....2
12.	What is the price of water per container	LOW PRICE (20-30 TZSH).....1 MEDIUM PRICE (40-90 TZSH).....2 HIGH PRICE (100 TZSH AND ABOVE).....3
13.	After the project started, where do you prefer to collect water from?	PIPED WATER.....1 BORE HOLES2 UNPROTECTED DUG WELL.....3 HAND PUMP.....4 RIVERS, STREAMS, PONDS, LAKE AND DAM.....5
14.	What are the reasons for you to collect water from the mentioned source above?	THE PRICE IS AFFORDABLE1 NO COST NEEDED.....2 SHORT DISTANCE FROM SOURCE.....3 OTHERS, MENTION4
15.	What is the distance from your household to the main source of water?	50 UP TO 90 METERS.....1 100 UP TO 250 METERS2 350 UP TO 400 METERS3 500 METERS AND ABOVE4
16.	How long does it take you to go at your main water source, get water and come back?	30 MINUTES.....1 60 MINUTES2 90 MINUTES3 120 MINUTES AND ABOVE4
17.	If water is not on premises who usually collects water?	ADULT WOMEN.....1 SCHOOL AGE FEMALE CHILDREN2 ADULT MEN.....3 SCHOOL AGE MALE CHILDREN4
18.	In what type of container is the water carried from your main source?	GALLON.....1 BUCKET.....2

		DRUM3 JERRY CAN4
19.	How many of these containers are carried at a time?	ONE TO FOUR1 FIVE TO TEN.....2 ELEVEN TO FIFTEEN.....3 SIXTEEN AND ABOVE.....4
20.	How many loads do you fetch per week?	ONE TO FOUR.....1 FIVE TO TEN.....2 ELEVEN TO FIFTEEN3 SIXTEEN AND ABOVE.....4
21.	Do you pay for water services from the main source?	YES.....1 NO.....2
22.	Do you think that price is reasonable?	YES.....1 NO.....2
23.	If no, give the reasons for why you think it is not reasonable	1..... 2.....

4. FACTORS FOR PROJECT FUNCTIONALITY

NO	QUESTIONS	CODING CATEGORY
24.	Does your water project function?	YES.....1 NO.....2
25.	In the last two weeks has the water from this source been unavailable for at least one whole day?	YES.....1 NO.....2
26.	For how many days did you not have water from the project?	ONEWEEK.....1 ONEMONTH.....2 FIVEMONTH.....3 ONEYEAR AND ABOVE.....4
27.	How long does it usually take to fill a container from your main source?	AMINUTE OR LESS.....1 MORE THAN ONE MINUTE.....2

		MORE THAN FIVE MINUTES3 ONE HOUR OR LONGER.....4
28.	How many times your project has been maintained	LESS THAN 2 TIMES.....1 2-3 TIMES.....2 4-5 TIMES.....3 6 TIMES AND ABOVE.....4
29.	How many times spareparts replacement has been done	LESS THAN I TIME.....1 2-3 TIMES.....2 4-5 TIMES.....3 6-7 TIMES.....4 8 TIMES AND ABOVE.....5
30.	What makes your water project to function well?	FREQUENT MAINTANANCE.....1 AVAILABILITY OF SPARE PARTS.....2 GOOD PROJECT MANAGEMENT.....3 COMMUNITY PARTICIPATION.....4
31.	If no, what makes your project not to function?	HIGH PRICES OF WATER.....1 LONG DISTANCE FROM THE SOURCE.....2 LACK OF FREQUENT MAINTENANCE.....3 LACK OF SPARE PARTS4 LACK OF COMMUNITY PARTICIPATION.....5
32.	How many days you get service from the project per month?	TWO – THREE DAYS.....1 FOUR – NINETEEN DAYS.....2 TWENTY-TWENTY NINE DAYS.....3 THIRTY DAYS.....4 NOT AT ALL.....5
OPERATION AND MAINTANANCE OF WATER PROJECT		
33.	Who is responsible for setting of water charges?	THE WHOLE COMMUNITY.....1 WATER USER ASSOCIATION LEADERS.....2 VILLAGE COUNCIL.....3 I DON'T KNOW.....4

34.	Who collects water funds?	WATER ATTENDANT.....1 VILLAGE COUNCIL.....2 WATER USER ASSOCIATION LEADERS.....3 WARD LEADERS.....4
35.	Do you receive any payment receipt after paying your water bill?	YES.....1 NO.....2
36.	What are the uses of these funds	MAINTANACE AND REPAIR.....1 UPGRADING AND NEW CONSTRUCTION.....2 RENUMERATION FOR MANAGEMENT.....3 OPERATIONAL COSTS.....4 WATER RESOURCES TAX.....5 COMMISSION FOR FEE COLLECTION.....6 OTHER COSTS (MENTION).....7
37.	Do you think these funds are managed properly?	YES.....1 NO.....2
38.	Who is making final decision concerning fund allocation?	WATER ATTENDANT.....1 VILLAGE COUNCIL.....2 WATER USER ASSOCIATION LEADERS.....3 WARD LEADERS.....4
39.	Are expenditure reports and bank statements of the project available	YES.....1 NO.....2 I DON'T KNOW.....3
40.	Are expenditures and bank statements announced in public	YES.....1 NO.....2
41.	Do you think the funds are managed properly?	YES.....1 NO.....2
42.	If no, give the reasons for not being managed properly?	1..... 2..... 3.....
43.	To what extent do the water funds cover the total	VERY GOOD1

	costs (operation, maintenance and repair) of the project?	GOOD.....2 BAD.....3
WATER USER ASSOCIATION IN THE MANAGEMENT OF WATER PROJECT		
44.	Is there any water user association in your village?	YES.....1 NO.....2
45.	What are the responsibilities of water user association in water project?	TO OPERATE AND MAINTAIN WATER PROJECT.....1 TO COLLECT WATER BILLS.....2 TO CONDUCT MEETING ON WATER PROJECT.....3 TO INFORM COMMUNITY ON PROJECT PROGRESS.....4
46.	When there is a problem with your water project/point whom do you tell or ask for help?	WATER USER ASSOCIATION.....1 PROJECT TECHNICIAN.....2 LOCAL GOVERNMENT.....3 MAINTENANCE WORKER FROM OUTSIDE.....4
47.	What is the level of performance of the water association in your village?	VERY GOOD.....1 GOOD.....2 BAD.....3
48.	Do you get any feedback about project progress from your water user association?	YES.....1 NO.....2
49.	How many meetings are conducted per annum concerning water project?	ONE MEETING.....1 TWO MEETINGS.....2 THREE MEETINGS.....3 FOUR AND ABOVE.....4
WATER DISTRIBUTION PLAN OF THE PROJECT		
50.	Is there any written water distribution schedule in place?	YES.....1 NO.....2
51.	In what ways are users involved in the making of a water distribution schedule?	1..... 2..... 3.....

52.	Who is making the final decision about water distribution?	THE WHOLE COMMUNITY.....1 WATER USER ASSOCIATION LEADERS.....2 VILLAGE COUNCIL.....3 I DON'T KNOW.....4
53.	How are users informed about the timing of the release of water?	THROUGH MEETING.....1 THROUGH ADVERTISEMENT.....2 THROUGH LETTERS.....3 NOT AT ALL.....4
WATER PROJECT AND PROBLEM RESOLUTION		
54.	Compare to the situation three years ago, the number of problems is	LESS.....1 SAME.....2 MORE.....3
55.	If changed, what is the reason for the change in problems?	1..... 2.....
56.	How the problems are usually solved?	1..... 2.....
57.	Are people satisfied about the way the problems have been solved?	YES.....1 NO.....2
58.	How can these problems be prevented in the future?	1..... 2.....
OPERATION AND MAINTANANCE PLAN OF THE WATER PROJECT		
59.	Is there any written operation and maintenance plan in place? Written by whom?	YES.....1 NO.....2 BY.....
60.	In what ways are users involved in the making of operation and maintenance plan?	1..... .. 2..... 3.....
61.	Is there any inspection annually or seasonal of the project facilities? By whom?	YES.....1 NO.....2

		BY WHOM.....
62.	Who are participating in this inspection of project facilities?	DISTRICT WATER TECHNICIANS.....1 THE WHOLE COMMUNITY.....2 WATER ATTENDANTS.....3 WATER USER ASS LEADERS.....4 VILLAGE COUNCIL.....5
63.	Who makes the final decision concerning the work to be done(operation and maintenance)	DISTRICT WATER TECHNICIANS.....1 THE WHOLE COMMUNITY.....2 WATER ATTENDANTS.....3 WATER USER ASS LEADERS.....4 VILLAGE COUNCIL.....5
PARTICIPATION AND GENDER ISSUES		
64.	How are women represented in the water user association? Mention number of them	TWO WOMEN MEMBERS.....1 FOUR WOMEN MEMBERS.....2 SIX WOMEN MEMBERS.....3 MORE THAN HALF MEMBERS.....4 NOT AT ALL.....5
65.	How often have you attended water meetings?	NEVER.....1 SOMETIMES.....2 OFTEN.....3 ALWAYS.....4
66.	If meetings are held do you have the feeling that you were able to speak?	YES.....1 NO.....2
67.	Have you or members of household received any technical training on water project management?	YES.....1 NO.....2 I DON'T KNOW.....3
68.	How many trainings conducted in your village concerning operation and maintenance of the project	LESS THAN 1.....1 2-3 TRAININGS.....2 4-5 TRAININGS.....3 6-7 TRAININGS.....4

		8 AND ABOVE.....5
69.	Have you or any member received trainings on bookkeeping of the project funds?	YES.....1 NO.....2 I DON'T KNOW.....3
70.	Who provided this training? How many times you received trainings?	DISTRICT WATER TECHNICIAN.....1 NON GOVERNMENTAL ORGANIZATION.....2 WARD EXTENSION OFFICERS.....3 PRIVATE CONSULTANTS.....4
HYGIENE AND SANITATION ISSUES IN THE WATER PROJECT		
71.	Do you store water for drinking in the household?	YES.....1 NO.....2
72.	Do you cover your containers?	YES.....1 NO.....2
73.	Who takes water from this container?	ADULTS.....1 SCHOOL AGE CHILDREN.....2 CHILDREN UNDER FIVE.....3 ANY ONE IN NEED.....4
74.	How do you remove water from the drinking water container?	POURING.....1 DIPPING.....2 BOTH POURING AND DIPPING.....3 CONTAINER HAS A TAP.....4 OTHERS.....5
75.	Do you treat your drinking water in any way?	YES.....1 NO.....2 I DON'T KNOW.....3
76.	How do you treat your water for drinking?	BOIL.....1 ADD CHLORINE.....2 WATER FILTER.....3 SEDIMENTATION.....4 OTHERS.....5

77.	When did you treat your drinking water the last time using this method?	TODAY.....1 YESTERDAY.....2 LESS THAN ONE WEEK.....3 ONE WEEK AGO OR MORE.....4 ONE MONTH AGO.....5 DON'T REMEMBER.....6
78.	What kind of toilet facility does this household use?	FLUSH TO SEPTIC SYSTEM.....1 POUR FLUSH TO PIT.....2 FLUSH ELSE WHERE.....3 VIP/PIT WITH FLOOR/SLAB.....4 PIT LATRINE WITH NO FLOOR/SLAB.....5 COMPOSTING/DRY LATRINE.....6 BUCKET LATRINE.....7 HANGING LATRINE.....8 NO FACILITY/FIELD/BUSH.....9
79.	If pit or septic system how frequently emptied?	ATLEAST ONCE A YEAR.....1 EVERY COUPLES OF YEARS.....2 NEVER.....3 I DON'T KNOW.....4
80.	Is the facility used day and night?	DAY AND NIGHT.....1 DAY TIME ONLY.....2 NIGHT TIME ONLY.....3 NOT AT ALL.....4
81.	How many household shares the toilet?	NOT SHARED.....1 LESS THAN NINE.....2 MORE THAN TEN.....3
82.	Is the facility cleaned?	YES.....1 NO.....2
83.	Is there a place for hand washing in the toilet or outside?	YES.....1 NO.....2

84.	Are these items available inside or outside the facility?	WATER FROM TAP.....1
		SOAP OR DETERGENT.....2
		ASH.....3
		TOWEL.....4
		BASIN OR SINK.....5
		NONE OF THE ABOVE.....6

5. ASSESSMENT ON THE QUALITY OF WATER FROM THE PROJECT AND OTHER SOURCES

NO	QUESTIONS	CODING CATEGORY
AVAILABILITY OF WATER FROM THE PROJECT AND OTHER SOURCES		
1.	Is water available in the project at all seasons?	YES1 NO.....2
2.	If no, mention the seasons which water is available at the project.	1..... 2.....
3.	Is water available in other sources at all seasons?	YES.....1 NO2
4.	If no, mention the season which water is available in other sources.	1..... 2.....
ACCESSIBILITY OF WATER FROM PROJECT AND OTHER SOURCES		
5.	Is the price of water from the project affordable?	YES.....1 NO.....2
6.	If no, mention the reasons for not being affordable.	1..... 2.....
7.	Is the price of water from other sources affordable?	YES.....1 NO.....2
8.	If yes, mention the reasons for being affordable?	1..... 2.....
9.	What is the distance from the project to your household?	1.....
10.	What is the distance from the other sources to your household?	1.....
CLEANNES OF WATER FROM PROJECT AND OTHER SOURCES		
11.	Is the water from the project clean?	YES.....1 NO.....2

12.	If yes give the reasons to why you think it is clean?	1..... 2.....
13.	Is the water from other sources clean?	YES.....1 NO.....2
14.	If no, give the reasons to why it is not clean?	1.....
TREATMENT OF WATER FOR PROJECT AND OTHER SOURCES		
15.	Is the water from the project treated?	YES.....1 NO.....2
16.	If yes how water is treated?	ADDITION OF CHLORINE.....1 SIEVE IT THROUGH CLOTH.....2 WATER FILTER.....3 SEDIMENTATION.....4
17.	Is the water from other sources treated?	YES.....1 NO.....2
18.	Do you wash clothes, utensils near the water point?	YES.....1 NO2
19.	Do you wash clothes, utensils near the other sources?	YES.....1 NO.....2
20.	Do you bring livestock near the water point to drink?	YES.....1 NO.....2
21.	Do you bring livestock near the other sources to drink?	YES.....1 NO.....2
SALINITY OF WATER FOM PROJECT AND OTHER SOURCES		
22.	Is water from the project soft?	YES.....1 NO2
23.	Do you prefer water from the project?	YES.....1 NO.....2
24.	If no, give the reasons?	1..... 2.....
25.	Is the water from other sources soft?	YES.....1 NO.....2
26.	Do you prefer water from other sources?	YES.....1 NO.....2
27.	If yes, give the reason	1..... 2.....

6. PERCEPTIONS OF PEOPLE ON FUNCTIONALITY OF THE WATER PROJECT

Please indicate the level of your agreement or disagreement as 1) strongly disagree

2) Disagree 3) Undecided 4) Agree 5) strongly agree against each of the following statements.

s/no	Statement	1	2	3	4	5
1.	Maintance of water projects is very potential for project functionality					
2.	Community participation is important in order to have sustainable rural water supply					
3.	Availability of spare parts contributes to project functionality					
4.	Setting of water charges facilitate the operations of the project					
5.	Good management of water funds contribute to project functionality					
6.	Frequent trainings of water attendants facilitate the operations of water projects					
7.	Distance from the household to water point contributes to preference of the project					
8.	Effectiveness of the water user association contributes to project functionality					
9.	Maintance of water projects is not necessary for project functionality.					
10.	A water project can be sustainable even without Community participation					
11	Lack of spare parts does not affect project functionality					
12.	The high water charges makes people to opt for local water sources					
13.	Bad management of water funds affects the operation and maintenance of the system					
14.	Frequent trainings of water attendants does not facilitate the operations of water project					
15.	Long distance from household to main source makes people to prefer other sources					
16.	Weakness of the water user association has great negative impacts to project functionality.					

Appendix 2: FOCUS GROUP DISCUSSION INTERVIEW GUIDE**A) MANAGEMENT OF RURAL WATER SUPPLY PROJECT**

- 1) How often do you meet to discuss issues concerning O& M of water projects?
- 2) How water users are informed on expenditures of funds collected from water services?
- 3) Are the people able to pay for the water services in this village?
- 4) Why some people are not able to pay for the water services?
- 4) Do you have a bank account for your project?
- 5) How do water funds managed in this village?
- 6) What are your opinions about management of funds for O& M of the project?
- 7) What are the main problems facing your water project?
- 8) What are your opinions to improve the functionality of water project?
- 9) Why do you think some projects are functioning properly and others not?
- 10) What do you think are factors which affect sustainability of water project?
- 11) What are your opinions about achieving sustainability of water projects?

Appendix 3: A CHECKLIST FOR KEY INFORMANTS

1. Are you aware about rural water supply and sanitation projects?
2. When did the projects start in Rufiji District?
3. How many villages were involved in the first phase of the project?
4. How many schemes were constructed?
5. How many water points were constructed?
6. Are all schemes functioning properly?
7. How many projects/points are not functioning properly?
8. What are factors affecting its functionality?
9. What should be done to maintain its functionality?