ASSESSMENT OF COMMUNITY PREPAREDNESS TO SUSTAIN WATER SUPPLY SERVICES IN RWANDA: A CASE STUDY OF MIGERA-3 WATER SUPPLY PROJECT

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DECLARATION

This research project report is my original work and has not been presented for a degree in any other University.

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This research project report has been submitted for examination with our approval as University Supervisors.

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DEDICATION

I dedicate this research project to my Fiancé Alice N and my Family.

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ABSTRACT

The research project intended to assess the community preparedness to sustain water supply services in Rwanda with a case study of migera-3 water supply project, which has been carried out in Mwili and Rwinkwavu sectors of kayonza district, Eastern province. The assessment has been based on different indicators of project sustainability such as effective functioning and use, client satisfaction and cost recovery. Specifically the objectives of the research were, to identify the skills possessed by community to sustain water supply service in kayonza District; to assess the cost and benefits of community to the project sustainability; to assess the communication effectiveness of maintenance issues by the community; and to analyze the link between demand responsiveness and sustainability. The study adopted quantitative and qualitative analysis and targeted a population of 10785 households equivalent to 40928 people around 33 km water pipe lines in which a sample of 100 households was taken using Slovin formula, and hence 100 questionnaires have been used to collect data which later have been analyzed using descriptive statistics with the help of percentage tables, correlations tables and summary of community thoughts. The major findings included that, only 87% of community have very low level to use water pump and a big number of people, at 88 % have very low level of skills in interpretation of technical symbols. The findings showed that 98% of community had very low level of satisfaction in cost of water where the cost of a twenty liters can was fixed to 30 Rwf even though 93 % have a very high level of knowledge on project benefits. The availability of people to communicate any problem of water supply service was at a very high level of about 83%, but the community of about 84% has medium means of reporting. For the community having their demands responded, they affected positively the project sustainability by the proper usage of service facilities, less wastage of water, reporting potential bad practices to water supply and participating freely in all development actions for expansion of the service.

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ABBREVIATIONS AND ACRONYMS

CARE: Cooperative for Assistance and Relief Everywhere

EDPRS: Economic Development and Poverty Reduction Strategies

EGC: Entreprise General de Construction

EWS: Energy Water and Sanitation

KPI: The Key Performance Indicators

MDG: The Millennium Development Goal

MININFRA: Ministry of Infrastructure

MINIRENA: Ministere de Resource Naturel

RIWSP: Rwanda Integrated Water Security Programme

RWSN: Rural Water Supply Network

SWG: Sector Working Group

UN: United Nations

UNDP: United Nation Development Program

USAID: United State Agency for International Development

WASH: Water and Sanitation for Health

WS&S: water supply and sanitation

OPERATIONAL DEFINITION

Sustainability is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. (John Roeder, 2012)

Sanitation: Sanitation literally means measures necessary for improving and protecting health and well being of the people. Sanitation is any system that promotes proper disposal of human and animal wastes, proper use of toilet and avoiding open space defecation. (Water aid, 2008)

Pump: A pump is a device used to raise, compress, or transfer fluids. (Fraenkel, 1986)

Potable water: Safe for drinking, free from pathogens which are introduced to the water through feces, dirty containers, etc. (WHO/UNICEF, 2000)

Water tap is any everyday type of valve, particularly the fittings that control *water* supply to bathtubs and sinks.

Water or flowing of water; also: the amount of water flowing (as past a valve) per unit of time.

Water quality: The quality of water may be described in terms of the concentration and state (dissolved or particulate) of some or all of the organic and inorganic material present in the water, together with certain physical characteristics of the water. (Chapman, 1996)

Queuing time: Amount of time a person spend before water tap waiting to be served

Community work (Umuganda): The word Umuganda can be translated as 'coming together in common purpose to achieve an outcome'. In traditional Rwandan culture, members of the community would call upon their family, friends and neighbors to help them complete a difficult task. (RGB, 2015)

CHAPTER 1

Introduction

This chapter provides a general introduction of the study. It has been discussed according to its four main points the background of the study, the statement of the problem, the research objectives and questions, significance of the study and scope of the study.

1.1 Background of the study

According to the Millennium Development Goal (MDG) (Summit Report, 2010) progress on the MDG target 'to reduce by half the proportion of people without sustainable access to safe drinking water and basic sanitation by 2015 was on track. Yet rural areas in developing countries across the world remain severely disadvantaged, with eight out of ten people not having access to an improved water supply. Only 47% of the rural communities of sub-Saharan Africa have access to an improved water source (UN, 2010). Water Aid's mission was to overcome this gap to achieve its vision of a world where everyone has access to safe water and sanitation.

However, the challenge of rural water supply sustainability was jeopardizing progress. It was estimated that only two out of three hand pumps installed in developing countries are working at any given time (RWSN, 2010). Without services providing a sustainable water supply, the number of people with access to an improved water supply would fall, and the achievement of MDG would be compromised.

Sustainability of rural water supply relates to whether or not these services last over time (Carter, 2010) and was dependent upon numerous factors ranging from spare parts availability to effective community management models to finance for operation and maintenance and external support. Sustainability was compromised when the effectiveness of one or several of these factors fails, or they cease to even exist.

Access to safe water and sanitation lies at the very core of poverty reduction. Improved access gives the poor, especially women, control over basic aspects of their life and a sense of empowerment. Within the context of the Millennium Development Goals for water and

sanitation, interventions must be designed to strike more effectively at the roots of global poverty and involve more than the mere construction of facilities. (Nilanjana and Van wijk, 2011)

Rwanda has committed itself to reaching very ambitious targets in water supply and sanitation, with the vision to attain 100% service coverage by 2020. The importance of adequate water supply and sanitation services as drivers for social and economic development, poverty reduction and public health was fully acknowledged in Rwanda's flagship policy documents and political goals. (Mininfra, 2010)

Rwanda's EDPRS I and II sets out the country's objectives, priorities and major policies for the respective five years (2008-2013 and 2013-2018) and provides a road map for the government, development partners, the private sector and civil society. It indicates where Rwanda wants to go, what it needs to get there, and how it was going to do it.

The national strategy provides a medium-term framework for achieving the country's long-term development goals and aspirations as embodied in Rwanda's Vision 2020, the 7-year program and the MDGs. As the EDPRS I period reaches its end, self-assessments have identified the achievements and challenges encountered during its implementation, setting the way forward for the preparation of EDPRS II. (Mininfra, 2013)

The overall objective of the National Water and Sanitation Policy was to "ensure sustainable and affordable access to safe water supply, sanitation and waste management services for all Rwandans, as a contribution to poverty reduction, public health, economic development and environmental protection". The government bodies, international development partners and non-government stakeholders cooperate through a Sector Working Group (SWG) framework, where they meet quarterly to discuss access to water and sanitation progress against set targets and share experiences. (Mininfra, 2010)

In an internal survey of donor experience, the USAID Development Assistance Committee (USAID 1988; OECD 1989) described sustainability as the "ultimate test of development efforts." In its review of ten years' experience, Lessons Learned, the Water and Sanitation for Health (WASH) Project (1990) viewed sustainability as "the basic measure of success of both the national system for development and the community systems." Thus, sustainability in water supply and sanitation (WS&S) was a dominant concern, affecting decisions and actions that "may shape donor policies for years to come" (Bossert, 1990). In spite of the

agreement that sustainability should be the goal of development assistance, there continue to be many projects undertaken by USAlD and other international donors whom most people would agree are unsustainable**.** (Wash, 2004)

The key challenge in infrastructure development was to preserve the achievements and good practices of the national rural water programmes while strengthening decentralized implementation capacities. Sector financing was still fragmented, with a variety of different financial management arrangements. A harmonized sector financing mechanism was desirable in order to streamline the flow of resources, reduce the transaction costs and reporting requirements and facilitate monitoring. (Mininfra, 2010)

1.2 Statement of the problem

In rural Africa, 'water poverty' can destroy lives and livelihoods, Children under five are highly vulnerable to waterborne diseases, While a broken water pipe in London may be a temporary inconvenience, a failed well in sub-Saharan Africa was potentially catastrophic. And this was a catastrophe that was spreading across the continent, where an estimated 50,000 water supply points have effectively died. The root cause was the water community's failure to plan for maintenance of the infrastructure in a systematic way, creating a massive drag on meeting the Millennium Development Goal target on water and sanitation. (Cumming, 2008)

The sustainable operation and management of rural water supply infrastructure was one of the key challenges of this sub-sector. Approximately one third of the existing infrastructure (about 30 rural water systems) needs rehabilitation. However, the situation has changed significantly with the delegation of service responsibility to the districts and the introduction of delegated management. The percentage of schemes managed by private operators was rising fast (attaining about 28% in 2008) and the first evaluations, in terms of improved functionality, are encouraging. (Mininfra, 2008). In a Selected rural area of Rwanda, maintenance practices of water supply infrastructure are not clear across the village, not everyone understands how to use water pump properly to reduce wear and tear. The Revenues are not sufficient to pay for recurrent repairs, there wasn't a clear process for deciding on a repair, and there wasn't a clear responsibility for who calls for a mechanic and when. (Wash, 2012)

1.3 Research objectives

1.3.1 General Objectives

The aim of this research was to assess how the community was prepared to sustain water supply service in Rwinkwavu and Mwili Sectors of kayonza district.

1.3.2 Specific Objectives

The aim of this research has been broken down into the following objectives:

1. To identify the skills possessed by community to sustain water supply service in kayonza District.
2. To assess the costs and benefits of community to the project sustainability.
3. To assess the communication effectiveness of maintenance issues in water projects by the community
4. To analyze the link between demand responsiveness and sustainability of water projects by community.

1.4 Research questions

The study aimed to answer the following research questions

1. What are the skills possessed by community to sustain water supply service?
2. How does the cost and benefits of community contribute to the project sustainability?
3. How was the communication of maintenance issues effective in water projects?
4. How did community link between demand responsiveness and sustainability of water projects?

1.5 Justification of the study

The results of this study is useful to determine the level at which the community was prepared to sustain water supply service after the contractors close the project.

Improving the sustainability of rural water supplies has a number of consequences. It ensures the ongoing provision of a service that is fundamental to improving health, reducing the burden of carrying water long distances, and enabling users to live a life of dignity. Sustainability today invariably depends upon communities taking financial responsibility for

their schemes, which if achieved would enable scarce resources from government and donors to be targeted specifically on areas where there was no improved water supply. The chances of achieving the Millennium Development Goals without access to safe water would be seriously lowered unless the levels of sustainability can be greatly improved.

1.6 Scope of the study

This research aimed to find out the community preparedness to sustain public water supply service however it has not gone beyond the following focus as a part of the research:

- The research project has been conducted within two sectors of kayonza district because it was where MIGERA 3 water supply project was being undertaken.
- The target community has been the beneficiaries of the project.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter gives a theoretical view on maintenance of water supply service by rural community. It gives answers on water-supply preparedness, protection, community participation with a case study to give more clarification.

2.2 Review of Theoretical Literature

2.2.1 Water Supply Reliability Theory

Water supply system reliability can be defined in terms of the shortage that results from failures of a system's physical components. A reliability factor for a single failure or for a selected time period can be defined in terms of the capacity lost during failure, which is measured as a fraction of the demand rate or the demand volume. Since the lost capacity is a random variable, so is the reliability factor, and its probability density function can be derived analytically from that of the lost capacity. Reliability, defined as the probability that a given reliability factor will be achieved, can be increased by adding facilities, storage, pumping capacity, pipelines. The least-cost combination of facilities can be identified from the cost functions and the probability distributions of the reliability factor. (Shamir and Charles, 1981)

2.2.2 The concept of Community Participation Theory

The term participation is hard to define or as Netshiswinzhe (2000) says ' has become an almost meaningless buzzword over the last decade or so'. Authors do agree that the depth/extent of participation influences the sustainability of a water supply service. Like Evans and Appleton (1993. In: Sohail et al, 2005) argue: 'The shift from participation as users of a new service to the participation of the beneficiaries as owners, partners, and managers is thought to be an important contributory factor to the sustainability of a project '. White (1981) considers that the 'depth of participation' is the extent to which all members of the community are involved in all aspects of a project. To get a better idea from the extent of

participation Arnstein introduced the ladder of participation in 1969, which describes the manner in which the community is involved in a project. The highest form of participation is the one in which the community feels in control in all stages of the project.

Netshiswinzhe (2000) argues that almost everybody agrees about the need for participatory development instead of a top-down approach, but still the reality remains that most development work is external driven or top-down. The kind of participation that works is the one in which 'all role-players actually believe that people, regardless of age, sex, educational background, socioeconomic status and history, can actually solve their own problems.' (Netshiswinzhe, 2000) . In summary implementing a project in a truly participatory way implies that the community members feel in control during all project phases and that the beneficiaries become owners, partners and managers. (Joanne, 2005)

2.2.3 Sustainability of Project

To ensure that the commitments and decisions made during design live on during the project these needs to be reflected in the project management policies, plans and systems – in the following way: The project vision, objectives and principles reflect the commitment to achieving excellence in environmental and social outcomes, Relevant Policies and Project Management Plans incorporate sustainability criteria as appropriate to each area Tendering and contracting processes are explicit about the project requirements related to environmental and social performance ,Project instructions are developed to support commitments to various practices such as resource efficiency, waste management, procurement, stakeholder relationships etc Appropriate training was provided at all levels to ensure understanding of the project commitments to sustainability. Project induction training translates the commitments of the project in ways that are understood across the project team Performance Management Systems include relevant key performance indicators (KPIs) at a project level and these are translated to individual managers and their teams. Reward and recognition schemes are linked to outstanding achievement, throughout the project KPIs are tracked and reported at governance, management and team level, Performance was also shared with stakeholders through regular communications. (Kerry, 2005)

2.2.4 Project Sustainability through Community Participation

The projects in most cases, suffer abandonment or at best low maintenance. For projects to be sustained, the communities must be carried along during conception and implementation. More importantly, however there must be government support either in cash or in kind. Community leaders must also accept the challenge for project sustainability.

Participation can therefore be said to be a sort of partnership which was built upon the basis of dialogue among the various actors during which the agenda was jointly set and local views and indigenous knowledge are deliberately sought and respected.

The general principles of participatory approach include among others the following; encouraging communities to take responsibilities, promote participation for all, reconcile different interests, listen to the community, examine the situation/problem from different points of view and then, adapt to local situations. (Ademola, 2008)

2.2.5 Project Benefit Sustainability Model

For most projects the following factors determine whether or not benefits will continue to be realized after the termination of donor funding.

Client-responsive services: To develop an enduring constituency for benefit continuation, the specific project benefits must address a recognized need of the target community. Therefore, deciding on which benefits to deliver was predicated upon identifying the target audience and eliciting from that audience information about what benefits they desire. Therefore, benefits should be designed with sufficient flexibility to respond and adapt to changes in demand.

Strategic management capacity: Implementing organizations and the people who staff them are crucial influences on whether or not benefits continue. Individuals, supported by the organizational culture and standard operating procedures, need to recognize and work toward long term objectives, acknowledge and account for opportunities and threats in the external environment, and adapt the organization and its products to continually meet evolving needs

Supportive institutional environment: although many external factors are beyond the direct control of project managers, they greatly influence whether benefits will be sustained. Such factors include the policy and legal framework, bureaucratic culture and procedures, social

norms, and economic and political conditions. In some cases, project managers may be able to influence their environment to make it more hospitable. In instances where the environment was less amenable to change, project design should acknowledge and accommodate potential constraints.

Adequate resources: Benefits will not be produced without adequate resources Financial, human, natural, and technical, to sustain them. Since development projects typically provide financial, and often human and technical resources, benefits cannot continue post project unless resources have been transferred to or can be acquired by the appropriate host-country organizations. Natural resources are finite and must be used responsibly to ensure their continued availability for the development of future generations. Assuring that these factors are in place implies different priorities and concerns for project design that transcend the issues that are important for mere effectiveness. (Marcus, 2005)

2.2.6 Water Supply & Sanitation Projects Sustainability

Projects follow a regular cycle of activities: planning and design, start-up, implementation, phase out, and finally, project completion (Roark et al. 1993). Project benefits, such as reductions in child mortality through the introduction of WS&S systems and hygiene education to rural villages in a targeted area, gradually accrue after project start-up and grow at a faster rate until phase out activities begin and ultimately external assistance (donors and projects) ceases. There can be some ambiguity in the term "post-project" as a project management entity, comprising staff from more than one institution, may be maintained after construction was completed. Donor assistance may continue after construction was completed or cease before the infrastructure was completed. In the case of donor-assisted rural water supply projects, the cessation of donor assistance was the milestone defining pre- and post-project boundaries.

The following ranking of projects by "sustainability" was a loose framework for evaluating the degree of sustainability. Its use depends on making value judgments as well as collecting data in conditions of poor and incomplete information.

Class I: Benefits exceed end-of-project levels because of replication or expansion of the WS&S systems to beneficiaries beyond the target community. This ideal is rarely achieved.

Class II: Benefits continue for the original target group at about end-of-project levels. Lack of funds or other resources prevents further expansion to new beneficiaries.

Class III: Benefits drop down to a stable level somewhat below the end-of-project status. When WS&S facilities are placed in diverse communities there are typically a range of capabilities involved from very limited to reasonably skilled. The least-skilled communities are marginal prospects, and some fail to manage their systems properly. Class III may be termed sustainable as long as benefits continue at an acceptable level.

Class IV: Benefits drop below an acceptable level and continue to decline, eventually disappearing entirely. Such projects have not been sustained and are termed failures. (Wash No. 94)

2.2.7 Water-supply preparedness and protection

Water-supply problems arise in all phases of the disaster-management cycle. As with all other elements of emergency management, water supplies can be designed and maintained in ways that help to reduce the health impacts of disasters.

It is useful to distinguish between large-scale, formal water-supply systems (e.g. urban water-supply systems) and small-scale, scattered supplies. The distinction is not so much between urban and rural areas, as one based on the level of technology and the institutional arrangements for management, maintenance, and protection. Whether the affected systems are rural or urban, sanitation surveys may be necessary to identify the main health hazards.

Water sources are exposed to a variety of hazards that may damage or contaminate them, but they can be protected against disasters to some extent. This section is concerned mainly with ways in which improvements to existing water supplies can make them more resistant to damage. (Who, 1997)

2.2.8 The Role of Project Manager in Project Sustainability

In 2008, European conference of the Project Management Institute (PMI), Russell elaborated on what Corporate Social Responsibility means for project managers Russell, J. (2008). She pointed out that a project manager, being in the frontline of new or changed activities within an organization, is perfectly positioned to influence the organization's operations towards greater sustainability. Russell also argued that this position is not without responsibility, both

for the organization as for the project manager. She concludes that "Corporate social responsibility is too big an issue to leave to someone else to address". (Schieg, 2009)

2.2.9 Routine forms of water supply service protection

In all activities to provide or improve water supplies during "normal" times, it is important that those responsible are aware of the specific hazards to which water sources might be subject. This hazard mapping should be as much a part of the planning of water supply systems as other factors, such as water quality and taste, distance to users, and capital and recurrent costs.

Simple modification in design can sometimes help to protect the water source from an extreme natural event or industrial accident. For instance, flexible plastic pipe is more resistant than rigid pipe to earth tremors.

Some basic improvements, such as raising the head wall of a dug well, and providing a cover and outward-sloping concrete apron around it, simultaneously provide additional protection from contamination due to floods and run-off into the open hole, and short circuit seepage from nearby puddles; they also prevent contamination by debris and animals falling into the well.

If the surface or groundwater could be affected by toxic hazards, it is probably better to avoid the water source. Providing an alternative water source should then be a high priority. (Who, 2007)

2.2.10 Monitoring and evaluation of water supply project

The most effective emergency water supply measures are ensured through a process of assessment, monitoring and review. Assessment is required to identify needs, damage and resources, so as to be able to respond appropriately and with maximum impact; monitoring of activities and the context is essential to ensure that the water supply activities are carried out as planned, with timely indications of problems and unmet needs; and periodic reviews of the situation and the response are essential to ensure that the response remains relevant to the needs and resources of the communities affected by the disaster. (Who, 2007)

2.2.11 The role of community in rural water supply Project

The local community has an important role to play in a rural water-supply program. The communities, for the purpose of the water project, that may be considered comprise: The local government, Leading citizens, the religious leaders, and Individuals.

The local government may be elective or appointive but, in any case, it has jurisdiction over the matters which affect the community. While it is true that in many countries public improvements for rural towns and villages are decided on a higher level and those decisions are handed down, a much more successful way is to obtain full and complete co-operation from local governments directly. In the case of a water-supply program, the task of obtaining the necessary local co-operation and participation in the development of the project should be assigned to an interested and responsible official, preferably the engineer in charge of the program. Almost without fail local governments welcome such gestures and usually volunteer more support than their resources allow.

The extent of the material support must always be soberly judged and evaluated.

The important thing at the beginning is to get the official consent and cooperation of the community concerned. Many prominent citizens may not be members of the local administration; but, at the same time, they may bring even more influence to bear on the success of the proposed water-supply program than does the official administration. It is not uncommon to find that community leaders are outside the government. Such persons should be brought into the planning of the scheme. They need to understand and support the project and therefore must be approached with tact. (Edmund, 1996)

2.2.13 Water supply project components

The water distribution system is composed of the pipes, valves, holding tanks, and pumps, which supply water to its end use points at the required flow rate and pressure. Water connections should be located to limit hose length to 60 feet. Pipes must be sized so pressure drops due to frictional are not excessive.

If well yield does not meet the peak flow requirements of the system, a pressure tank can be installed to provide peak flow demands. A pressure tank provides a small amount of storage, usually 10 to 30 percent of the tank size. This provides a small amount of water without starting the pump. It also helps satisfy water needs during short peak use periods. Size

pressure tanks volume for about 10 minutes of pump operation. Multiply the pump capacity, in gpm, by 10 to get the size of the pressure tank in gallons. When the water source and pressure tank cannot deliver the required flow rate, an intermediate storage and two-pump system can be used. Intermediate storage also facilitates water reuse, which can significantly reduce total water quantity requirements.

Plastic and copper are preferred for underground installations. Highly mineralized water greatly reduces the life of steel pipe. (Douglas, 2004)

Transmission of water itself causes severe problems. The supply system of large European cities, for example, can lose up to 80% of the water transported because of pipe damage; with some Mexican cities losing up to 60% through leakage from their old supply systems, (Dossier, 1997). Countries like Bangladesh, the Philippines and Thailand experience water losses of 50%. In Middle East countries like Jordan, Yemen and others with rising water scarcity, more than 40% of the available water cannot be traced. (Chaturvedi, 2000)

2.2.14 The Role of Trainings for Sustainability of Water Supply

Participation requires training on household- and committee level. At committee level the training should provide the needed competences to keep the system operational. Brikké and Rojas (2001) mention that an assessment of the management capacity before a project starts is crucial. If capacity building activities appear to be too complex, it might prove necessary to choose for another technology. This also indicates the needed training to run the service efficiently. Training should provide committees with technical information about how to prevent major problems, to operate the water system and repair parts. Further the committee should receive the needed financial and managerial training, especially those skills related to budgets, organizing bills, collection, recording expenses and revenue, monitoring, and applying sanction (Brikké and Rojas, 2001). With regard to financial training of the committee Netshiswinzhe (2000) mentions a problem. Financial training of the water management committee has mainly focused on basic bookkeeping. The result is that committees don't have the capacity to do financial planning, for example, to recalculate tariffs and deal with non-payment. Training should broaden the local level of financial management capacities instead of focusing on the individual.

At household level the main purpose of training is awareness to create user commitment. The first kind of awareness is on the linkage between hygiene and health. Ntengwe (2004) argues that this health and hygiene education should focus on single behaviours, which once they have changed have a positive impact on the community. The education should not be prefabricated, generalized messages, but depending on the situation inside a community. The second awareness is 'what it takes to produce water and have it delivered at the tap near or in households'. This contains the provision of information about cost of pumping, maintenance of lines, treatment, supply and their relation to the water tariff. Research proved that this kind of awareness has a positive effect on the willingness to pay, which will prevent financial problems during the O&M phase (Ntwengwe, 2004).

2.3 Review of Empirical Literature

2.3.1 Sustainability of water supply schemes in rural communities of Nepal

Water-supply programs consist of three essential components: technology, people, and institutions. The interface of these facets determines whether a particular scheme is sustainable. This article highlights the differences in maintaining and operating water-supply systems in rural villages and rural market centers in Nepal.

The analysis considers disparities between users' willingness to pay based on data collected through surveys of 205 households and representatives of 12 water-user committees.

Due to varying geographical locations and socioeconomic conditions among rural villages and rural market centers, core operation and maintenance problems for drinking water sustainability are immensely different.

Weak institutional capacity is the prime obstacle in the provision of drinking water in the rural villages while technicalities such as insufficient water quality and inconvenient water-point locations are the major issues in the rural market centers.

Moreover, levels of user satisfaction influence the operation and maintenance of both types of systems.

This study considers user-satisfaction parameters and the overall influence of satisfaction on users 'willingness to pay. (Betman & Miriam, 2007)

2.3.2 User satisfaction to a water supply service in Tanzania

The citizens' survey 2006 reveals widespread dissatisfaction with water supply; less than one quarter, 23% of all respondents were satisfied with the quality of their water supply, and only 28% reported improvement in recent years. Sixty percent of the respondents say that water shortage is a major problem in their area, especially during the dry season.

This view is also shared by the view of the people survey, with 63% of the respondents reporting shortages as common for both urban and rural areas during the dry seasons, The survey further indicate high dissatisfaction with water supply particularly in distance, cleanliness ,Cost and queuing time. Citizens perceive that these problems have been there for a long time and there have not been any observed change. Among those who did see a change, overall, more respondents saw deterioration rather than improvement in water supply, cleanliness, cost and queuing time. (Lucas et al, 2008)

2.3.3 Technological capacity for urban water supply project in Ethiopia

Innovative technologies are essential to overcome barriers to water and sanitation service provision**.** Technological capacity includes the development and application of new technologies, the technical skills needed to effectively construct, operate and manage a technical solution; the translation of information regarding technologies to promote informed decision-making when implementing a technical solution; the availability and accessibility of spare parts. However, technology providers need a better understanding of local conditions and policies. (Chala , 2011)

There is a need for institutions that bring together many disciplines, such as the natural sciences, public health, engineering and the social sciences. Integration and interaction between institutions and different sectors of the community, at decision-making, executive and participative levels is required to plan and execute actions in a coordinated way. This integration is the basis for multi spectral approaches to ensure that planned goals are achieved and actions converge to solve environmental, water and health problems (Wallace et al, 2008). According to the 1994 Ethiopia community census report showed, the total urban community was 7,323,122 (13.7% of the total community), after ten years (i.e. 2004) the total urban community increased to 17,588,735 (32.89%) and by the year 2015 urban

community is going to increase by 22,925,177 (32.26%) Ethiopia Central Statistical Authority (1994, 2004 and 2015 projection).

In order to meet the future water demand, cities will need to tap their water supply either from a deep ground or surface sources situating a far distance away from the urban area. (Chala, 2011)

2.3.4 Sustainability of Water Supply and Sanitation in South Africa

Social, economic, environmental and cultural sustainability have been addressed. All communities have been targeted with the programmes with a focus on poor communities, women, children (schools) and educators. Continuous feedback is sought and programmes are re-evaluated on a regular basis. Investment in education material is recovered through the savings made in the reduction in water use, illegal connections and an increase in revenue from previously non paying consumers. The traditional beliefs and indigenous knowledge was incorporated into all educational material developed to ensure acceptance by the targeted communities.

The EWS, together with funding from the Development Bank of South Africa (DBSA) has developed a Toolkit guide which contains all the education material that EWS has used in the role out of their water and sanitation services. This Toolkit can be used by other municipalities to initiate similar programmes within their areas. (Teddy, 2003)

2.3.5 Maintenance of water supply -Case study of Lusaka, Zambia

This case study looks at a system of pre-payment cards in a peri-urban area. Chipata is a high density, low-income peri-urban area of Lusaka, the capital city of Zambia.

Supply of water comes from groundwater. To address cost recovery, the area has developed a system of monthly prepayment for water supplies. This system was decided upon by the residents of Chipata, and was provided with seed financing from CARE.

Under this system, consumers go to the local committee office and pay a cashier 2,500 kwacha for a pre-paid monthly use card, which allows seven 20-litre buckets/ day per family. Consumers receive their water from communal taps, which are only accessible when attended by employees, who work fixed hours and stamp the card to keep track of use. The

limit for consumption was made factoring demand and public health considerations, but also the capacity of the borehole where the taps are installed. (Rachel, 2003)

2.3.6 Sustainability of Water Supply System in Cameroon

In the Northwest Province of Cameroon Plan is mainly implementing gravity water systems. The sustainability of such systems has been assessed, by comparing a sustainable performance with the actual performance of two implemented systems. This assessment is based on the definition of a sustainable rural water supply system, which is made operational in a framework of indicators.

An advantage of gravity water systems is that it is relatively easy and cheap to maintain. This might also give an explanation why the systems in both case studies are still functional most of the time, in spite of the poor financial management. However this 'managing of the situation' is not in accordance with the definition of sustainability. Comparing the definition of sustainability with the results of the case studies shows that the facilities are functional and being used for about 95%, that it has institutionalised management and that it can technically be operated and maintained at local level. Both systems lack however the recovery of costs at local level and –especially Bamali – lacks the delivery of appropriate benefits to all users. Most striking is that the lack of planning doesn't give the facilities the capacity to continue to function over a prolonged time of life. This leads to the conclusion that though some elements of sustainability are there, both systems cannot be called sustainable. Results show also that the project implemented with the traditional approach is more sustainable than the one implemented with the CMP-approach.

Due to the definite period project implementation will support a community; all responsibilities for a water system will be handed over after project completion towards the community, eventually in cooperation with a government partner. To enable the communities to manage their system they have to appoint a water management committee. Training of this committee will be supported by Plan. Besides this Plan also provides IEC on hygiene and sanitation, involving education on collection, transportation and storage of water.

A more recent development is the empowerment of the community already during a project, the community-managed project approach. This approach aims to let the community members in control during all phases of the project. From comparison of a CMP with a

project executed following the traditional approach it appears that the CMP-approach has not been able to deliver a more sustainable system. From this single comparison it's not able to prove whether this is caused by the CMP-approach or community-related factors. In principle there are however some objections against the way the CMP-approach has been implemented. The focus of the CMP approach on training of the project committee might enhance inequality, since it doesn't involve community members, and is not providing the supposed advantage of ensured sustainability.

Further, the CMP-approach might be too demanding and it is doubtful whether the committee is truly empowered to manage their project budget. In theory, the CMP-approach should enhance sustainability, but this is not the case for the way it has worked out in this project. (Joanne, 2005)

2.4 Conceptual Framework

This research was based on two types of variables, independent variables which were mainly the elements of community preparedness and dependent variables which were the elements of a sustained water supply service.

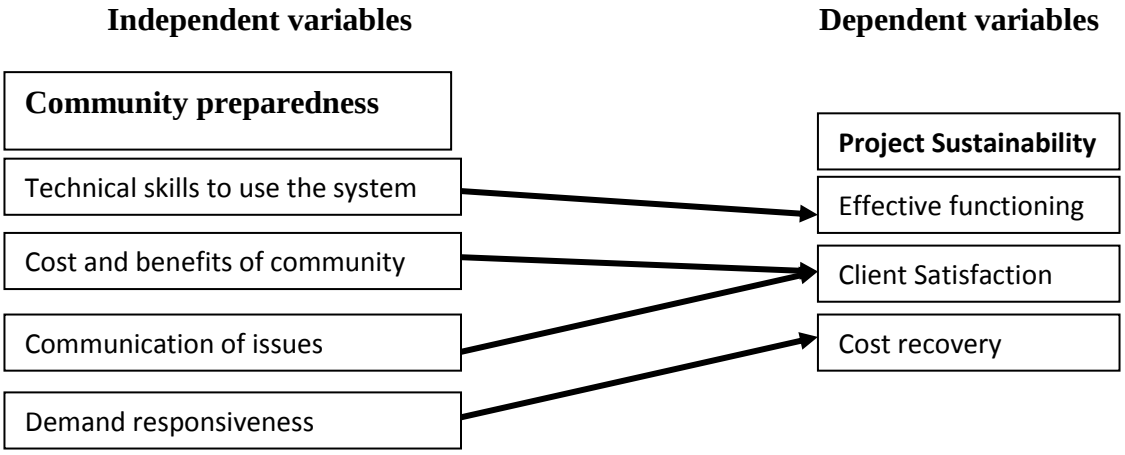

Figure 2-1: The conceptual framework

2.5 Critical Review

According to the literature review, there are no specific theories written to Rwanda, for the coordination of water supply management and the mechanisms for the monitoring and assessment as well as the purchasing power of the community even when the potable water was available. This was the same for the participation of women in water supply infrastructures and the analysis of gender problematic. According to Minirena, the human capacities to develop and manage the sanitation and water sector in a satisfactory matter are not yet sufficient in term of quality and quantity. (Minirena, 2004)

2.6 Gaps to be filled by the Study

Many of the researches under water supply sector are engineering project, dealing on water treatment and sanitation, but no single research has been conducted to link those projects with the community behavior of a particular location.

This research comes to complement the engineering research works in assessing the level at which the beneficiaries are prepared to use the technologies, required to use the services, developed by engineers, to assess how they are sensitive to service maintenance and how the maintenance issues have been matched to the benefits

2.7 Summary

This chapter contains literatures written on project sustainability especially water supply projects with sustainability of project phases to ensure that the commitments and decisions made during design live on during the project these needs to be reflected in the project management policies, plans and systems.

Project Sustainability through Community Participation was a very important aspect because the projects in most cases, suffer abandonment or at best low maintenance. For projects to be sustained, the communities must be carried along during conception and implementation. More importantly, however there must be government support either in cash or in kind. Community leaders must also accept the challenge for project sustainability.

The water distribution system was composed of the pipes, valves, holding tanks, and pumps, which supply water to its end use points at the required flow rate and pressure. Water

connections should be located to limit hose length to 60 feet. Pipes must be sized so pressure drops due to frictional are not excessive.

In Tanzania, the citizens' survey 2006 reveals widespread dissatisfaction with water supply; less than one quarter, 23% of all respondents were satisfied with the quality of their water supply, and only 28% reported improvement in recent years. Sixty percent of the respondents say that water shortage was a major problem in their area, especially during the dry season.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes the methodology of the research. It covers the methods for measuring sustainability, the choice of MIGERA 3 as a case study, the research design, the community and sampling procedures and the data gathering processes. Furthermore, it discusses the process that was used for data analysis and interpretation.

3.2 Research Design

The UNDP-World Bank Water and Sanitation Program (1999) developed a framework, which focuses on measurement of sustainability indicators at community level. The indicators are: effective functioning and use, demand-responsiveness, client satisfaction, and cost recovery. These indicators capture the key aspects of sustainability: The usage and performance of the infrastructure, The demand responsiveness of village-level institutions (institutional), The adequacy in cost recovery (financial or non financial).

This proves that, sustainability is not only measured by the current state of the facilities and the management, but that participation in earlier phases was also important. However, by putting all these elements in one framework it was also suggested that informed choice was a way to measure sustainability.

Sara and Katz (1998) provided another interesting assessment of sustainability. This was a quantitative study with sustainability as a dependent variable in relation to the independent variable 'level of demand-responsiveness', project-related factors and external factors. Indicators for sustainability identified by them are the physical condition, consumer satisfaction, operations and maintenance and willingness to sustain the system. This report proves linkages between the project approach and the performance of sustainability, by statistically excluding external factors. This was the kind of approach that was truly needed to prove linkages between a certain project approach and sustainability. Unfortunately it was not possible to prove statistically the linkages between these factors for just one case studies.

3.3 Choice of case study

The case study has provided enough information on the performance of the system to draw conclusions on the sustainability of pump water systems in general. The first issue was that a sustainable project approach can never guarantee sustainability, because external factors are also influencing this. In the second place a variety of assumptions exist about a sustainable project approach.

3.4 Population

The target population of this study were the beneficiaries of MIGERA 3 water supply project, that consisted of 10785 households equivalent to 40928 people around 33 km water pipe lines and covered two sectors Mwili and Rwinkwavu of Kayonza district.

Table 3- 1 Population distribution

District	Population	Beneficiaries (Target population)
Mwili	22933	17309
Rwinkwavu	28225	23619
Total	**51158**	**40928**

Source: Researcher, 2015

3.5 Sampling Frame

The ideal sampling frame was a straightforward list of the elements that was to be sampled. So, for the beneficiaries of MIGERA 3 water supply project, a comprehensive list of members of the community would be ideal. A house to house survey would be ideal to provide a comprehensive list of beneficiaries. In practice the ideal sampling frame hardly ever exists, the designed beneficiaries of the project within two sectors of Kayonza district, served as list of community, a proportion of 50% of the sample in each sector has been taken.

3.6 Sample and Sampling Technique

A simple random sampling technique has been used since it ensured that everyone in the community had an equal chance of being selected.

- ***Slovin Formula:***

$$n = \frac{N}{1+NE^2}$$

Where: n = sample size

N = community size

E = margin of error desired

For this research a margin of error of 10% has been used which was the allowable error in percent due to the use of the sample, instead of the whole community.

This gave

$$\text{Community Sample} = \frac{10785}{1+10785\,(0.1)^2} = \textbf{100 households}$$

The sampling technique for sample selected was a simple random sampling where a sampling frame was required to ensure that each element from the community had equal chance of being selected. Unfortunately a list of community cannot be obtained from the project, the researcher has picked the sample on site randomly.

3.7 Data Collection Techniques and Procedures

Data-collection techniques allow to systematically collecting information about the objects of study (people, objects, phenomena) and about the settings in which they occur. (Kongmany, 2009)The data of this research was gathered through administered written questionnaires and those questionnaires have been given to the respondents during community work (Umuganda).The questionnaire was divided into two main parts. Part I was related to the identification of the respondent, and was requested to answer questions pertaining to the respondent's profile, Close ended questions was employed.

Part II was filled to gather the information relating to level of understanding the project deliverables by the community; this has enabled the researcher to assess how they value the

project benefits and also the questions in connection with technical skills, communication, demand responsiveness and client satisfaction.

3.8 Data Analysis

Data analysis was guided by a quantitative analysis method and complemented by some theory. The data collected from the questionnaires was analyzed, interpreted and presented. The results helped to assess in depth the real situation on community preparedness to maintain the water supply service after the project closes.

3.8 Quantitative analysis

A quantitative analysis was the way the data were analyzed when the researcher chosen to use quantitative method in data analysis. The researcher followed steps below during data analysis:

Data Preparation: the researcher checked the data accuracy, entered the data in the computer, transformed the data, developed and built a database structure which contained measures.

Descriptive statistics: here the researcher has described the basic features of the data being studied using either frequency tables or percentages. The simple summaries about the sample and the measures have been provided.

In that case, SPSS software has been used in data analysis and provided the results in tables. The data has been coded into a language recognized by the software. The classification of information was an important step in preparation of data for computer processing with statistical software. The researcher has used coding to show the response rated from very low to very high level in SPSS for easy analysis.

In this research, a scale was used. Ordinal scale as shown in Table 3-1 was a ranking or a rating data that normally uses integers in ascending or descending order. The numbers (1,2,3,4,5) were assigned to the level at which the community are prepared.

Table 3- 2 Scale of Assessment

Item	Very Low	Low	Medium	High	Very High
Scale	1	2	3	4	5

Source: Researcher, 2015

3.9 Validity

Validity determines whether the research truly measures that which it was intended to measure or how truthful the research results are. Joppe (2000)

For this research the validity has been tested by pre-testing the questionnaires using a sample of 5 respondents. This enabled the correction of some errors that occurred in the way questions were asked.

3.10 Reliability

The extent to which results are consistent over time and an accurate representation of the total community under study was referred to as reliability and if the results of a study can be reproduced under a similar methodology, then the research instrument was considered to be reliable. (Joppe, 2000)

To ensure that the data of this research were reliable the respondent of questions should be the beneficiaries of the service who were above 18 years old and who have suffered of not having water supply before and who have been provided the water by this project.

3.11 Ethical Considerations

In conducting research, the researcher and research assistants must get the permission from the local authorities as well as the respondents, and inform them that all data included in the questionnaire would be used only for academic research and would be strictly confidential with no name of respondent to appear on the questionnaire.

CHAPTER 4

RESEARCH FINDINGS AND DISCUSSIONS

4.1 Introduction

This chapter presents the results of data collected with a questionnaire and the discussions of the findings.

4.2 Biodata

4.2.1. Respondents Profile

The researcher gave out 100 questionnaires to the respondents, comprised of all gender in the following age categories 12-25; 26-35; 36-45; 46-55; 56 and above.

Table 4-1 Percentage of Respondent's Gender, Status and Age

Status / **Gender and Age**	**Husband**	**Wife**	**Single**	**Other**	**Total**
Male	54	0	11	6	71
Female	0	23	6	0	29
12-25 years old	2	3	1	3	9
26-35 years old	9	5	2	0	16
36-45 years old	31	10	9	3	53
46-55 years old	8	5	1	0	14
56 and above	4	0	4	0	8

Source: Primary data, 2015

This table indicates the population distribution of this research; all categories of community have participated in this research, 71% of which was male and 29% was female. The community at the age of work has fully reached in this research, as most of data were collected during community work (Umuganda) whose participation is mandatory for all population at the age of work in Rwanda.

4.2.2 Community accessibility to Potable Water

The community accessibility to potable water was assessed to make sure that the respondents were beneficiaries of Migera 3 water supply, and the findings show that a great portion of community lived in less than 500m from the water pipes.

Table 4-2 Community accessibility to potable water

Distance	Percentage
Less than 500 m	96
Between 500m to 2 km	4
More than 2 Km	0
Total	**100**

Source: Primary data, 2015

This table shows how far were to get to the water supply lines, most of respondents at 96% are located at less than 500m to the water pipe. This was an indicator that they were using the water of this project and hence the answers to the next questions were authentic. The remaining 4% said that they were far at 500 m, this due to the scarce of potable water in the region and the need to expand the region covered by water pipes.

4.3 Skills and knowledge on water supply use

4.3.1 Technical skills to use the system

The results in the table below shows how the beneficiaries were able technically to use water supply components like mainly water pump, water tap and pipes and their capacity to communicate in writing.

Table 4-3 Level of technical skills to use the system

Levels Skills	Very Low	Low	Medium	High	Very High	Total
Interpretation of Symbols	88	10	1	1	0	100
Reading and writing	0	0	0	7	93	100
Open/Close water tap	0	0	0	0	100	100
To connect pipes	98	0	1	1	0	100
To Use water pump	87	0	12	1	0	100
To identify depth of pipes	91	4	3	0	2	100

Source: Primary data, 2015

The findings shows that a big number of people had very low level, at 88 % of skills in interpretation of findings, this had negative impact on use of some system's components like water tap, pumps etc. on the other hand 93% of people can read and write at a very high level and can open or close water tap at 100%.

To connect pipes, only one percent of community can do and the remaining portion of 98 % cannot, and 91% can't even identify the depth of pipe lines. This also had negative impact on maintenance of pipes because too many accidents on pipes break out may occur.

The system use water pumps to operate and 87% of community had very low level of its functionality or believed that they can't use it, the only portion of community at 17 % had medium level and believed that it was simple.

This was a serious problem on project sustainability because due to lack of necessary skills and knowledge, effective functioning, demand responsiveness and client satisfaction would be affected and future services would be negatively affected.

Table 4-4 Correlation between Technical skills and Effective Functioning

		Water availability Frequency	Pump Functioning	Water pipes Functioning
Interpretation of Symbols	Pearson correlation	**0.149**	**0.104**	**0.133**
	Sig.(2-tailed)	0.139	0.305	0.188
	N	100	100	100
Reading and writing	Pearson Correlation	**0.606**	**0.872**	**0.68**
	Sig.(2-tailed)	0	0	0
	N	100	100	100
To connect pipes	Pearson Correlation	**0.063**	**0.044**	**0.056**
	Sig.(2-tailed)	0.531	0.664	0.577
	N	100	100	100
To Use water pump	Pearson Correlation	**0.175**	**0.122**	**0.156**
	Sig.(2-tailed)	0.082	0.228	0.121
	N	100	100	100
To identify depth of pipes	Pearson Correlation	**0.122**	**0.085**	**0.109**
	Sig.(2-tailed)	0.228	0.403	0.282
	N	100	100	100

Source: Primary data, 2015

Pearson's correlation between technical skills variables and the effective functioning variables were close to zero in all variables. This means that there was a weak relationship between community preparedness in technical skills and the project sustainability in its effective functioning but even though the relationship was low the correlation was positive which indicated that the technical training would improve the effective functioning of the service. This means that changes in one of the community technical skills variables are not correlated with changes in the effective functioning of water supply project variables.

4.3.2 Knowledge on maintenance of the service

The table below contains the results from 100 questionnaires given to beneficiaries of the services to assess their level of different service component maintenance like mainly pipes, tap and water tank and the results proved that large part of community fairly have medium knowledge.

Table 4-5 Level of knowledge on service maintenance

Levels Knowledge	**Very Low**	**Low**	**Medium**	**High**	**Very High**	**Total**
Pipe maintenance	0	84	16	0	0	100
Tap maintenance	0	6	93	1	0	100
Water tank maintenance	0	0	98	2	0	100
Other Tasks: (Cutting Grass near water Tank)	0	0	0	0	100	100

Source: Primary data, 2015

The majority of community at about 84% had low level of pipe maintenance and 16% medium level. On the other hand 6%, 93% and 1% had respectively low, medium and high level of knowledge those findings indicated vulnerability of water pipes and a medium positive impact on tap and tank maintenance. Moreover 100% of community believed that cleaning the area around the water tank and planting appropriate plants along the pipe lines was a good maintenance practices.

This level of service maintenance had a positive effect on the sustainability of the project in the way that the community at 93% and 98% level respectively maintained water tap and water tanks. The only vulnerable parts were water pipes.

4.4 Costs and benefits of community

4.4.1 Awareness on project benefits

These findings were the evidence that the community beneficiaries of the project, acknowledged the benefits of having that service and hence it was their responsibility to sustain it.

Table 4-6 The level of knowledge on project benefits

Project benefits Levels	**Clean Water**	**Water tap nearby**	**Water accessible**
Very low	0	0	0
Low	0	0	0
Medium	0	17	0
High	7	70	0
Very high	93	13	100
Total	**100**	**100**	**100**

Source: Primary data, 2015

The results showed that, most of beneficiaries at more than 93 % had a very high level of knowledge on project deliverables while 70% believed that they can get water tape nearby, this might be due to their inaccessible or isolated household that may cost too much to get. Since the community had a high level of knowledge to the project deliverables, they would try their best to ensure their functioning effectiveness and hence its sustainability.

Table 4-7 Correlation between Community Benefits and their Satisfaction

		Queuing Time	Cost of Water
Clean Water	Pearson Correlation	0.15	0.039
	Sig.(2-Tailed)	0.136	0.699
	N	100	100
Water tap Nearby	Pearson Correlation	0.066	0.272
	Sig.(2-Tailed)	0	0.006
	N	100	100

Source: Primary data, 2015

The Pearson's correlation between community's knowledge on project benefits and their satisfaction were close to zero in all variables. This means that there was a weak relationship between their preparations in project benefits and their levels of satisfaction. This means that changes in knowledge of community understanding of project benefits are not correlated with changes in the community satisfaction.

4.4.2 The cost of daily potable water

The results from one hundred questionnaire used to assess the daily cost of potable water indicate that majority of community use between 50 and 100 Rwf. The distributions of results are presented in the table below.

Table 4-8 The cost of daily potable water

Range of Cost	Percentage
Less than 50 Frw	21
Between 50 Frw to 100 Frw	42
More than 100 Frw	37
Total	**100**

Source: Primary data, 2015

The findings showed that 21% spend daily less than 50 Rwf on water and 42% which was the majority of community spend between 50-100 Rwf on water this was due to the presence of

alternative source of water from natural sources that was used for other activities than cooking and drinking, the rest community spent more than 100 Rwf. This was a good indicator that the beneficiaries contribute to the project development and have contributing financially they have a sense of ownship.

4.4.3 Cost recovery

A water supply service to be sustainable, there should be plan for cost recovery, by minimizing costs or deterioration of facilities or by making payment for repair. The following table shows the percentages of facilities deteriorated and mode of payment for repair.

Table 4-9 Deterioration and cost recovery

Facilities deteriorated	**Percentages**
1-5	100%
6-10	0%
More than 10	0%
Payment for Repair	**Percentages**
Cash payment	0%
Community work	100%
Improvement of Service	**Percentages**
Yes	97%
No	3%

Source: Primary data, 2015

According to the table 4-9 of the findings the rate of facilities deterioration was very low at less than 5% in four months and the payment of repair was done through community work commonly known as umuganda where the trained persons responsible for water supply have to identify components in the system that need intervention of the whole community every last Saturday of the month. The needed cash for buying some items was obtained through service funds paid by the community. On the view of service improvement 97% are optimistic that the service was being improving while 3% were pessimistic on service

improvement and fair that service may stop working properly one day due to mostly lack of adequate number of trained persons.

To meet cost recovery challenges, other resources was needed to expand coverage since revenues are only sufficient for the operation and maintenance of existing systems. In addition, the devolution of WSS to the districts does not include fiscal decentralization. This constraint severely limits District service providers from having control over future infrastructure and management developments since funding streams are uncertain. (USAID, 2010)

4.4.4 Cost Benefit Analysis (CBA)

It is a technique of project assessment to weight anticipated costs against the benefits over a time period of up to 20 years. CBA is an analysis of the cost effectiveness of different alternatives in order to see whether the benefits outweigh the costs. Canada, T. B. (2007).

For Migera-3 water supply project, Multi-Criteria Analysis (MCA) has been used because it has the ability to consider a large variety of criteria with different importance and with a large amount of information such as health, environmental well being, safety and security. With MCA, not all costs and benefits were enumerated in monetary values and each criterion has been defined with its measurement scale. Thus, they don't have to be converted into monetary value.

The evaluation of this project was based on the following criteria: Project cost, Environmental effects, Health effects, Time saving and Person capacity.

Table 4-10 Project Cost Benefits Analysis

Criteria	Score		Weight
	Utility	Disutility	
Project cost		9	0.82
Environmental effects	3	1	0.18/0.09
Maintenance costs		1	0.09
Health effects	9		0.53
Time saving	4		0.24
Person capacity	1		0.06
Total	**17**	**11**	

Source: RIWSP, 2012

The comparison between benefits and costs indicated that the benefits were much higher than costs and hence the project was right to be undertaken.

4.5 Communication effectiveness

4.5.1 Community's level to communicate effectively

Communication is essential in water supply to ensure smooth service and to maintain the service materials, equipments. Communication issues focused in this research was the availability of person to report to, the availability of means of reporting and knowledge of issues to report.

Table 4-11 Level of communication effectiveness

Level Communication issues	Very low	Low	Medium	High	Very high	Total
Person to report to	0	0	6	11	83	100
Means of reporting	2	2	84	12	0	100
Issue to report	0	0	94	6	0	100

Source: Primary data, 2015

The finds show that the availability of people to address any problem of water supply service was at a very high level of about 83%, which was a good indicator of service ownership by the community. On the other hand the community of about 84% had medium means of reporting and 12% had high level of means. The large portion of community lacked some communication possibilities especially phone airtime that was why they felt that their level of means of communication was medium, which might result in ignorance to report small issues, furthermore the large part of community at about 94% felt that their level of knowledge on issue to report was medium, which means that they had some gaps on water supply service and might ignore unintentionally, which also affected negatively the project sustainability.

Table 4-12 Correlation between Communication of issues and Client Satisfaction

		Cost of Water
Person to report to	Pearson Correlation	-0.464
	Sig.(2-Tailed)	0
	N	100
Means of reporting	Pearson Correlation	-0.633
	Sig.(2-Tailed)	0
	N	100
Issues to report	Pearson Correlation	0.565
	Sig.(2-Tailed)	0
	N	100

Source: Primary data, 2015

The Pearson's correlation between community preparedness on communication of issues and the project sustainability in their satisfaction were close to 0.5 in all variables. This means that the correlation between the availability of person to report to, the issues to report and the cost of water were slightly weak correlated this and hence the increase in availability of persons to report to and the knowledge of issues to report did not affect the cost of water. On the other hand the correlation between the availability of means of reporting and the cost of water in client satisfaction was negative. This means that as when one variable increases in value, the second variable decreases in value.

5.6 Demand Responsiveness

5.6.1 Level of demand responsiveness

A water supply service to be effectively working must responds its user demands, the following table indicate the level at which the demands was responded so that can be relayed on to assess future demand responsiveness.

Table 4-13 Level of demand responsiveness

Level Responsiveness	Very Low	Low	Medium	High	Very high	Total
Quantity of available water	0	0	0	0	100	100
Water tap access	0	19	67	14	0	100
Potable water availability	0	0	0	0	100	100

Source: Primary data, 2015

The results show that on one hand the level of quantity of available water and potable water was very high this was due to the presence of other alternative source of water and the demand that may be too low compared to the service capacity since most people in rural area only use potable water for cooking and drinking. On the other hand the level of water tap access was not very high but 67% of community was medium and 19% low this was due to the community settlement that was not adequate for access to infrastructures because some households are widely spaced and those that are far away water pipes cannot access water tap

easily. But this would not be the problem in future since there are policies on human settlement to group household for infrastructure facilities.

5.6.2 Level of service satisfaction

For the demands of the community to be responded the level of service would be at a satisfying level. The following table shows different parameters of water supply service qualities and their levels of satisfaction.

Table 4-14 Level of the service satisfaction

Level	Very Low	Low	Medium	High	Very High	Total
Water quality	0	0	0	0	100	100
Queuing time	0	10	77	13	0	100
Cost of water	98	0	2	0	0	100

Source: Primary data, 2015

The community felt that water quality was very high at 100% and the queuing time was medium at a level of 77% and high at 13 % this low level of satisfaction occur especially during pick hours of morning and evening. On the other hand the level of satisfaction in cost of water was very low at 98%of respondents, where the cost of a twenty liters can was fixed to 30 Rwf and for the community being used to get water from natural source without paying any cash this cost was a big burden.

5.6.3 Service function effectiveness

The present service function effectiveness affects the future performance; the following table shows the level of effectiveness for the different service components like water availability frequency, pump function, water pipes etc .

Table 4-15 Level of service function effectiveness

Level Function	Very low	Low	Medium	High	Very high	Total
Water availability frequency	0	0	0	17	83	100
Pump functioning	0	0	0	9	91	100
Water pipes functioning	0	0	0	14	86	100

Source: Primary data, 2015

The results show that the community believes that the service function at a very high level though they are some variables that that are not effectively working, that should have affected the service like lack of adequate skills and knowledge, etc. This can be explained in two ways the first one was that the service components are still new and operate at its highest level of performance. The second one was that that region has been experiencing the problem of potable water scarcity since many years ago and they don't have any reference to compare this to and they may say that the service was operating at a very high level while it was not.

5.6.4 Effect of demand responsiveness on sustainability

Based on the results from the questionnaire, for the effect of demand responsiveness on sustainability of the service, the following were their summary, the proper usage of service facilities, less wastage of water, reporting potential bad practices to water supply and participating freely in all development actions for expansion of the service. These elements are the major understandings of the community.

Given that, from table 4-15 quantity of available water and potable water, was at a very high satisfying level and that the rate of facilities deterioration was very low at less than 5% in four months and there was a mechanism for repair and from table 4-6 the results show that, most of beneficiaries at more than 93 % have a very high level of knowledge on project deliverables this complemented the thought of community that there was link between demand responsiveness on sustainability.

CHAPTER 5

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter gives a summary, concludes the research study of the level at which community was prepared to sustain water supply and makes recommendations which would be necessary for water supply service sustainability, and for future researchers.

5.2 Summary

The researcher mainly focused on Community preparedness to sustain water supply service in sectors of Kayonza district. In the study the researcher was able to identify the skills possessed by community, to assess the cost and benefits of community, the communication effectiveness and the effect between demand responsiveness and sustainability of water projects. The sample size was of 100 individuals and all of them responded giving a 100 % of the sample. The data collected from the questionnaire was sorted, edited, analyzed and then presented in tables of percentages.

Some of the major findings included that the system use water pump to operate and only 87% of community have very low level or believe that they can't use it, the only portion of community at 17 % have medium level and believe that it was simple. Moreover a big number of people at 88 % have very low level of skills in interpretation of technical symbols, which has negative impact on use of some system's components like water tap, pumps etc

The findings showed that 98% of community had very low level of satisfaction in cost of water where the cost of a twenty liters can was fixed to 30 Rwf and for the community being used to get water from natural source without paying any cash this cost was a big burden even though that cash are used for replacing defected items. On the other hand, most of beneficiaries at more than 93 % have a very high level of knowledge on project benefits while 70% believed that they can get water tape nearby.

The availability of people to communicate any problem of water supply service was at a very high level of about 83%, but the community of about 84% has medium means of reporting and 100% of the community believes that the service function was at a very high level.

The community felt that their demands were responded by water quality being very high at 100% and the queuing time being medium at a level of 77% and high at 13 %, this low level of satisfaction occurred especially during pick hours of morning and evening. Based on these levels of demands responsiveness the following effects were drawn from beneficiaries, the proper usage of service facilities, less wastage of water, reporting potential bad practices to water supply and participating freely in all development actions for expansion of the service.

5.3 Conclusion

From the findings of the study, the following conclusions were made in the assessing community preparedness to sustain water supply service. Large part of community knew very well the project deliverables and hence its importance, but they didn't have enough skills and knowledge to proper use the system components like water tap and pumps. Only a small number of people (1%) could do water pipe junction, which had a serious negative impact on service sustainability because it would take a big time to find a technician to fix the problem if the water pipe break out. In addition the system used water pump to operate and a big number of community had low level of its operational use which was also a serious problem on project sustainability because due to lack of necessary skills and knowledge, effective functioning, demand responsiveness and client satisfaction would be affected and future services might be negatively affected.

The results showed that most of beneficiaries at 93% had a very high level of knowledge on project benefits and majority spent above 50 Frw daily on water service, which had positive effect on project sustainability because they would have a sense of ownership. The payment of cost for repair was done through community work commonly known as umuganda where the trained persons responsible for water supply had to identify components in the system that need intervention of the whole community every last weekend of the month. The needed cash for buying some items was obtained through service funds paid by the community.

The large portion of community lacked some communication possibilities and skills especially phone airtime which made them feeling their level of communication to be medium, and would result in ignorance to report small issues, and also the large part of community felt that their level of knowledge on issue to report was medium, which meant that they had some gaps on water supply service and might ignore unintentionally some issues which also would affect negatively the project sustainability.

There was a high level of demand responsiveness in quantity, quality and accessibility of water despite low level of skills in service components usage, which could be explained in two ways the first one being that the service components was still new and operated at its highest level of performance, the second one being that the region had been experiencing the problem of potable water scarcity since many years ago and they didn't have any reference to compare that project to and they might say that the service was operating at a very high level while it was not.

5.4 Recommendations

Potable water is one of the basic needs for the community, and it requires much millions of dollars to establish. This water supply project was funded by USAID in collaboration with government of Rwanda and the local community was responsible for its sustainability.

The local institution might strengthen their focus on water supply maintenance and probably a trained person would be in a team at lower level of management. Policies would be developed to mitigate system components deterioration due to water consumption disputes. More training on how to connect and identify location of water pipes and also to use water pump, was much needed for a big proportion of community in addition to the training on big issues to report. The communication between community and water responsible persons would be reshaped and a mechanism would be established to avoid lack of person to address the problem.

Water supply programs would build linkages to other Development programs, especially in basic education, health and also other aspects of economic development and infrastructure to improve project benefits. Encourage private sector involvement and the local manufacture of hand pumps and the development of low-cost water supply and sanitation technologies.

5.5 Suggestions for further research

Water supply project cost much money, and it requires a continuous maintenance cost, for Migera 3 water supply projects the service fees was fixed to 30 Rwf per can. For further research, it is suggested to assess the cost recovery and financial sustainability for the service and also the possibility for expansion because the population growth rate was rapid in sub-Saharan countries.

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APPENDICES

Appendix 1. SPECIMEN LETTER FOR RESPONDENTS (English version)

Dear sir / Madam,

My name is Philippe MUGIRANEZA a student in Jomo Kenyatta University of Agriculture and Technology,

The attached questionnaire has been designed to assist gather data for research project: ASSESSMENT OF COMMUNITY PREPAREDNESS TO SUSTAIN WATER SUPPLY SERVICES A Case Study of Migera-3 Water Supply Project.

This project is in partial fulfillment for the reward of Master of Science in Project Management of JKUAT. I therefore kindly request you to facilitate the collection of the necessary data.

The information sought is purely for academic purpose and thus I assure you strict confidentiality.

Yours faithfully,

Philippe MUGIRANEZA

Appendix 2. RESEARCH QUESTIONNAIRE (English Version)

PART ONE

General Information: Please Tick **V** as appropriate:

1. Respondent profile:

Gender: Male ◯ **Female** ◯

Husband ◯ Wife ◯ Single ◯ Child ◯ Other ……

Age: 12-25 ◯ 26-35 ◯ 36-45 ◯ 46-55 ◯ 56 and above ◯

2. Accessibility to potable water:

How far is it to get to potable water?

◯ Less than 500 m ◯ Between 500m to 2 km

◯ More than 2km

PART TWO

Please Tick with V as appropriate

Community Preparedness	**Very Low**	**Low**	**Medium**	**High**	**Very High**
1. At what level do you have the following skills to use the system?					
Interpretation of symbols					
Reading and writing skills					
Ability to open/close water tap					
Ability to connect pipes					
Ability to use water pumps					
Ability to identify depth for water pipes					
2. At what level do you have the following knowledge on service maintenance?					
Knowledge on pipe maintenance					
Knowledge on tap maintenance					
Knowledge on Water tank maintenance					
Any other task to sustain the service					
3. At what level do you know the following project benefits?					
Potable water (Clean water)					
Water tape near by					
Water accessible					
Others:					
4. How much does it cost to get daily potable water home in Rwf ?					
◯ Less than 50 ◯ Between 50 to 100 ◯ More than 100					

b) How many facilities are they deteriorated? (In last four months) 1-5 ☐ 6-10 ☐ more than 10 ☐

c) How do you pay for repair? Pay cash ☐ Community work (umuganda) ☐

d) Do you see improvement of service? Yes ☐ No ☐

If No; Why?

	Very Low	**Low**	**Medium**	**High**	**Very High**
At what level is the communication effective for any issue in the service?					
Availability of the person to report to					
Availability of the means for reporting					
Knowledge on issues to report					
1. At what level are the following demands responded?					
Needed quantity of water available					
Possibility of access to water tap at any place					
Potable water availability					
2. At what level are you satisfied with the following elements					
Water quality					
Queuing time					
Cost of water					
3. At what level is the following service function effective?					
Water availability frequency					
Pump functioning					
Water pipes functioning					

4. How does your demands responsiveness affect sustainability?

Appendix 3. SPECIMEN LETTER FOR RESPONDENTS (Kinyarwanda version)

Bwana / Madamu,

Nitwa Philippe MUGIRANEZA ndi umunyeshuli muri Universite yitwa Jomo Kenyatta University of Agriculture and Technology,iba i Kigali, nkaba nifuza kubaza ibibazo bigendanye n'ubushakashatsi.

Ibibazo biri k'umugereka byateguriwe kumfasha kubona amakuru azamfasha mubushakashatsi aribwo:

KUGENZURA UKO ABATURAGE BITEGUYE K'UGUFATA NEZA UMUSHINGA UMUYOBORO W'AMAZI Y'ISOKO YA MIGERA 3.

Ubu bushakashatsi buzifashishwa kugirango nuzuze ibyemerwa mukubona impamyabumenyi ihanitse mugucunga imishinga. Nkaba mbasaba ubufasha mukanyorohereza kubona amakuru ya ngombwa.

Amakuru mpabwa azifashishwa mu masomo gusa nkaba mbizeza ibanga ryayo.

Mbaye mbashimiye.

Philippe MUGIRANEZA

Appendix 4. RESEARCH QUESTIONNAIRE (Kinyarwanda version)

IGICE CYA MBERE

Amakuru Rusange: Koresha aka kamenyetso **V** aho bikwiye:

1. **Usubiza**:

Igitsina ◯ **Gabo** ◯ **Gore**

Gabo w'ubatse◯ Gore w'ubatse◯ Ingaragu◯ Umwana ◯ Other ……

imyaka: 12-25◯ 26-35◯ 36-45 ◯ 46-55 ◯ 56 no hejuru◯

2. **Kugera kumazi meza:**

Ni kure bingana iki kugera kumazi meza?

◯ Munsi ya 500 m ◯ hagati ya 500m na 2 km

◯ Hejuru ya 2km

IGICE CYA KABIRI

Koresha V aho bikwiranye

Uko abaturage bateguwe	Gakeya cyane	Gakeya	Biringaniye	Byohejuru	Byo hejuru cyane
1. Ese ni kuruhe rugero ufite muri ubu bumenyi kuri uyu muyoboro?					
Gusoma ibimenyetso?					
Gusoma no Kwandika					
Gufungura/Gufunga Robine					
Guteranya amatiyo					
Gukoresha imashini isunika amazi					
Kumenya aho itiyo iri mubutaka					
2. Ese ni kuruhe rugero ufite mubumenyi kukubungabunga muyoboro w'amazi?					
Kubungabunga amatiyo					
Kubungabunga robine					
Kubungabunga ibigega					
Indi mirimo ku kubungabunga umuyoboro					
3. Ese ni kuruhe rugero uzi ibyo uzungucyira muri uyu mushinga?					

Amazi meza					
Robine hafi yanjye					
Tuzabona amazi					

Ibindi:

4. a)Bitwara amafaranga angahe kugeza amazi meza murugo buri munsi?(Rwf)

◯ Munsi ya 50 ◯ Hagati ya 50 na 100 ◯ Hejuru ya 100

b) Ni ngano ki ibikorwa remezo byangiritse ? (Mu mezi 4 ashize)

1-5 ☐ 6-10 ☐ Hejuru ya 10 ☐

c) Ni gute mwishyura ibisanwa? Kwishyura amafaranga ☐ Gukora umuganda ☐

d) Ese mubona hari iterambere ry'umuyoboro? Yego ☐ Oya ☐

Niba ari oya kubera iki?

	Gakeya cyane	**Gakeya**	**Biringaniye**	**Byohejuru**	**Byo hejuru cyane**
5. Ese ni kuruhe rugero amakuru muyahana hana iyo havutse ikibazo k'umuyoboro?					
Iboneka ry'umuntu wo kubwira icyibazo					
Iboneka ry'ubushobozi bwo gutanga amakuru					

Ubumenyi bw'ikibazo cyo kuvuga					
6. Ese ni kuruhe rugero mubona amazi uko muyifuza ?					
Ingano y'amazi					
Robine aho ariho hose wayifuza					
Imibonekere y'amazi yo kunywa					
7. Ni kuruhe rugero w'ishimiye aya mazi					
Ubuziranenge bw'amazi					
Iboneka ry'amazi?					
igihe mumara mutonze umurongo?					
8. Ese ni kuruhe rugero umuyoboro ukora neza?					
Incuro amzi aboneka					
Uburyo ipombo ikora					
Uburyo amatiyo akora					

9. Nigute ibisubizo mukura mukubona amazi bifasha mukuyabungabunga?
