

EVALUATION OF FACTORS INFLUENCING SUSTAINABILITY OF WATER PROJECTS IN GAHONDO: A CASE OF WATER PROJECTS IN MUHANGA DISTRICT, RWANDA.

Gatari Samuel

Jomo Kenyatta University of Agriculture and Technology,
Kigali, Rwanda.
Email: g2010sam@gmail.com

Dr. Mbabazi Mbabazize

Jomo Kenyatta University of Agriculture and Technology,
Kigali, Rwanda.
Email : mbabazimbabazize@gmail.com

Dr. Jaya Shukla

Jomo Kenyatta University of Agriculture and Technology,
Kigali, Rwanda.
Email: js.jayashukla@gmail.com

ABSTRACT

Water is a natural resource that is necessary for sustenance of life, ecological systems and a key resource to social and economic development. Governments, Non-governmental organizations, local and international organizations from all over the world have implemented water projects to promote safe rural water supply and sanitation over the years. However in most project areas there is lack of sustainability of these water infrastructures and water supply systems. The purpose of this study was to evaluate the factors that influence sustainability of water projects in Rwanda. Muhanga District is selected as the case for the study. The study employed descriptive survey design. The target population of this study was 140 household. Simple random sampling was used in this study. Through random sampling 103 household were selected for the study. Primary data for the study was collected using structured questionnaires that were administered to the respondents by the researcher. Data collected was edited, coded and analyzed using SPSS. Findings were presented using tables. The findings of the study indicated that community participation, project financing, project management practices and community training do influence sustainability of community water projects. It was also found out that the accountability and transparency among the committee members who manage the water resources is also a key factor which influences sustainability. If there is a perceived lack of transparency and accountability, community members tend to withdraw their support for the water projects. The study recommends that community participation in the whole project cycle should be enhanced, there should be high level of transparency and accountability in the management of water projects, donors should have adequate budgets for any water projects designed for implementation and organizations should strongly support monitoring and evaluation of their water projects beside ensuring that community responsible for management and operation of water projects are well trained in operation and maintenance

Key words: Sustainability of water projects, community participation, Project financing, Project management and Community training

1. Introduction

Water is a natural resource that is necessary for sustenance of life, ecological systems and a key resource to social and economic development, Peter Maburi, (2014). Governments, Non-governmental organizations, local and international organizations from all over the world have implemented water projects to promote safe rural water supply and sanitation over the years, Harvey & Reed, (2007) However in most project areas there is lack of sustainability of these water infrastructures and water supply systems, (Francisco *et. al* 2014).

One of the United Nation's 2000 Millennium Goals (MDG's) is to increase the proportion of the world's population that has access to safe drinking water and basic sanitation (United Nations, 2010). While the international community has made advancements toward this goal over the past decade, progress in rural areas is lagging relative to urban areas (United Nations, 2011). Worldwide, 80 percent of the people who have limited access to drinking water supplies live in rural areas (United Nations, 2010). Even where rural supply systems are developed, many are in disrepair or not functioning properly (Brikke and Bredero, 2003; Moe and Rheingans, 2006; RWSN, 2012).

With over 75% of the Africa's poor living in rural areas the need to expand sustainable water service to these areas is imperative (De Regt 2005). When community based projects fail due to a lack of understanding of the specific context of the community or a lack of effective support structures (Reif *et al.* 1996; Baker 2000). Access to rural water supply remains low in Rwanda. In particular, access to piped water has only increased from 9 to 10 percent of rural households over the past eight years. Small community-based water providers are seen as part of the solution and are supported by the Water and Sanitation Corporation (WASAC) 2015, which introduced regulatory and tariff reforms. By separating Energy and Water operations through creating two companies Rwanda Energy Group, a holding company and Water and Sanitation Corporation, Government sought to have undivided attention to each sector and thereby be more effective to meet the stated objectives. With this in mind, the United Nations Millennium Development Goals (MDG) aims at halving the proportion of people without sustainable access to safe drinking water and basic sanitation by the year 2015 (WHO, 2010).

Groundwater provides the only realistic water supply option for meeting dispersed rural demand as alternative water resources can be unreliable and expensive to develop (Foster, 2000; MacDonald, 2005). However many projects spend large amounts of money installing water sources without trying to understand the groundwater resources on which these sources depend. As a result, many supplies are unsuccessful or perform poorly (Robins 2006). Arid areas where groundwater recharges are limited and erratic. According to Gleitsmann (2007) in a qualitative assessment of the participatory water management strategies implemented at the community level in rural Mali through a water supply project The West Africa Water Initiative (WAWI) - community-based rural water supply was found to be a positive step in responding to the needs of rural Malians.

However, the assessment noted that the installation of such water projects with limited consultative participatory approaches and limited extension services do not necessarily proffer sustainable rural water supply. Furthermore, since the United Nations Conference on Environment and Development (UNCED) of 1992, the international community has made considerable effort to raise awareness about water resources concerns and management. Non-governmental organizations, farmers, local authorities, the scientific and technological community, business and industry, trade unions, indigenous people, children and youth and women, have become an integral part of the sustainable development and management of water resources at the international, national and local levels. Many non-governmental organizations have been more

successful in building community awareness and local capacity than in providing technical support for water assessments, water supply and sanitation. Attempts to encourage the transfer of operation and maintenance to water-user associations have had mixed results, since the generally low economic returns on irrigated agriculture and uncertain land tenure provide little incentive for farmers to make long-term capital investments.

Adoption of technology is key in sustainability of community based water projects as it eases operations and maintenance. The effective operation and maintenance of rural water supply systems is crucial element for the sustainability of the water project. The community management of rural water supply systems on operation and maintenance is not successful, if financing resources are not available and frequent supports are not provided (Binder, 2008). Budgeting sufficient funding for rural water supply systems is an important issue for sustainability and proper maintenance but not only one (Niyi et.al, 2007).

A cross the developing world access to water is a critical issue. According to the United Nations, one in eight people worldwide, or 884 million, live without access to safe water (UNICEF, 2009). In Rwanda, the numbers are even more startling; the World Health Organization's 2008 assessment reports that 35 percent of the population collects water from unsafe sources, including unprotected springs or shallow wells and surface water (rivers, streams) (WHO, 2008). Rwanda's hilly terrain makes the installation of public water systems difficult, which means 28 percent of the population, mainly women and children, must travel more than 30 minutes daily on foot and often up to 4 hours to collect water then carry the heavy jugs back to their villages (NISR, 2010). Rwanda is currently having many water projects which are helping mitigate the water crisis. Most of these projects are fund by NGOs. Studies on the sustainability of these projects are an area of interest to estimate the possibility of the projects to continue after the funders withdraw.

Gahondo Water Supply Project in Muhanga district, Rwanda is one of the water projects in Rwanda. The project was started in year 2014 and ended in 2015. It was jointly funded by Association Rwandaise pour le Développement Endogène (ARDE/KUBAHO) and Nancy Uslan via Partners in Conservation (PIC). The purpose of the project was to provide safe water to the people of Gahondo village in Muhanga District-Rwanda. Residence of Gahondo which is among marginalized communities in the region face challenges of accessing safe water. Women walk for long distances in search of water. Access to basic needs, hygiene related diseases were among challenges that the community faced (ARDE, 2014).

2. Statement of the problem

Africa has been found to have the lowest total water supply coverage compared to other continents in the world (ADF, 2005). In Africa and other developing countries national and regional governments, local and international NGOs and other concerned organizations invest large sums every year for the implementation of rural water supply projects (Gebrehiwot, 2006). Despite the continuous efforts of community based water project in ensuring access to clean drinking water for all the commodity is still not enough for the ever growing human population. According to Gleik (2006) most of the water projects fail to achieve the intended objective of providing communities with safe water soon after the funders close the project. In order to make the investment in water supplies more effective, failure rates of these systems should be reduced. According to Gebrehiwot (2006), sustainability of water projects could originate from the project environment, lack of sufficient resources and management related issues. Obtaining sufficient knowledge of the factors, which influence sustainability of water projects, has the potential to positively influence sustainability of the water projects. In this regard, the study sought to evaluate the factors, which influence sustainability of rural water projects in Muhanga District, Eastern province of Rwanda.

3. Research objectives

3.1 General Objective

The purpose of the study was to evaluate the factors that influence sustainability of water projects in Muhanga District, Rwanda.

3.2 Specific Objectives

- i. To determine the extent to which project financing influences sustainability of water projects in Muhanga District
- ii. To examine the extent to which community participation influences sustainability of water projects in Muhanga District.
- iii. To assess the extent to which project management practices influences sustainability of water projects in Muhanga District.
- iv. To explore the extent to which community training influence sustainability of community water projects in Muhanga District.

4. Research Questions

- i. To what extent does project financing influences sustainability of water projects in Muhanga District?
- ii. To what extent does community participation influences sustainability of water projects in Muhanga District?
- iii. To what extent do project management practices influences sustainability of water projects in Muhanga District?
- iv. To what extent does community training influence sustainability of community water projects in Muhanga District?

5. Literature review

5.1 conceptual Framework

In this study the dependent variable is sustainability of water projects while the independent variables are the factors influencing sustainability of water projects which are: Community participation, project financing, project organization management practices and community training. The variables and their relationship are shown in the figure below:

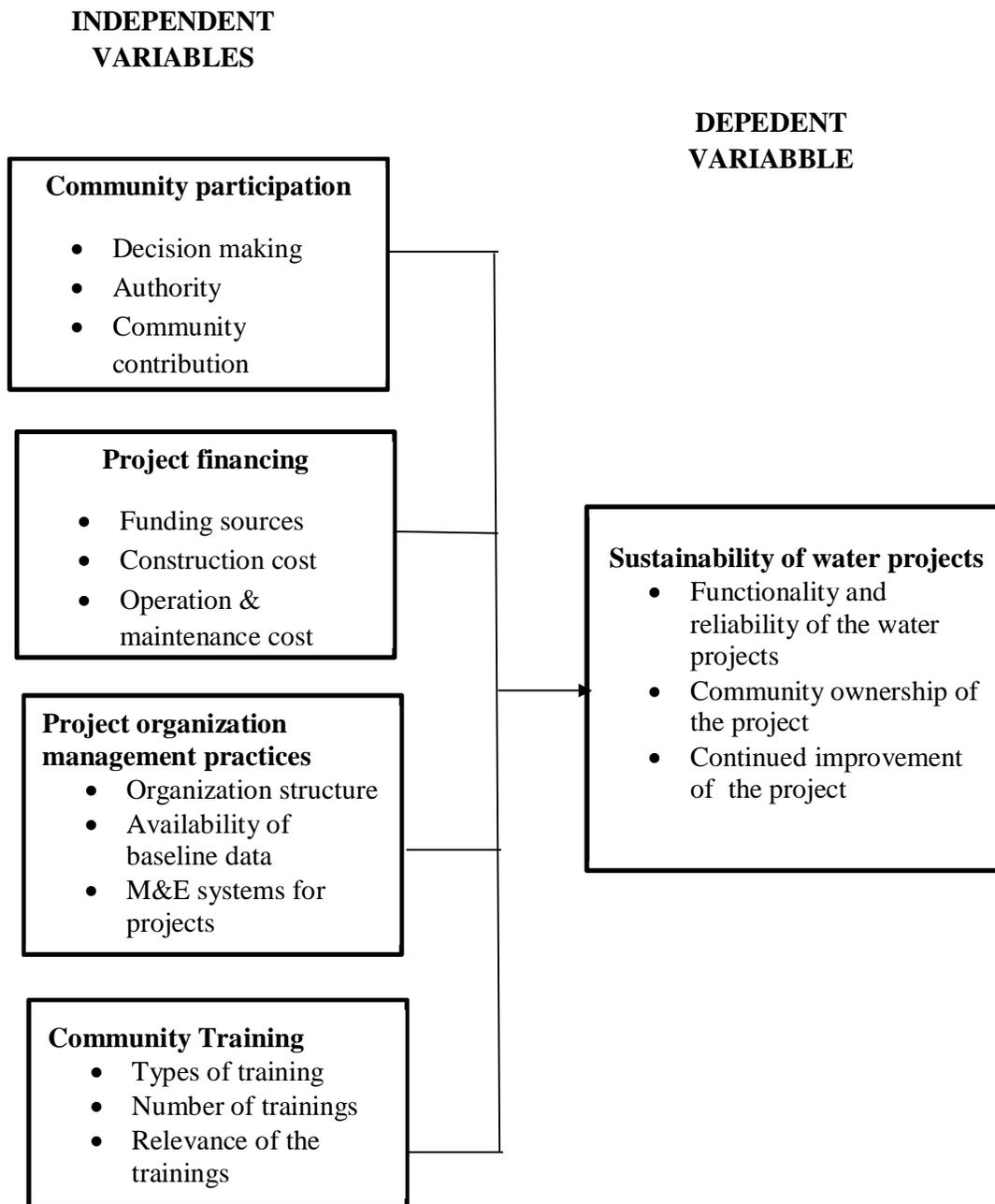


Figure 1 Conceptual framework

6. Research Design

This study adopted descriptive research design. A descriptive study is a study concerned with describing the characteristics of a particular individual or of a group (Kothari, 2004). The study sought to evaluate the factors that influence sustainability of water project in Muhanga District. It adopted a case study survey. A case study involves careful and complete observation and analysis of a unit in its relationship to any other unit in the group (Kothari, 2004). A survey design is associated with a guided and quick collection, analysis and interpretation of observation (Mugenda & Mugenda, 1999).

7. Target population

The target population of this study will be 140 household. According to ARDE 2014 Gahondo sector have 140 households which were expected to benefit from the project.

8. Sample size and sampling procedure

A sample size of 103 respondents will be determined from a total population of 140 households using the formula by Yamane (1967). Simple random sampling and purposive sampling will be used in this study. Through random sampling 103 households will be selected for the study. Stratified sampling divides the population into homogeneous groups such that the elements within each group are more alike than the elements in the population as a whole (Nachimas & Nachimas 2008).

$$n = \frac{140}{1 + 140 (0.05)^2} = 103$$

9. Data collection

9.1 Data collection instrument

Primary data was collected regarding the factors that influence sustainability of water project in Muhanga District. The respondents for this study were selected from the residents of Gahondo. Data was collected using structured questionnaires which were self-administered. Questionnaires are preferred because of the simplicity in their administration and low cost associated.

9.2 Reliability of the instrument.

Reliability is the extent to which results of a study are consistent over time and there is an accurate representation of the total population under study (Golafshani, 2003). Reliability analysis aims at finding out the extent to which a measurement procedure will produce the same result if the process is repeated over and over again under the same conditions (Toke et al., 2012). Cronbach alpha coefficient was computed using SPSS. The Cronbach alpha coefficient value above 0.7 was interpreted to mean that the measurement instrument was reliable (Toke et al., 2012).

9.3 Data analysis technique

The data collected was coded, and analyzed through SPSS (Statistical Package for Social Sciences). Descriptive statistics specifically frequencies and percentages were used to describe the factors that influence sustainability of water project in Muhanga District. Inferential statistics mainly Pearson correlation was conducted to determine the relationship between the variables.

The researcher further employed a multivariate regression model to study the relationship between community participation, project financing, project organization management practices and community. The research deemed regression method to be useful for its ability to test the nature of influence of independent variables on a dependent variable. Regression is able to estimate the coefficients of the linear equation, involving one or more independent variables, which best predicted the value of the dependent variable. This is what a correlation analysis cannot provide as compared to a regression analysis. Further, correlation analysis was meant to illustrate the direction of relationship between two variables but not how much the independent variable influences the dependent variable. Therefore, the researcher used the linear regression analysis to analyze the data. The regression model was as follows:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \mu$$

Y= Dependent variable – Sustainability of water projects.

α = Constant

μ = Error

β = Coefficient of the Disbursement

X1 = community participation

X2 = Project financing

X3 = project organization management practices

X4 = Community training

10. RESEARCH FINDINGS AND DISCUSSION

10.0 Demographic Information

The study sought to determine the demographic characteristics of the respondents. Gender, age and education levels of the respondents were hence determined.

Table 16: Gender of Respondents

| Characteristic | Frequency | Percentage % |
|------------------------|-----------|--------------|
| Gender | | |
| Male | 86 | 84 |
| Female | 17 | 16 |
| Total | 103 | 100 |
| Age | | |
| 31-40 | 49 | 48 |
| 41-50 | 52 | 50 |
| 51-60 | 2 | 2 |
| Total | 103 | 100 |
| Education level | | |
| None | 26 | 25 |
| Primary | 34 | 33 |
| Secondary | 43 | 42 |

From the findings in table 1 majority (84%) of the household respondents were male while minorities (16%) were female. The findings indicate that majority of the households were headed by males who were involved in the water projects in the locality. In addition the table shows that 48% of the respondents were within age bracket of 31-40 years while 50% and 2% were within age brackets of 41-50 years and 51 years and above respectively. This implies that both young adults and adults benefited from the water project.

The study also sought to find the highest academic qualifications of the respondents. Table 1 show that majority of the household respondents (42%) had secondary level of education, 33% had primary while 25%

had never attended school. Therefore it can be noted that majority of the household respondents had attained the basic education and thus would provide valid and consistent information about sustainability of water project in their locality

10.1.1 Being a resident

The study sought to find out the whether the household respondents were resident of the area.

Table 17: Being a resident

| | Frequency | Percentage % |
|-------|-----------|--------------|
| Yes | 103 | 100 |
| No | 0 | 0 |
| Total | 103 | 100 |

From the Table 2, majority (100%) of the household respondents were residents of Gahondo and therefore they would give valid and reliable information about water project in Gahondo.

10.2.2 Years of being a resident

The study sought to find out for how long the household respondents had lived in Gahondo.

Table 18: Years of being a resident

| | Frequency | Percentage % |
|--------------------|-----------|--------------|
| 10 years and below | 12 | 11.7% |
| 11-20 years | 36 | 35% |
| 21-30 years | 40 | 38.8% |
| 31 years and above | 15 | 14.6% |
| Total | 103 | 100 |

From the findings in Table 3 most of the household respondents (38.8%) had lived in Gahondo for 21-30 years, 35% for 11-20 years while 14.6% had lived 31 years and above. This implies that the household respondents had lived in Gahondo for long enough to give credible information about the sustainability of water projects in Gahondo.

10.3 Community participation

Table 19: Perceived extent of community participation

| Responses | Greater extent | Moderate extent | Less Extent |
|--|----------------|-----------------|-------------|
| Extent that community members participate in the conception, design and implementation of the water projects | 11(11%) | 47(46%) | 45(43%) |
| Extent of women representation in the membership of community structures for management of water projects | 6(6%) | 53(51%) | 44(43%) |

Table 4 indicates that majority (46%) of the study respondents felt that the community members participated in the conception, design and implementation of the water project to a moderate extent, 43% indicated to a less extent while 11% stated to a greater extent.

The table also show that 6% of the respondents stated that women representation in the membership of community structures for management of water project was to a great extent, 51% stated to a moderate extent while 43% indicated to a less extent. This shows that the community participated in conception of the project implying that the water project was their idea. Also findings means that gender equality was fairly respected in project management.

Table 20: Contribution by community members

| | Yes % | No % |
|--|---------|---------|
| Contributions of community members influence decisions being made during conception, design and implementation of water projects | 79(77%) | 24(23%) |
| There is community structures in place for management of water projects | 82(80%) | 21(20%) |

Table 5 indicates that 77% of the respondents felt that the contributions of community members influenced decisions being made during conception, design and implementation of the water project while 23% felt it didn't. Further the table shows that majority (80%) of the respondents believed that there was community structures in place for management of the water project unlike 20%.

10.4 Project financing

The study sought to determine the opinion of the respondents on influence of project financing on sustainability of the water project

Table 21: project financing

| | Yes | No |
|--|---------|---------|
| Are you aware of the total cost of the water project | 42(41%) | 61(59%) |
| Do community members make financial contributions for implementation and maintenance of water projects | 56(54%) | 49(48%) |
| In your opinion is the community capable of meeting the cost of operation and maintenance of water projects without further donor support? | 82(80%) | 21(20%) |

Table 6 indicates that majority (59%) of the study respondents were not aware of the total cost of the water project while 41% were aware. Majority (54%) were found to believe that the community members were making financial contributions for implementation and maintenance of the water project while 48% felt that members were not making contributions. The table also shows that 80% of the respondents were of the opinion that the community was capable of meeting the cost of operation and maintenance of water projects without further donor support while 20% felt the community wasn't capable.

These findings indicates that as much as community members contribute towards the implementation of the water project, they are not properly informed of the costs of the water project may be because the funders did not keeping them informed of every detail of the water project. Also findings indicate that the community has the capacity to operate and maintain the water project.

Table 22: Source of funds for the project

| | Frequency | Percentage (%) |
|-------------------|-----------|----------------|
| Donors | 55 | 53 |
| Government | 2 | 2 |
| Community Members | 46 | 45 |

Table 7 indicate that majority (53%) of the respondents stated that the main source of funds for the project was donors, 2% indicated that the funds came from the government while 45% felt that the community members were the main source of funds. This implies that a fair percentage of the project’s funds were being raised by the community members. This trend is expected to increase the capacity of the community to manage the projects and enhance their feeling of ownership thus increase sustainability.

These findings are in agreement with a study by Water Supply and Sanitation Performance Enhancement Project (2003) which recommended that government and international community should not be expected to finance all expenditures required in the life of water system.

10.5 Project Management Practices

The study further sought to establish the influence of Project Management Practices on the sustainability of the water project.

Table 23: Responses on Project Management Practices

| | SA (%) | A (%) | UD (%) | D (%) |
|---|-----------|----------|-----------|----------|
| Water project goals and objectives are clear | 52% | 25% | 9% | 14% |
| Responsibilities and lines of authority of the project manager and water committees are properly defined | 28% | 69% | 3% | |
| Project manager has the necessary knowledge and skills required for successful implementation of water projects | 27% | 67% | 6% | |
| Standard project management tools and techniques such as work plans and monitoring and evaluation plans are used for managing the project | 12% | 48% | 35% | 5% |
| The progress of water project implementation and project team work is frequently reported in project meetings | 6% | 45% | | 49% |
| There is adequate, quality and timely communication within the project team | 33% | 62% | | 5% |

SA - Strongly agree A - agree UD – undecided D - Disagree

Table 8 indicates that majority (52%) of the study respondents strongly agreed with the statement that the goals and objectives of the water project were clear, 25% just agreed, 9% stated they were not sure of the statement while 14% disagreed with the statement. The table also shows that 69% of the respondents agreed with the statement that responsibilities and lines of authority of the project manager and water committee were properly defined, 28% strongly agreed while 3% were undecided. Twenty seven percent strongly agreed with the statement that the project manager had the necessary knowledge and skills required for successful implementation of the water project, 67% just agreed while 6% were undecided. Majority (48%) agreed with the statement that standard project management tools and techniques such as work plans and

monitoring and evaluation plans are used for managing the project, 12% strongly agreed, 35% were undecided while 5% disagreed with the statement. Majority (49%) disagreed with the statement that the progress of water project implementation and project team work is frequently reported in project meetings, 45% agreed while 6% strongly agreed. The table also shows that 33% strongly agreed with the statement that there was adequate, quality and timely communication within the project team, 62% only agreed while 5% disagreed with the statement.

These findings are in agreement with observations made in other studies. According to Sahlin (1998) & Zimmerer (1998), a project manager should be competent in the science of project management and also have technical competence in some aspects of the work being performed on a project. Meredith and Mantel (2009) further have the opinion that a project manager should be both generalist and facilitator and should have a reasonably high level of technical competence in the science of the project. Gido (2009) further notes that it is also essential for every member of the project team to clearly understand the goals and objectives of the water projects at every stage of the project implementation.

10.6 Community Training

The study sought to establish the influence of community training on sustainability of the water project

Table 24: Responses on influence of community training on project sustainability

| | Yes | No |
|---|-----|-----|
| Training affect community ownership of water projects in your community | 46% | 54% |
| Water management committee members have been trained on operation and maintenance and management of water systems | 77% | 23% |
| Trainings offered were sufficient | 91% | 9% |

Ninety four respondents representing 46% indicated that training affected community ownership of the water project in your community while majority (54%) stated that training had no effect on ownership of the project. Majority (77%) indicated that members of water committees had been trained on operation and maintenance of water projects while 23% respondents indicated that training wasn't received. The table also shows that 91% of the respondents felt that the trainings offered were sufficient while 9% indicated that training wasn't sufficient

These findings show that most of the committee members have been trained though there is still a big population of the committee members who have not been trained.

This agrees with observations by Campos (2008) who argued that training on issues like operation and maintenance empower communities to look after water supply systems thus aiding sustainability. Ademiluyi and Odugbesan (2008) identified lack of community education as one of the important factors which could lead to breakdown and non-sustainability of water supply projects in developing countries.

10.7 Correlation analysis

To quantify the relationship and strength of the relationship between the variables, the study used Karl Pearson's coefficient of correlation.

The Pearson product-moment correlation coefficient (or Pearson correlation coefficient for short) is a measure of the strength of a linear association between two variables and is denoted by r . The Pearson correlation coefficient, r , can take a range of values from +1 to -1. A value of 0 indicates that there is no association between the two variables. A value greater than 0 indicates a positive association, that is, as the value of one variable increases so does the value of the other variable. A value less than 0 indicates a negative association, that is, as the value of one variable increases the value of the other variable decreases

Table 25: Correlation and the coefficient of determination

| | Sustainability of water projects | ofCommunity participation | Project financing | Project organization management practices | Community Training |
|---|----------------------------------|---------------------------|-------------------|---|--------------------|
| Sustainability of water projects | 1.000 | | | | |
| (r) (p) Sig. (2 tailed) | | | | | |
| Community participation | 0.894 | 1.000 | | | |
| (r) (p) (2 tailed) | 0.018 | | | | |
| Project financing | 0.493 | 0.316 | 1.000 | | |
| (r) (p) Sig. (2 tailed) | 0.031 | 0.047 | | | |
| Project organization management practices | 0.661 | 0.163 | 0.216 | 1.000 | |
| (r) (p) Sig. (2 tailed) | 0.024 | 0.019 | 0.047 | | |
| Community Training | 0.402 | 0.161 | 0.233 | 0.462 | 1.000 |
| (r) (p) Sig. (2 tailed) | 0.046 | 0.029 | 0.0464 | 0.014 | |

According to the table 4.10, there is a positive relationship between water project sustainability and Community participation, project financing, project organization management practices and community training (0.894, 0.661, 0.493, and 0.402) respectively. The positive relationship indicates that there is a correlation between the factors influencing sustainability and sustainability of Gahondo Water Supply Project in Muhanga district.

This notwithstanding, all the factors had a significant p-value ($p < 0.05$) at 95% confidence level. The significance values for relationship between sustainability of Gahondo Water Supply Project in Muhanga district, Rwanda and Community participation, project financing, project organization management practices and community training were 0.018, 0.031, 0.024 and 0.046 respectively. This implies that community participation was the most significant factor. This findings are consistent with Manyan et al., (2009) who found a significant relationship between Community participation, project financing and water project sustainability. Mengesha et al., (2003) found that project financing, project organization management practices and community training positively and significantly related to sustainability of water projects. This is in agreement with the findings of the current study.

10.8 Regression Analysis

Regression analysis was done to determine the relationship between the factors influencing sustainability of water projects and sustainability of water projects.

Table 26: Model Summary

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|-------|-------------------|----------|-------------------|----------------------------|
| 1 | .542 ^a | .294 | .268 | .130 |

a. Predictors: (Constant), Community participation, project financing, project management practices and community training.

Table 11 shows that the coefficient of determination R square is 0.294 and R is 0.542 at 0.05 significant level. The coefficient of determination indicates that 29.4% of the variation in the factors is explained by the independent variables (Community participation, project financing, project management practices and community training.).

Table 27 ANOVA^a

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|-------|------------|-------------------|----|-------------|--------|-------------------|
| 1 | Regression | .575 ^a | 3 | .192 | 11.388 | .000 ^b |
| | Residual | 1.379 | 82 | .017 | | |
| | Total | 1.953 | 85 | | | |

a. Dependent Variable: Sustainability of water projects

b. Predictors: (Constant), Community participation, project financing, project management practices and community training

Table 12 presents the results of Analysis of Variance (ANOVA) on the factors influencing sustainability of water projects and sustainability of water projects. The ANOVA results for regression coefficient indicate that the significance of the F is 0.00 which is less than 0.05. This implies that there is a positive significant relationship between the factors influencing sustainability of water projects and sustainability of water projects and that the model is a good fit for the data

Table 28: Coefficient results showing the relationship between the combined factors and sustainability of water projects.

| Mode | | Unstandardized | | Standardize | t | Sig. |
|------|------------------------------|----------------|------------|-------------|-------|------|
| | | Coefficients | | | | |
| 1 | | B | Std. Error | Beta | | |
| 1 | (Constant) | .455 | .231 | | 1.973 | .106 |
| | Community participation | .016 | .009 | .444 | 1.815 | .009 |
| | project financing | .182 | .050 | 1.231 | 3.616 | .036 |
| | project management practices | .153 | .017 | 1.075 | 3.159 | .025 |
| | Community training | .204 | .240 | .230 | .850 | .028 |

From the data in the above table the established regression equation was

$$Y = 0.455 + 0.016 X_1 + 0.182 X_2 + 0.153 X_3 + 0.204 X_4$$

From the above regression equation it was revealed that Community participation, project financing, project management practices and community training to a constant zero, sustainability of water projects would be at 0.455. A unit increase on Community participation would lead to increase in sustainability of water projects by a factor of 0.016, a unit increase in project financing would lead to increase in sustainability of water projects by a factor of 0.182, a unit increase in project management practices would lead to increase in sustainability of water projects by a factor of 0.153 and unit increase in reward and community training would lead to increase in sustainability of water projects by a factor of 0.204.

11. Conclusions And Recommendations

11.1 Conclusions

The study sought to establish the factors influencing sustainability of water project in Rwanda.

The study concludes that community participation during conception, design, implementation and operation and maintenance of water projects influences sustainability of community water projects. Their participation ensures that the project being designed borrow from their opinion being the end users. This factor increases community ownership of water project thus enhancing their willingness to effectively manage the project after implementation.

Sources of project's financing whether government, donors or community member's contributions influences sustainability of the water project. There is need for adequate funds for implementing water project according to the designs and plans. The water systems and technologies established should be those that do not need heavy financial investments during operation and maintenance that may be beyond the capacity of the community members. If the operation costs are higher than the community's capacity to meet, then such water project can easily fail.

The study also concluded that project management practices influences sustainability of water projects. Project management practices like project monitoring and evaluation, establishing skilled project team and ensuring effective communication structures ensure that projects are implemented according to the expected quality, within schedule and budget.

Training of community members especially those responsible for operation and maintenance of water projects influences sustainability of water projects. Trained operators are more efficient while operating the water structures thus minimizes any breakdowns during maintenance or operation. In cases of breakdowns, availability of trained community members on maintenance ensures that maintenance are done more promptly and cheaply as opposed to when community members have to depend on hired skilled labor.

11.2 Recommendations

The study recommended that training of water management committee members on water resources operation and maintenance is very crucial. It is recommended to the water management committee that untrained community members should not be entrusted to manage water facilities as this could lead to mismanagement and unwarranted system breakdowns. The study also recommended that implementers of water project should ensure that water management committee is formed and members adequately trained.

There is need to enhance transparency and accountability levels among the committee members. Openness should be encouraged in the management of finances. Auditing of financial records by independent parties should be encouraged. This will encourage community members to contribute promptly towards operation and maintenance of the water project. Close monitoring and evaluation of water projects by implementing organizations is recommended to enhance sustainability.

Community participation right from conception and design of water projects to implementation is recommended so as to enhance community ownership of water project. The views of community members should be appreciated by the donors implementing water projects.

11.3 Areas of further research

Despite the overall findings procedure in this study, there are still open opportunities for further studies. Similar studies should be conducted on:

- i. The role of women in enhancing the sustainability of rural community based water projects in Rwanda
- ii. Factors influencing community ownership of water projects in other regions so as to allow for generalization of factors influencing community ownership of water projects in Rwanda.
- iii. The influence of social cultural factors on long term sustainability of water projects. Especially age, gender and education levels of members of water management committees.

REFERENCES

1. Adams W. M. et al., (1994). *Indigenous Farmer-Managed Irrigation in Sonjo*, Tanzania. The Geographical Journal.
2. Ademiluyi, I.A. and Odugbesan, J. A. (2008). *African Journal of Agricultural Research* Vol. 3 (12), pp. 811-817, December, 2008.
3. ADF (African Development Fund) (2005) Rural Water Supply and Sanitation
4. ARDE, (2014) Muhanga water supply project. Retrieved on 5th February, 2016 from <http://www.arde-kubahorwanda.org>
5. Arata C. M., Picou J. S. and Johnson, G. D. (2000). *Copying with technological disaster: An application of the conservation of resources model to the Exxon Valdez Oil Spill*. Journal of Traumatic Stress.
6. Bell R. G., (2001). *The Conceptual Perspective for Public Participation: The Proceedings of the Workshop on Good Governance, Public Participation and and the*
7. *Decision Making Process for Environmental Protection*, March 18 Saitharn Publication House, Bangkok, Thailand.
8. Binder D (2008). *Sustainability of Water Service Delivery in Rural Environment: Past Approaches and the Way Forward*. Emerging Markets Group, Ltd.
9. Brett A. Gleitsmann, Margaret M. Kroma and Tammo S (2007). *Analysis of a rural water supply project in three communities in Mali: Participation and sustainability*. Natural Resources Forum 31 (2007) 142–150.
10. Brooks C. P. J., (1996). *Getting the Private Sector Involved in Water-What to Do in the Poorest of Countries?* Public Policy of Private Sector. Wahington D.C.: The World Bank.
11. Campos, M. (2008). *Making sustainable water and sanitation in the Peruvian Andes: an intervention model*. Journal of Water and Health 6 (1) 2008.
12. Cleaver, F. (2001). *Institutions, agency and the limitations of participatory environments are critical competencies needed in supporting approaches to development*.
13. Cohen, M. (1999). *Sustainable development and ecological modernization: National Capacity for Environmental reforms*. OCEES Research Paper No. 14, Oxford center for the Environment, Ethics and Society, Oxford.
14. Cohen M., (1997a). *Risk Society and Ecological Modernization: Alternative Visions for Capacity for Rigorous Environmental Reform*. Oxford England: Oxford Center for Environment, Ethics and Society. OCEES Research Paper.
15. Creswell, J. W. (2003). *Research design: Qualitative, quantitative, and mixed methods and approaches* (2nd ed.). Thousand Oaks, CA: Sage.
16. David W., (1999). *Globalization, Uneven Development and Poverty: Recent Trends and Policy Implications*. UNDP.
17. DFID 2001. *Addressing the water crisis: healthier and more productive lives for poor people*. Department for International Development, London
18. Diane R., (undated). *Theory and Practice in Sustainability and Sustainable Development: Lessons for USAID's Move towards Sustainability and Sustainable Development*. USIAD center for Information and Evaluation.
19. Dungumaro E. Madulu N (2003). *Public participation in integrated water resources management: the case of Tanzania*. Journal of Physics and Chemistry of the Earth (2003) 1009–1014.
20. Frankfort-Nachmias and David Nachmias(1996). *Research Methods In Social Sciences*. 5th edition.St. Martins Press Inc. Great Britain.
21. Gerald F. Davis and Adam J. Cobb (2009), *Resource Dependence Theory: Past and Future*.

22. Gebrehiwot, M. (2006). An Assessment of Challenges of Sustainable Rural Water Supply: The Case of Ofleta Woreda in Tigray Region. *Msc Thesis, Regional and Local Development Study (RLDS)*. A.A.U. Ethiopia
23. Gido, J., and Clement, J. P. (1999). *Successful Project Management*. Cincinnati: South Western College Publishers.
24. Gill D., A., and Steven P. (1998). *Technological Disaster and Chronic Community Stress. Society and Natural Resources*.
25. Gleick P. (2006) The World's Water 2006-2007. *The Biennial Report on Freshwater Resources*. Island Press, Washington, D.C.
26. GOK, *National Policy For The Sustainable Development of Arid And Semi Arid Lands of Kenya, 2004*.
27. Hendarto H. (2007). *Project Failures and Project Success*.
28. Hillman A. Shropshire, C. and Cannella, A. (2007). "Organizational predictors of women on corporate boards," *Academy of Management Journal*, Vol. 50, pp. 941-952
29. IFAD (2009). *Sustainability of Rural Development Projects: Best Practices and Lessons Learned by IFAD*. Asia.
30. Ijjasz E. *Exploring Access to Microfinance for Community-Managed Rural Water Supply Projects: Emerging Experience from Kenya*. Water and Sanitation Program, World Water Forum, Mexico, March 17, 2006
31. JMP (2004). *Global Water Supply and Sanitation 2004 Report*. Joint Monitoring Programme WHO/UNICEF, World Health Organization, Geneva.
32. Kaliba, Aloyce R.M (2000). *Participatory Evaluation of Community Based Water and Sanitation Programs: The Case of Central Tanzania*. Ph.D. Dissertation, Department of Agricultural Economics, Kansas State University.
33. Kemp, R., Parto, S. and Gibson R. B. (2005). *Governance for sustainable development: moving from theory to practice*. *International Journal Sustainable Development*, Vol.8 (1/2).
34. Livingstone, A and McPherson, H. J (1993). *Community Management of Rural Water Supplies: Lesson for Developing Countries from a Western Canadian Experience*. *Water International*, 18 (1993) 225 – 232.
35. Mangin, J.M., 1991. *Rural water supply in southern Ethiopia: Failures and alternatives*. *Canadian Journal of Development Studies*, 12(2): 97–312.
36. Manyan H., Offat I. and Kamuzungu T. (2009), *access to safe drinking water by rural communities in Zimbabwe: a case of Mundenda village in Mutasa district of Manicaland province in Journal of Sustainable Development in Africa* Vol. 11, No.1, 2009) . Pennsylvania : Clarion University of Pennsylvania.
37. McCommon, C., Warner, D. and Yohalem, D. (1990) Community management of rural water supply and sanitation services. WASH Technical Report Number 67. Washington DC: UNDP/World Bank Water and Sanitation for Health Program.
38. Mengesha A., Abera K. and Mesganaw F. (2003) *Sustainability of drinking water supply projects in Rural of North Gondar, Ethiopia*. *Ethiopian Journal of Health Development* 2003; (3):221-229.
39. Meredith J. R., and Mantel S. J., (1995). *Project Management: Management Approaches*. 2nd ed., New York: Wiley.
40. Mugenda O. and Mugenda A., (1999). *Research Methods; Quantitative and Qualitative Approaches*. Nairobi, Africa Center for Technology Studies.
41. Narayan, D. (1995) *Participatory evaluation: tools for managing change in water and sanitation*. World Bank Technical Paper Number 207. Washington, DC: The World Bank.
42. National Academy of Sciences (1997). *Safe Water From Every Tap: Improving Water Service to Small Communities*. National Academy Press, Washington, D.C.

43. Nikkhah H. A. and Redzuan M (2009). *Participation as a Medium of Empowerment in Community Development*. European Journal of Social Sciences – Volume 11, Number 1 (2009).
44. NISR (2010) Access to potable water increased over last five years in Rwanda. <http://statistics.gov.rw/publications/article/access-potable-water-increased-over-last-five-years-rwanda>
45. Sara, J. and Katz, T. (1998) *Making Rural Water Supply Sustainable: Reports on the Impact of Project Rules*. Washington, DC: UNDP/World Bank Water and Sanitation Program.
46. Scott, W. R. and Davis, G. F. (2007), *Organizations and Organizing: Rational, Natural, and Open System Perspectives*, Pearson Prentice Hall, Upper Saddle River NJ.
47. Sen, Amartya. (1999). *Development as freedom*. New York: Random House.
48. Singh, N., Jacks, G., Bhattacharya, P. (2005). *Women and community water management. Natural Resources perspective*. Natural Resources Forum.
49. Smith O., and Anthony (1996). *Anthropological Research of Hazards and Disasters*. Annual Review of Anthropology.
50. Solow, Robert M. (1993). *Sustainability: An economist's perspective*. In Robert Dorfman and Nancy S. Dorfman (Eds.), *Economics of the Environment* (pp. 179–187). New York: Norton.
51. Soriono C., and Test Consultants Inc. (2003). “*Rural Water: Models for Sustainable Development and Sector Financing*.” Water Supply and Sanitation Performance Enhancement Project. Manila.
52. Stern P. C., and Harvey v. Fineberg (eds. 1996). *Understanding Risk: Informing Decisions in a Democratic Society*. Washington, DC: National Academy Press.
53. Thompson, J. D. (1967), *Organizations in Action*, McGraw Hill, New York. United Nation Economic and Social Council, Economic Commission for Africa: Third meeting of the Committee on Human Development and Civil Society, 2005, Addis Ababa, Ethiopia.
54. Wakeman, W. (1995). *Gender Issues Source book for Water and Sanitation Projects*. Washington, DC: UNDP/World Bank Water and Sanitation for Health Program.