

Research Article

Beneficiary Involvement and Financial Sustainability of Selected Rural Water Supply Projects in Rulindo District

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Abstract

The main objective of this study was to investigate the effect of beneficiary involvement on financial sustainability of selected rural water supply projects in Rulindo District, Rwanda. It focused on understanding how genuine involvement of beneficiaries in the initiation, planning, implementation, and monitoring phases of rural water supply projects can enhance their financial sustainability, using Rulindo District as a case study. A quantitative research design was adopted, with a target population of 20,074 households from three administrative sectors of Rulindo District namely Shyorongi, Rusiga, and Bushoki. A proportional sampling was used to ensure the sample accurately represented the population, with 203 respondents from Shyorongi Sector, 63 from Rusiga Sector, and 111 from Bushoki Sector. Primary data were collected through a self-developed questionnaire, and the reliability of the instrument was tested, yielding Cronbach's Alpha coefficients above 0.7. The study achieved a 100% response rate. Data were analyzed using both descriptive and inferential statistics, multiple linear regression, to explore the contribution of beneficiary involvement on financial sustainability. Quantitative results indicated that beneficiary involvement explained about 54.1% of variance in financial sustainability. The study concluded that the involvement of beneficiaries, particularly during the initiation and monitoring phases, is crucial for achieving financial sustainability. The study recommends that the beneficiaries of rural water supply projects should be involved across all phases of these projects via structured community involvement strategies such as water user committees, participatory rural appraisal, community contracting, stakeholder workshops and consultations, training and capacity building programs, community monitoring and reporting systems and inclusion of women and marginalized groups.

Keywords

Rural Water Supply Project, Beneficiaries Involvement, Project Phases, Financial Sustainability

1. Introduction

The involvement of beneficiaries is seen as a solution for financial sustainability of rural water supply projects [1]. It promotes a sense of ownership which is essential for the overall sustainability of these projects [1]. Its absence can lead to water supply system failures, ineffective management, and

poor service delivery [1].

In the USA, the involvement of beneficiaries improved decision-making, saved costs, and enhanced trust between communities and governing bodies [2]. Because of the involvement of beneficiaries in decision-making, beneficiaries

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are more likely to support and maintain water supply projects [2]. The involvement of beneficiaries improved compliance with regulations and encouraged long-term investment in water supply infrastructure development [2].

Similarly, the UK moved towards a more community-based approach in water management under the EU Water Framework Directive and the Catchment-Based Approach [3]. The involvement of beneficiaries improved trust and compliance with water management policies and also opposition to water supply projects decreased, leading to smoother operation and maintenance [3].

In Brazil, the involvement of beneficiaries transformed water governance, ensuring projects were designed to meet local needs [4]. Education and participation empowered beneficiaries to maintain and protect water supply systems [4]. Also, the accountability of beneficiaries improved, leading to greater investment in rural water supply projects [4].

In Sub-Saharan Africa, water user committees were formed in many countries to ensure local ownership of water supply infrastructure [5]. Peer education models helped communities take responsibility for water safety, hygiene, and maintenance [5]. Water conservation practices were more effective when designed with local knowledge rather than imposed externally [5]. Water supply projects success rates increased by 60% in areas where communities were involved in planning and maintenance [5]. WASH projects were more financially sustainable when beneficiaries contributed to their maintenance [5].

In EAC, the involvement of beneficiaries ensured projects aligned with local needs, leading to stronger commitment and ownership [6]. In Kenya, beneficiaries were involved in water governance, requiring local water user associations to manage rural water systems [7]. In Tanzania, water committees were established to manage boreholes and shallow wells, improving operational efficiency [1]. Community members were included in decision-making, ensuring fair water tariffs and transparent financial management [8]. In Uganda, village water committees provided regular feedback to government agencies, reducing project abandonment and 81% of surveyed projects were still operational five years after implementation when communities were actively involved [9]. Water user committees introduced small user fees, helping cover maintenance costs without external support [9]. Communities took a more proactive approach to fixing water supply issues rather than waiting for government intervention [9].

In Rwanda, the involvement of beneficiaries in information dissemination and consultation significantly contributed to the sustainability of water supply projects in the southern province of Rwanda [10]. It was found that projects involving beneficiaries in decision-making and system operations showed stronger sustainability outcomes [10]. In Rulindo District, the involvement of beneficiaries promoted a sense of ownership among community members [11]. When beneficiaries are part of the decision-making and project management processes, they are more likely to support the project's

maintenance and success [11].

In Rwanda, however, there are many rural water users that remain unwilling to contribute financially to the maintenance of water supply systems, resulting in limited local revenue for operations and repairs [12]. This has led to persistent over-reliance on government and donor support to sustain these services [10]. As a consequence, several water supply systems, whether gravity or pumping, often remain non-functional for extended periods after breakdowns due to the unavailability of funds for timely repairs [12]. This situation raises concerns about the financial sustainability of rural water supply projects and highlights the need to understand how the involvement of beneficiaries might address these challenges.

This study is expected to contribute to the design of more inclusive and sustainable water interventions. Additionally, the findings shall inform national rural water supply programs and support the achievement of Sustainable Development Goal 6, which aims to ensure availability and sustainable management of water and sanitation for all.

The main objective of this study was to assess the effect of beneficiary involvement in project initiation, planning, implementation and monitoring phases on the financial sustainability of selected rural water supply projects in Rulindo District. The specific objectives were: To determine the effect of beneficiary involvement in initiation phase on the financial sustainability of selected rural water supply projects, to investigate the contribution of beneficiary involvement in planning phase to the financial sustainability of selected rural water supply projects in Rulindo District, to assess the impact of beneficiary involvement in implementation phase on the financial sustainability of selected Rural water supply projects in Rulindo District and to examine the role of beneficiary involvement on the financial sustainability of selected rural water supply projects in Ruindo District.

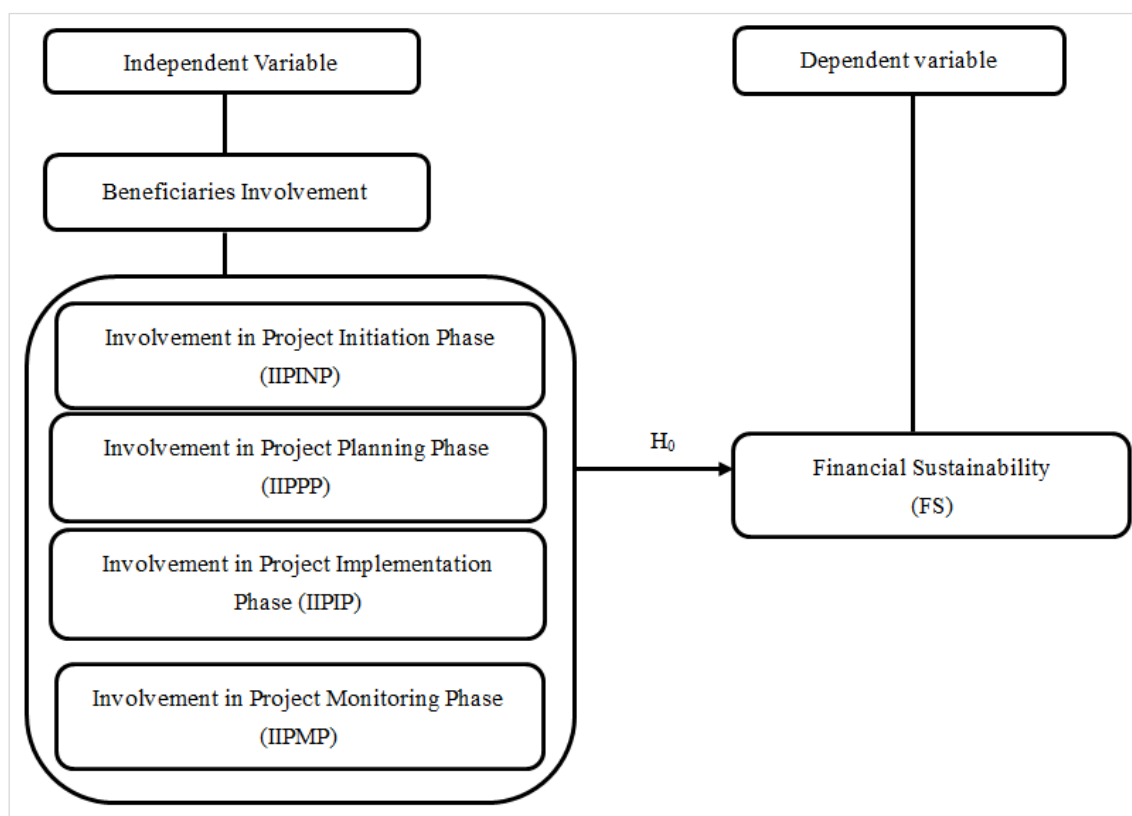
This study was based on the hypothesis that beneficiary involvement (involvement in initiation phase, involvement in planning phase, involvement in implementation phase, involvement in monitoring phase) does not significantly affect the financial sustainability of selected rural water supply projects in Rulindo District.

This study was grounded in Stakeholder Theory and Community Participation Theory. Stakeholder Theory emphasizes inclusive engagement for improved relevance and ownership [13]. Community Participation Theory supports involvement across all project phases, fostering long-term sustainability [14, 15].

A number of scholars highlighted that the involvement of beneficiaries in the financial aspects of rural water supply projects significantly enhanced financial sustainability. In East African countries, it was found that when community members were involved in financial decision-making such as tariff setting and budgeting, the chance of timely payment and operational cost recovery increased [6]. Similarly, in Rwanda, it was showed that involving communities in financial planning and imple-

mentation encouraged transparency and accountability, reducing

the risk of financial mismanagement [10].



Source: Researcher, 2024

Figure 1. Conceptual Framework.

This study found that the involvement of beneficiaries in the initiation and monitoring phases had a positive and significant effect on the financial sustainability of selected rural water supply projects in Rulindo District. Early participation helped establish effective financial mechanisms, while active monitoring reduced mismanagement. These results align with previous studies which found that the involvement of beneficiaries at these stages improved transparency and fee collection [16]. In contrast, involvement during the planning and implementation phases had a positive but no significant effect [17]. Overall, it was found that beneficiary involvement enhanced ownership, accountability, and financial contribution, supporting the findings of previous studies on the role of community participation in promoting financial sustainability [1].

This study recommends involving beneficiaries in all phases of rural water supply projects through structured strategies like water user committees, participatory planning, and inclusive training. Although initiation and monitoring phases had the strongest impact on financial sustainability, involvement during planning and implementation is still vital for promoting ownership, transparency, and accountability.

2. Materials and Methods

This section deals with the methodology used for this study. It is subdivided into research design, population of the study, sample size and sampling techniques, data collection techniques, instrument for data collection, procedures for administration of research questionnaire, pilot study for questionnaire validity and reliability tests, data analysis techniques, model specification, *a-priori* expectation, and ethical consideration.

2.1. Research Design

This research used quantitative research design, and data were analyzed using descriptive and inferential statistics (Multiple Linear Regression Analysis) with SPSS version 20. It adopted a cross-sectional design, descriptive design. It was conducted in Rulindo District located in the Northern province of Rwanda.

2.2. Timing and Context of the Study

This study was conducted between February and May 2025, targeting beneficiaries of more than 5 years old water supply systems in Rulindo District. Respondents were individuals who could have had direct or indirect involvement in the project lifecycle through participation in village committees, local consultations, or community labor contributions. The typical duration of each project phase was approximately 3 months for project initiation, 8 months for planning, 12 months for implementation, and 12 months for the monitoring phase. The survey questions were structured to capture beneficiary involvement specifically tied to these distinct phases based on their actual experience with the projects, rather than hypothetical scenarios. This approach ensured that responses reflect grounded, phase-specific insights rather than general opinions.

2.3. Population of the Study

The target population consisted of 20,074 households served by the water supply systems of Bitete-Rwahi-Muvumu, Gisoro-Nyundo, Kirikumuryango, Maya, and Runyinya in Shyorongi Sector. Households served by the water supply systems of Gashinge, Kigarama, Ntakara, Ntaruka, Nyakabizi, Rushinya-Taba-Gitanda, and Tare in Rusiga Sector. Households served by the water supply systems of Buramira, Gasebeya, Nkombe, Nyabishengehi, Nyagahondo, Rukungeri-Busave, Rutare-Nyirangarama, Rutembe-Mpango-Bushoki, Rutomvu and Tare in Bushoki Sector of Rulindo District.

2.4. Sample Size and Sampling Techniques

The sample size was calculated using the formula for finite population: $n = \frac{N \cdot Z^2 \cdot p \cdot q}{(N-1) \cdot e^2 + Z^2 \cdot p \cdot q}$; where n = required sample size, N = population size, Z = standard error associated with the chosen confidence level, p = estimated proportion of success, q = estimated proportion of failure, e = margin of error between the true proportion and the sample proportion. The researcher used the following values for parameters indicated in the formula: $N = 20,074$; $Z = 1.69$; $p = 0.5$; $q = 0.5$ and $e = 0.05$. Substituting the parameters in the formula by their corresponding values, it was determined that the total sample size required was 377 households. To guarantee that the sample accurately reflects the population, a proportional sampling technique was used. Based on sectors' proportion of the total household population, Bushoki Sector, with 5,893 households [18], represented approximately 29.4% of the total population and contributed 111 households to the sample. Rusiga Sector, with 3,363 households [18] (16.8% of the total), contributed 63 households. Shyorongi Sector, the largest with 10,819 households [18] (53.9%), contributed 203 households to the sample. Altogether, the total household population across the three sectors was 20,074, and the total sample size for the

study was 377 households.

2.5. Data Collection Techniques

A questionnaire was used to collect data regarding the perceptions of the respondents on the statements that measure the involvement of beneficiaries and sustainability of selected rural water supply projects in Rulindo District and helped in validating the quantitative findings of this study.

2.6. Instrument for Data Collection

The structured questionnaire used was designed in terms of five Likert-Scale where 1 = Strongly Disagree (SD), 2 = Disagree (D), 3 = Neutral (N), 4 = Agree (A) and 5 = Strongly Agree (SA). The questionnaire was closed-ended where the respondents were given the statements from which they were required to select appropriate option according to their view on each item. The questionnaire was entitled "Beneficiaries Involvement and Sustainability of Selected Rural Water Supply Projects in Rulindo District". It was divided into three sections: Section A was about demographic questions in terms of gender, age, level of education, and marital status. Section B was about the independent variable which is beneficiaries involvement: Involvement in initiation phase had 6 statements, involvement in planning phase had 6 statements, involvement in implementation phase had 6 statements, and involvement in monitoring phase had 5 statements. Section C was about the dependent variable which is sustainability of rural water supply projects. Financial sustainability had 5 statements.

2.7. Procedures to Administer the Questionnaire

The data collection was conducted using an online questionnaire created through Google Forms. The questionnaire link was used by selected and trained enumerators who conducted the survey on ground under supervision of the researcher. This method allowed for efficient data collection and made the process easier to monitor.

2.8. Pilot Study

A pilot study was conducted on 65 households of Shyorongi Sector to assess the feasibility of this research, allowing the researcher to test and refine the design, procedures, and instruments on a smaller scale before the full study. The pilot study helped in identifying potential problems related to data collection, respondents' identifications, and logistics, enabling necessary adjustments. The pilot study also allowed for refining research instrument, estimating time and other resources that were needed, and self-training for better accuracy.

2.8.1. Validity of Research Instrument

The validity of the research instrument was assessed using

Average Variance Extracted (AVE) for each variable. For the beneficiaries involvement construct, the AVE values were as follows: involvement in the project initiation phase (6 items) scored an AVE of 0.826, involvement in the planning phase (6 items) had an AVE of 0.803, involvement in the implementation phase (6 items) had an AVE of 0.788, and involvement in the monitoring phase (5 items) had an AVE of 0.810. For the sustainability of selected rural water supply projects, the AVE values were also satisfactory with financial sustainability (5 items) scoring an AVE of 0.733.

2.8.2. Reliability of Research Instrument

The results for reliability test demonstrated that the Cronbach's Alpha Coefficients were 0.906 for involvement in project initiation phase, 0.890 for involvement in project planning phase, 0.876 for involvement in project implementation phase and 0.869 for involvement in project monitoring phase meaning that all measurements of beneficiaries involvement were highly reliable. For the measurements of sustainability, it was shown that the Cronbach's Alpha Coefficients was 0.833 for financial sustainability meaning that all measurements of sustainability were also highly reliable since all Cronbach's Alpha Coefficients were greater than 0.7.

2.9. Method of Data Analysis

The inferential statistics were used to help in the analysis of the effect of beneficiaries involvement variables on financial sustainability, and they also produced empirical results that formed the basis for decision model. Each probability value of the independent variable indicators was compared with the critical p-values of 0.05. If $p < 0.05$, the effect was statistically significant, and if $p > 0.05$, the effect was not statistically significant.

The primary data gathered from the returned copies of the questionnaire were processed by using SPSS version 20. The respondents' profile information which is gender, age, and level of education, were analyzed by using descriptive statistics (frequency counts, and percent). The demographic information was analyzed through descriptive statistics in order to determine the characteristics of the participants. This was followed by the descriptive analysis of the respondents' perceptions concerning beneficiaries involvement practices and financial sustainability of selected rural water supply projects in Rulindo District (frequency counts, percentage, mean score and standard deviation).

2.10. Model Specification

Considering that "Beneficiaries Involvement and Financial Sustainability of Selected Rural Water Supply Projects in Rulindo District" is the research topic, the modelling is as follows: $X = \text{BINV} = \text{Beneficiaries Involvement (independent variable)}$; $X = f(x_1, x_2, x_3 \text{ and } x_4)$ Where;

$x_1 = \text{IIPINP (Involvement in Project Initiation Phase)}$

$x_2 = \text{IIPPP (Involvement in Project Planning Phase)}$

$x_3 = \text{IIPIP (Involvement in Project Implementation Phase)}$

$x_4 = \text{IIPMP (Involvement in Project Monitoring Phase)}$

$Y = \text{FS} = \text{Financial Sustainability of Selected Rural Water Supply Projects (Dependent variable)}$:

Based on the above, the following functional relationship was developed to align with the research objective: $\text{FS} = (\text{IIPINP, IIPPP, IIPIP, IIPMP})$ function 1.

Function 1 is the functional relationship of this study. This function was used in testing the effect of beneficiaries involvement (involvement in project initiation phase, involvement in project planning phase, involvement in project implementation phase, involvement in project monitoring phase) on the financial sustainability of selected rural water supply projects in Rulindo District. Based on the specifications of variables, the following model was deduced: $\text{FS} = \beta_0 + \beta_1 \text{IIPINP} + \beta_2 \text{IIPPP} + \beta_3 \text{IIPIP} + \beta_4 \text{IIPMP} + \mu_1$. In this model, β_0 is the intercept, β_1 to β_4 are coefficients of the explanatory variables and μ_1 is the error term.

2.11. A Priori Expectation

The anticipated outcomes of the econometric model suggested that all independent sub-variables would have a significant effect on dependent variable. It was expected that this effect would be positive. Overall, beneficiaries involvement was predicted to have a significant and positive effect on the financial sustainability of selected rural water supply projects in Rulindo District.

2.12. Ethical Consideration

This research was conducted with strict adherence to ethical principles to ensure the rights, safety, and dignity of all participants. Prior to data collection, all participants received comprehensive information regarding the study's objectives, methodology, potential risks, and benefits. Informed consent was obtained from each participant, ensuring their voluntary participation without any intimidation or influence.

Confidentiality and anonymity were strictly maintained throughout the research process. Personal identifiers were not included in the study, and all collected data were securely stored and accessible only to the researcher and his supervisor. The information gathered was used exclusively for academic purposes and was not shared with unauthorized individuals or institutions.

During data processing and analysis, maximum care was taken to ensure objectivity and accuracy. No data was manipulated, misrepresented, or selectively reported to influence the findings. Instead, the results were presented transparently, reflecting the actual responses and realities observed in the field. Furthermore, necessary permissions were sought from relevant authorities before engaging with participants, demonstrating compliance with institutional and professional research standards.

Additionally, participants had the right to withdraw from the study at any stage without facing any consequences. Their rights and well-being were prioritized, and no participant was subjected to harm or distress during the research process.

3. Results

This section presents the findings of the study on the effect of beneficiary involvement on the financial sustainability of selected rural water supply projects in Rulindo District. The analysis is based on data collected focusing on key areas of beneficiary involvement which are initiation, planning, implementation, and monitoring. Both descriptive and inferential statistics were used to analyze the data. Descriptive statistics summarize the general trends in responses, while inferential statistics, multiple linear regression, were used to test the significance of the effect of the independent variable on the dependent variable. These results provide insight into the extent to which beneficiary involvement predicts financial sustainability in the selected rural water supply projects in

Rulindo District.

3.1. Descriptive Analysis of the Indicators of Beneficiary Involvement

Indicators that are statistically analyzed in this subsection are beneficiary involvement in selected rural water supply projects initiation phase with six statements, involvement in projects planning phase with six statements, involvement in projects implementation phase with six statements, and involvement in projects monitoring phase with five statements. For simplicity, the “agree” and “strongly agree” responses were combined into one category labelled “agree,” while “disagree” and “strongly disagree” responses were combined into another category labelled “disagree”.

3.1.1. Involvement in Project Initiation Phase

The findings on respondents’ perceptions regarding beneficiary involvement in selected rural water supply projects initiation phase are presented in [Table 1](#).

Table 1. Perceptions on Beneficiary Involvement in Project Initiation Phase.

Items	SD	D	N	A	SA	$\bar{x}$	σ
My household participated in identifying the need for our water supply project.	14 3.7%	13 3.4%	30 8.0%	170 45.1%	150 39.8%	4.14	0.966
My household had a say in defining the key problems that our water supply project aimed to address.	17 4.5%	10 2.7%	27 7.2%	194 51.5%	129 34.2%	4.08	0.960
My household participated in the process of decision-making regarding our water supply project goals and objectives.	23 6.1%	22 5.8%	53 14.1%	181 48.0%	98 26.0%	3.82	1.074
My household views were considered in the assessment of our water supply project potential risks and challenges.	26 6.9%	23 6.1%	52 13.8%	178 47.2%	98 26.0%	3.79	1.106
Our water supply project initiation phase incorporated suggestions and feedback from my household.	27 7.2%	28 7.4%	50 13.3%	179 47.5%	93 24.7%	3.75	1.123
My household was involved in our water supply project initiation phase in transparent and inclusive manner.	20 5.3%	19 5.0%	43 11.4%	180 47.7%	115 30.5%	3.93	1.047

Source: Primary Data, 2025

From [Table 1](#), the analysis showed that 320 respondents representing 84.9% agreed with the statement that beneficiaries participated in identifying the need for water supply projects while 27 respondents representing 7.1% disagreed. A total of 30 respondents representing 8.0% did not indicate their views. Overall, the respondents agreed with a mean score of 4.14 and standard deviation of 0.966. Those who agreed that beneficiaries had a say in defining the key problems that water supply projects aimed to address were 323 respondents representing 85.7%. On the other hand, 27 respondents representing 7.1% disagreed with

the statement. A number of 27 respondents representing 7.2% did not indicate their views. Overall, the respondents agreed with a mean score of 4.08 and standard deviation of 0.960. Respondents who agreed that beneficiaries participated in the decision-making process regarding water supply projects goals and objectives are 279 representing 74.0% while 45 respondents representing 11.9% disagreed. A number of 53 respondents representing 14.1% did not indicate their views. Overall, the respondents agreed with a mean score of 3.82 and standard deviation of 1.074. Regarding whether beneficiaries’ views were

considered in the assessment of water supply projects potential risks and challenges, 276 respondents representing 73.2% agreed while 49 respondents representing 13.0% disagreed. A number of 52 respondents representing 13.8% did not show their views. Overall, the respondents agreed with a mean score of 3.79 and standard deviation of 1.106. Respondents who agreed that water supply projects initiation phases incorporated suggestions and feedback from beneficiaries were 272 representing 72.2% while 55 respondents representing 14.6% disagreed. A total of 50 respondents representing 13.3% did not show their views. Overall, the respondents agreed with a mean score of 3.75 and standard deviation of 1.123. Regarding whether the involvement of bene-

ficiaries in rural water supply projects initiation phase was transparent and inclusive, 295 respondents representing 78.2% agreed while 29 respondents representing 10.3% disagreed. A total of 43 respondents representing 11.4% did not show their perceptions. Overall, the respondents agreed with a mean score of 3.93 and standard deviation of 1.047.

3.1.2. Involvement in Project Planning Phase

The findings on respondents' perceptions regarding beneficiary involvement in selected rural water supply projects planning phase are presented in Table 2.

Table 2. Perceptions on Beneficiary Involvement in Project Planning Phase.

Items	SD	D	N	A	SA	$\bar{x}$	σ
My household was consulted in determining the design specifications of our water supply project.	29 7.7%	27 7.2%	65 17.2%	178 47.2%	78 20.7%	3.66	1.116
My household played an active role in planning our water supply project timeline and milestones.	31 8.2%	41 10.9%	55 14.6%	167 44.3%	83 22.0%	3.61	1.180
My household was involved in the selection of water sources and technologies for our water supply project implementation.	24 6.4%	24 6.4%	60 15.9%	157 41.1%	112 29.7%	3.82	1.120
Our water supply project design incorporated feedback from my household regarding our needs and preferences.	16 4.2%	27 7.2%	42 11.1%	183 48.5%	109 28.9%	3.91	1.031
My household was included in discussions about the allocation of resources and budget planning for our water supply project.	41 10.9%	35 9.3%	50 13.3%	163 43.3%	88 23.3%	3.59	1.245
Our water supply project planning phase ensured that it met the needs and preferences of my household.	13 3.4%	12 3.2%	31 8.2%	165 43.8%	156 41.4%	4.16	0.953

Source: Primary Data, 2025

From table 2, the analysis indicated that 256 respondents representing 67.9% agreed with the statement that beneficiaries were consulted in determining the design specifications of water supply projects while 56 respondents representing 14.9% disagreed. A total of 65 respondents did not indicate their views. Overall, the respondents agreed with a mean score of 3.66 and standard deviation of 1.116. Those who agreed that beneficiaries played an active role in planning water supply projects' timeline and milestones were 250 respondents representing 66.3%. On the other hand, 72 respondents representing 19.10% disagreed with the statement. A total of 55 respondents representing 14.6% did not indicate their views. Overall, the respondents agreed with a mean score of 3.61 and standard deviation of 1.180. Respondents who agreed that beneficiaries were involved in the selection of water sources and technologies for water supply projects implementation were 269 representing 70.70% while 48 respondents representing 12.82% disagreed. A total of 60 respondents representing 15.9% did not indicate their views. Overall, the respondents agreed with a mean score of 3.82 and standard deviation of 1.120. Regarding whether

water supply projects designs incorporated feedback from beneficiaries regarding their needs and preferences, 292 respondents representing 77.4% agreed while 43 respondents representing 11.4% disagreed. A total of 42 respondents representing 11.1% did not show their views. Overall, the respondents agreed with a mean score of 3.91 and standard deviation of 1.031. Respondents who agreed that beneficiaries were included in discussions about the allocation of resources and budget planning for water supply projects were 251 representing 66.6% while 46 respondents representing 20.2% disagreed. A total of 50 respondents representing 13.3% did not show their views. Overall, the respondents agreed with a mean score of 3.59 and standard deviation of 1.245. Regarding whether the involvement of beneficiaries in water supply projects planning phase ensured that the water supply systems met local needs and preferences, 321 respondents representing 85.2% agreed while 25 respondents representing 6.6% disagreed. A total of 31 respondents representing 8.2% did not show their perceptions. Overall, the respondents agreed with a mean score of 4.16 and standard deviation of 0.953.

3.1.3. Involvement in Project Implementation Phase

The findings on respondents' perceptions regarding bene-

ficiary involvement in selected rural water supply projects implementation phase are presented in Table 3.

Table 3. Perceptions on Beneficiary Involvement in Project Implementation Phase.

Items	SD	D	N	A	SA	$\bar{x}$	σ
My household was consulted regularly throughout our water supply project implementation process to provide feedback and ensure our needs were being met.	36 9.5%	33 8.8%	46 12.2%	183 48.5%	79 21.0%	3.63	1.185
My household was actively involved in monitoring the quality of the work during our water supply project implementation.	26 6.9%	35 9.3%	50 13.3%	182 48.3%	84 22.3%	3.70	1.122
Our water supply project implementation adapted based on suggestions and feedback provided by my household.	18 4.8%	24 6.4%	46 12.2%	194 51.5%	95 25.2%	3.86	1.020
My household played a role in procuring labor and materials during the implementation of our water supply project.	26 6.9%	22 5.8%	39 10.3%	189 50.1%	101 26.8%	3.84	1.097
There was an open communication between our water supply project team and my household during the project implementation phase to discuss progress and expectations.	28 7.4%	31 8.2%	48 12.7%	178 47.2%	92 24.4%	3.73	1.140
My household took part in decision-making related to adjustments or changes during our water supply project implementation phase.	26 6.9%	28 7.4%	55 14.6%	180 47.7%	88 23.3%	3.73	1.108

Source: Primary Data, 2025

From Table 3, the analysis revealed that 262 respondents representing 69.5% agreed with the statement that beneficiaries were consulted regularly through water supply projects implementation process to provide feedback and ensure their needs were being met while 69 respondents representing 18.3% disagreed. A total of 46 respondents did not indicate their views. Overall, the respondents agreed with a mean score of 3.63 and standard deviation of 1.185. Those who agreed that beneficiaries were actively involved in monitoring the quality of the work during water supply projects implementation phase were 266 respondents representing 70.60%. On the other hand, 61 respondents representing 16.2% disagreed with the statement. A total of 50 respondents representing 13.3% did not indicate their views. Overall, the respondents agreed with a mean score of 3.70 and standard deviation of 1.122. Respondents who agreed that water supply projects implementation adapted based on suggestions and feedback provided by beneficiaries were 289 representing 76.70% while 42 respondents representing 11.2% disagreed. A total of 46 respondents representing 12.20% did not indicate their views. Overall, the respondents agreed with a mean score of 3.86 and standard deviation of 1.020. Regarding whether beneficiaries played a role in procuring labor and materials during water supply projects implementation, 290 respondents representing

76.90% agreed while 48 respondents representing 12.7% disagreed. A total of 39 respondents representing 10.3% did not show their views. Overall, the respondents agreed with a mean score of 3.84 and standard deviation of 1.097. Respondents who agreed that there was open communication between water supply projects team and beneficiaries during the implementation phase to discuss progress and expectations were 270 representing 71.6% while 59 respondents representing 15.6% disagreed. A total of 48 respondents representing 12.7% did not show their views. Overall, the respondents agreed with a mean score of 3.73 and standard deviation of 1.140. Regarding whether beneficiaries took part in decision-making related to changes during the implementation phase of water supply projects, 268 respondents representing 71.0% agreed while 54 respondents representing 14.3% disagreed. A total of 55 respondents representing 14.6% did not show their perceptions. Overall, the respondents agreed with a mean score of 3.73 and standard deviation of 1.108.

3.1.4. Involvement in Project Monitoring Phase

The findings on respondents' perceptions regarding beneficiary involvement in selected rural water supply projects monitoring phase are presented in Table 4.

Table 4. Perceptions on Involvement in Project Monitoring Phase.

Items	SD	D	N	A	SA	$\bar{x}$	σ
My household was adequately informed about our water supply project progress through regular monitoring updates.	45 11.9%	30 8.0%	58 15.4%	169 44.8%	75 19.9%	3.53	1.236
My household feedback was actively sought during our water supply project monitoring phase.	25 6.6%	34 9.0%	53 14.1%	169 44.8%	96 25.5%	3.73	1.134
My household believes that his involvement in monitoring helped improve the quality of our water supply project.	20 5.3%	20 5.3%	54 14.3%	193 51.2%	90 23.9%	3.83	1.023
My household was encouraged to participate in identifying and addressing issues during our water supply project monitoring phase.	22 5.8%	14 3.7%	50 13.3%	181 48.0%	110 29.2%	3.91	1.045
Our water supply project team valued and considered my household's input in monitoring activities.	22 5.8%	13 3.4%	58 15.4%	184 48.8%	100 26.5%	3.87	1.033

Source: Primary Data, 2025

From Table 4, the analysis indicated that 244 respondents representing 64.7% agreed with the statement that beneficiaries were adequately informed about water supply projects progress through regular monitoring updates while 75 respondents representing 19.9% disagreed. A total of 58 respondents representing 15.4% did not indicate their views. Overall, the respondents agreed with a mean score of 3.53 and standard deviation of 1.236. Those who agreed that beneficiaries' feedback was actively sought during water supply projects monitoring phase were 265 respondents representing 70.3%. On the other hand, 59 respondents representing 15.6% disagreed with the statement. A total of 53 respondents representing 14.1% did not indicate their views. Overall, the respondents agreed with a mean score of 3.73 and standard deviation of 1.134. Respondents who agreed that beneficiaries believed their involvement in monitoring helped improve the quality of water supply projects were 283 representing 75.1% while 40 respondents representing 10.6% disagreed. A total of 54 respondents representing 14.3% did not indicate their views. Overall, the respondents agreed with a mean score of

3.83 and standard deviation of 1.023. Regarding whether beneficiaries were encouraged to participate in identifying and addressing issues during water supply projects monitoring phase, 291 respondents representing 77.2% agreed while 36 respondents representing 9.5% disagreed. A total of 50 respondents representing 13.3% did not show their views. Overall, the respondents agreed with a mean score of 3.91 and standard deviation of 1.045. Regarding whether water supply projects teams valued and considered beneficiaries' inputs in monitoring activities, 282 respondents representing 75.3% agreed while 35 respondents representing 9.2% disagreed. A total of 58 respondents representing 15.4% did not show their perceptions. Overall, the respondents agreed with a mean score of 3.87 and standard deviation of 9.2.

3.2. Descriptive Analysis of Financial Sustainability

The findings on respondents' perceptions regarding the financial sustainability are presented in Table 5.

Table 5. Perceptions on Financial Sustainability.

Items	SD	D	N	A	SA	$\bar{x}$	σ
My household believes that our water supply project was established with a reliable and sustainable funding mechanism for operation and maintenance.	17 4.5%	19 5.0%	41 10.9%	196 52.0%	104 27.6%	3.93	0.995
My household believes that there is a clear and transparent financial management system in place for our water supply system.	19 5.0%	12 3.2%	38 10.1%	207 54.9%	101 26.8%	3.95	0.975
My household believes that funds for maintaining and upgrading our water supply infrastructure are consistently available to ensure the system's long-term functionality.	13 3.4%	16 4.2%	40 10.6%	209 55.4%	99 26.3%	3.97	0.922

Items	SD	D	N	A	SA	$\bar{x}$	σ
My household believes that our water supply project included a contingency fund to cover unexpected costs related to repairs or emergency maintenance.	20 5.3%	18 4.8%	45 11.9%	196 52.0%	98 26.0%	3.89	1.019
My household believes that our water supply system generates adequate revenue to ensure its continued operation without reliance on external funding.	18 4.8%	22 5.8%	34 9.0%	205 54.4%	98 26.0%	3.91	1.004

Source: Primary Data, 2025

From Table 5, the analysis showed that 300 respondents representing 79.6% agreed with the statement that water supply projects were established with a reliable and sustainable funding mechanism for their operation and maintenance while 36 respondents representing 9.5% disagreed. A total of 41 respondents representing 10.9% did not indicate their views. Overall, the respondents agreed with a mean score of 3.93 and standard deviation of 0.995. Those who agreed that there was a clear and transparent financial management system in place for established water supply systems were 308 respondents representing 81.7%. On the other hand, 31 respondents representing 8.2% disagreed with the statement. A total of 38 respondents representing 10.1% did not indicate their views. Overall, the respondents agreed with a mean score of 3.95 and standard deviation of 0.975. Respondents who agreed that funds for maintaining and upgrading water supply infrastructure were consistently available to ensure the projects' long-term functionality were 308 representing 81.7% while 29 respondents representing 7.6% disagreed. A total of 40 respondents representing 10.6% did not indicate their views. Overall, the re-

spondents agreed with a mean score of 3.97 and standard deviation of 0.922. Regarding whether water supply projects included a contingency fund to cover unexpected costs related to repairs or emergency maintenance, 294 respondents representing 78.0% agreed while 38 respondents representing 10.1% disagreed. A total of 45 respondents representing 11.9% did not show their views. Overall, the respondents agreed with a mean score of 3.89 and standard deviation of 1.019. Respondents who agreed that water supply projects generated adequate revenue to ensure their continued operation without reliance on external funding were 303 representing 80.4% while 40 respondents representing 10.6% disagreed. A total of 34 respondents representing 9.0% did not show their views. Overall, the respondents agreed with a mean score of 3.91 and standard deviation of 1.004.

3.3. Inferential Analysis and Hypothesis Testing

The linear regression analysis output data are presented in Table 6.

Table 6. Effect of Beneficiary Involvement on Financial Sustainability.

Model	Unstandardized Coefficients		Standardized Coefficients		t	Sig.
	B	Std. Error	Beta			
1	(Constant)	1.055	.142		7.448	.000
	IIPINP	.325	.068	.327	4.754	.000
	IIPPP	.120	.080	.126	1.508	.133
	IIPIP	.160	.084	.175	1.912	.057
	IIPMP	.145	.071	.158	2.044	.042
R = .739						
R2 = .545						
Adj R2 = .541						
F = 111.571, sig. = .000						
Predicators:(Constant), IIPINP, IIPPP, IIPIP, IIPMP						
Dependent Variable: Financial Sustainability						

Source: SPSS Regression Output, 2025

Table 6 presents a summary of the regression analysis results examining the influence of beneficiary involvement across the initiation, planning, implementation, and monitoring phases on the financial sustainability of selected rural water supply projects in Rulindo District.

The results revealed that beneficiaries involvement in project initiation phase ($\beta_1 = 0.325$, $t = 4.754$, $p\text{-value} < 0.05$) had positive and significant effect on financial sustainability. The magnitude of the estimated parameter suggests that 1 percent increase in beneficiaries involvement in project initiation phase will lead to 0.325 percent increase in financial sustainability.

On the other hand, beneficiaries involvement in planning phase ($\beta_2 = 0.120$, $t = 1.508$, $p\text{-value} > 0.05$), and implementation phase ($\beta_3 = 0.160$, $t = 1.912$, $p\text{-value} > 0.05$) individually had positive but no significant effect on financial sustainability. This indicates that 1 percent increase in beneficiaries involvement in planning and implementation phases will lead to 0.120, 0.160 percent increase in financial sustainability respectively.

The results continued to indicate that beneficiaries involvement in monitoring phase ($\beta_4 = 0.145$, $t = 2.044$, $p\text{-value} < 0.05$) had also positive and significant effect on financial sustainability. This means that 1 percent increase in beneficiaries involvement in monitoring phase will lead to 0.145 percent increase in financial sustainability. The resulting regression model one (1) from the analysis was given as follows: $FS = 1.055 + 0.325 IIPINP + 0.120 IIPPP + 0.160 IIPIP + 0.145 IIPMP + 0.142$.

The Adjusted R^2 indicated that beneficiaries involvement (involvement in project initiation phase, involvement in project planning phase, involvement in project implementation phase, involvement in project monitoring phase) explained about 54.1% of variance in financial sustainability ($Adj R^2 = 0.541$). While the remaining 45.9% of changes in financial sustainability resulted from other factors that were not captured in the model. The correlation coefficient ($R = 0.739$) shows that there is a strong and positive relationship between beneficiaries involvement variables and financial sustainability. The F-test of 111.571 with $p < 0.05$ is statistically significant which indicated that the variables used in the model (IIPINP, IIPPP, IIPIP, IIPMP) have a goodness of fit and are good predictors of financial sustainability (FS). The results indicated that beneficiaries involvement (involvement in project initiation phase, involvement in project planning phase, involvement in project implementation phase, involvement in project monitoring phase) significantly affects the financial sustainability of selected rural water supply projects in Rulindo District and hence the null hypothesis was rejected.

3.4. Test of Normality of Standardized Residuals

The normality of standardized residuals for the model was assessed using graphical and statistical techniques. The his-

togram displayed an approximately normal distribution with a bell-shaped curve and slight skewness. The normal Q-Q plot confirmed that most residuals followed the diagonal reference line closely, with minimal deviations observed at the ends. Although the Kolmogorov-Smirnov ($D = 0.123$, $p < 0.001$) and Shapiro-Wilk ($W = 0.930$, $p < 0.001$) tests indicated a significant departure from normality, these findings are expected in large samples ($n = 377$) where even minor deviations become statistically significant. Given the visual evidence and the robustness of regression to minor violations of normality, the assumption of normality was considered sufficiently met.

4. Discussion

The findings of this study showed that beneficiary involvement in project initiation and monitoring phases had positive and significant effect on financial sustainability of selected rural water supply projects in Rulindo District. This means that early involvement of beneficiaries in rural water supply projects initiation phase helped establish financial mechanisms through better cost-sharing models, fundraising, and willingness to pay for water service. It also means that active involvement of beneficiaries in monitoring phase helped sustain financial mechanisms by ensuring proper revenue collection and reducing financial mismanagement. These findings collaborate with the findings of the study of [13] who found that involving beneficiaries in the initiation and monitoring phases improved transparency, resulting in more consistent fee collections and reduced reliance on external funding.

Although the planning and implementation phases also showed positive coefficient estimates (0.120 and 0.160 respectively), their effects were found to be statistically non-significant at the 5% level. However, while the study found that the planning and implementation phases had statistically no significant effect on financial sustainability, this finding does not imply that these phases are unimportant for sustainability. Instead, the lack of significance could be attributed to several contextual factors. First, in the selected rural water supply projects in Rulindo District, planning activities were conducted by WASAC, NGO such as Water for People, World Vision and contracted consultant teams with limited community input, resulting in plans that could not reflect local cost realities. Second, implementation was often constrained by budgetary limitations, contractor performance variability, and rigid timelines imposed by donors, all of which could cause misalignment between implementation and long-term financial planning. Moreover, the short-term focus of the implementation phase prioritized physical outputs over financial structures. These factors suggest that while planning and implementation are foundational, their impact on financial sustainability becomes meaningful only when they are inclusive, context-specific, and integrated with

post-construction management strategies.

The findings further demonstrated that beneficiaries involvement significantly enhanced financial sustainability in selected rural water supply projects in Rulindo District. This means that beneficiaries involvement promoted a sense of ownership, increasing their willingness to contribute financially through user fees and other funding mechanisms. Additionally, this involvement ensured financial accountability, transparency, and better management of resources. These findings are in accordance with the findings of the study of [15] who found that community participation across all project phases led to ownership and improved financial sustainability.

The conduct of this study faced several methodological challenges. Firstly, data collection was limited to selected rural water supply projects in Rulindo District, which may not fully represent the diversity of experiences across other districts in Rwanda. This affects the generalizability of the findings to a national context. Secondly, although the study relied on structured questionnaires to collect primary data, some respondents had limited technical knowledge of the full project cycle. This posed a risk of response bias, as some participants may have over- or under-reported their level of involvement or understanding. Thirdly, the study used cross-sectional data, which captures perceptions and effects at a single point in time. This limits the ability to assess how beneficiary involvement and sustainability outcomes evolve over time. A longitudinal design would have provided deeper insights into changes in involvement and sustainability performance. Finally, logistical constraints including access to remote villages and scheduling conflicts with respondents occasionally hindered timely data collection. Despite these limitations, the researcher employed validation techniques and statistical thoroughness to ensure that the results remain credible and useful for policy-making and academic purposes.

Based on the findings and the difference between the 100% expected influence and the Adjusted R² results it is suggested to future researchers to investigate other variables that may affect the financial sustainability of rural water supply projects beyond beneficiary involvement, such as external funding mechanisms, tariff policies, and local government support.

5. Conclusions and Recommendation

5.1. Conclusion

The findings of the study indicate that the involvement of beneficiaries significantly influences the financial sustainability of selected rural water supply projects in Rulindo District. Specifically, involvement in the project initiation and monitoring phases demonstrated a positive and statistically significant effect on financial sustainability, while involvement in planning and implementation phases showed positive but statistically no significant effects. The regression model accounted for 54.1% of the variance in financial sustainability (Adj-R² = 0.541), with a strong positive correlation

($R = 0.739$) and a statistically significant F-test ($F = 111.571$, $p < 0.05$), confirming the model's overall fit. The remaining 45.9% are explained by other factors that were not considered (tariff policy, technical design, external subsidies...) in the model. These results affirm that active and meaningful involvement of beneficiaries, especially during the initiation and monitoring stages of a rural water supply project, is crucial for enhancing its financial sustainability.

5.2. Recommendation

Based on the study findings, it is recommended to involve beneficiaries in all phases of rural water supply projects via structured community involvement strategies such as water user committees, participatory rural appraisal, community contracting, stakeholder workshops and consultations, training and capacity building programs, community monitoring and reporting systems and inclusion of women and marginalized groups. Even though the initiation and monitoring phases showed a statistically significant impact on financial sustainability, involving beneficiaries in planning and implementation remains essential for fostering a sense of ownership, transparency, and accountability. To enrich findings, it is recommended that future studies incorporate interviews or focus group discussions to provide deeper insight into beneficiaries' experiences and perceptions.

Abbreviations

USA	United States of America
UK	United Kingdom
EU	European Union
EAC	East African Community
WASH	Water Sanitation and Hygiene
SPSS	Statistical Package for the Social Sciences
WASAC	Water and Sanitation Corporation
NGO	Non-governmental Organizations

Author Contributions

Fils James Shyaka: Conceptualization, Data curation, Formal Analysis, Funding acquisition, Investigation, Methodology, Resources, Software, Writing - original draft

Jean Claude Karekezi: Project administration, Supervision, Validation, Visualization, Writing - review & editing

Data Availability Statement

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Conflicts of Interest

The authors declare no conflicts of interest.

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Biography



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