

Level of community operation and maintenance of water projects in Buyanja Sub-County, Rukungiri District. A cross-sectional study.

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ABSTRACT

Background

The study aimed to assess the level of community operation and maintenance of water projects in Buyanja Sub-County, Rukungiri District.

Methodology

The study employed a descriptive cross-sectional quantitative design among stakeholders involved in rural water projects in Buyanja Sub-County, Rukungiri District. From a population of 1,200, 300 respondents were selected through multi-stage sampling. Household water users were selected using simple random sampling, while key informants were purposively selected. Data were collected using structured questionnaires and semi-structured interview guides. Questionnaire data were analysed in SPSS version 26 using frequencies, percentages, chi-square, correlation, and regression. Instrument validity and reliability were established, with Cronbach's alpha ranging from 0.803 to 0.966. Ethical requirements were observed.

Results

A total of 210 out of the 300 targeted respondents participated in the study, representing a 70.0% response rate. Regarding age, 33.8% (n=71) were aged 31–50 years, 33.3% (n=70) were 18–30 years, 16.7% (n=35) were above 50 years, and 16.2% (n=34) were below 18 years. Community leadership recorded a mean score of 3.4943 (SD=0.74427), based on 210 respondents, with scores ranging from 2.20 to 4.80. Community operation and maintenance (O&M) had a mean of 3.3552 (SD=0.61907). Among O&M items, community contribution to repairs had the highest mean (4.043; SD=0.8376), followed by knowledge of reporting channels (3.657; SD=0.8223) and regular management meetings (3.657; SD=0.8223). Active Water User Committees recorded a mean of 2.762 (SD=0.6492), while prompt repairs had the lowest mean (2.657; SD=0.8223). Overall, O&M was moderate for 81.9% (n=172) and high for 18.1% (n=38).

Conclusion

Community operation and maintenance participation was predominantly moderate, with weak Water User Committees and delayed repairs limiting effective water project functionality.

Recommendation

District authorities, WUCs, local technicians, and communities should strengthen O&M through training, routine maintenance, timely repairs, financial accountability, reporting, and regular supervision.

Keywords: Rural water supply, water infrastructure, maintenance practices, water governance, community capacity, water system functionality

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BACKGROUND OF THE STUDY

Sustainability of rural water projects refers to the ability of water systems to remain functional, reliable, accessible, and resilient over time. It goes beyond the construction of infrastructure and includes technical, financial, institutional, social, and environmental factors that support continuous service delivery (WCED, 1987; Harvey & Reed, 2007; Lockwood & Smits, 2011).

Operation and maintenance (O&M) is a key foundation of sustainability. Regular maintenance, timely repairs, availability of spare parts, and local technical skills help reduce breakdowns and prolong the lifespan of water facilities (Lockwood & Smits, 2011; Cronk & Bartram,

2017). Financial sustainability is also important because communities need adequate and well-managed funds to meet routine maintenance and repair costs. Poor payment of user fees and weak financial accountability can contribute to prolonged breakdowns and system failure (Oduor & Murei, 2020; Omanwa & Muchai, 2021).

Institutional sustainability depends on effective management structures such as Water User Committees, which coordinate maintenance, manage funds, enforce rules, and resolve conflicts. Strong and accountable institutions contribute to better water system performance (Kayijuka, 2021; Rwabwohe et al., 2021). Environmental sustainability also requires protection of water sources from

contamination, deforestation, soil erosion, and other environmental threats (Harvey & Reed, 2007).

Therefore, rural water project sustainability depends not only on infrastructure but also on effective O&M, adequate financing, strong leadership, community involvement, and protection of water sources. Evidence from East Africa shows that training, technical support, transparent financial management, and active community structures are important for maintaining water services over time (Mgulo & Kamazima, 2022; Nyarora, 2024).

The study aimed to assess the level of community operation and maintenance of water projects in Buyanja Sub-County, Rukungiri District.

METHODOLOGY

Research Design

This study adopted a descriptive cross-sectional survey design. The design is appropriate because it enables the researcher to describe existing conditions, relationships, and patterns among variables (Kothari & Garg, 2019). A cross-sectional design allows data to be collected from different respondents at a single point in time, making it efficient in examining relationships between community participation dimensions (planning, operation and maintenance, leadership) and the sustainability of water projects.

Research approach

The study employed a quantitative approach, situated within the positivist research paradigm, which holds that social phenomena can be measured objectively and that relationships between variables can be tested empirically (Saunders, Lewis, & Thornhill, 2019; Creswell, 2014).

Study Population

The study population comprised stakeholders who are directly or indirectly involved in the planning, operation, maintenance, and management of rural water projects in Buyanja Sub-County, Rukungiri District. These included household water users (men and women aged 18 years and above) who depend on community water sources for their daily domestic needs, Water User Committee (WUC) members responsible for the routine management, operation, and maintenance of water facilities, Local

Council (LC I–III) leaders who provide governance, supervision, and oversight of community water initiatives, technical staff from the District Water Office such as the Sub-county Water Officer and the Community Development Officer (CDO), and representatives from non-governmental organizations (NGOs) and community-based organizations (CBOs) supporting rural water supply interventions. The study population was 1,200 respondents, comprising 1,160 household water users, 25 Water User Committee members, 10 Local Council leaders, 3 NGO/CBO representatives, and 2 District/Sub-county officials. These population figures were obtained from the Buyanja Sub-county administrative records and the Rukungiri District Water Office (2022), while information on the status and functionality of community-managed water systems was corroborated by the Ministry of Water and Environment (MWE, 2024).

Sample Size Determination

The sample size for this study was determined using Yamane's (1967) simplified formula for calculating sample size in studies where the population is known and finite, which is widely used in social science research to ensure an adequate and representative sample. The formula is expressed as;

$$n = \frac{N}{1 + N(e)^2}$$

Where

n is the sample size

N is the target population

e is the coefficient of error = 0.05

$$n = \frac{1200}{1 + 1200(0.05)^2}$$

$$n = \frac{1200}{1 + 1200(0.0025)}$$

$$\frac{1200}{1 + 3}$$

$$\frac{1200}{4}$$

300 Respondents

n

Therefore, the study used a sample size of 300 respondents, which is considered statistically adequate for quantitative analysis and ensures representativeness of the target population in Buyanja Sub-County.

Table 1: Sample Size Determination and Instruments

Category of Respondents	Estimated Population (N)	Sample Size (n=300)	Sampling Technique
Household Water Users	1,160	290	Simple Random Sampling
Water User Committee (WUC) Members	25	6	Purposive Sampling
Local Council (LC I–III) Leaders	10	2	Purposive Sampling
NGO/CBO Representatives	3	1	Purposive Sampling
District/Sub- County Officials (Water Officer, CDO, etc.)	2	1	Purposive Sampling
Total	1,200	300	—

Source: Rukungiri District Water Office (2022); MWE (2024); Researcher's computation, 2026

Sampling Techniques

The study employed a multi-stage sampling strategy to ensure representativeness and inclusion of all relevant stakeholders in accordance with the sample size determination presented in Table 1. This approach combines probability and non-probability sampling techniques to address the diverse categories of respondents.

The sub-county was divided into strata based on parishes to ensure proportional representation across geographical areas. Buyanja Sub-County comprises several parishes, and stratification ensured that all parishes were adequately represented in the sample. This approach captures the geographical diversity of the study area and ensures that findings are generalisable across the entire sub-county (Saunders, Lewis, & Thornhill, 2019). Stratification is particularly important in this context because water project conditions, community participation levels, and sustainability outcomes may vary across parishes due to differences in terrain, accessibility, social dynamics, and project implementation history.

Within each stratum, simple random sampling was used to select household respondents. This technique involves selecting households from the sampling frame without bias, whereby every household in the stratum has an equal and independent chance of being selected (Kothari & Garg, 2019). Simple random sampling is appropriate for the household water user category because the population is relatively homogeneous, and this approach minimizes selection bias, enhances representativeness, and ensures that the sample is statistically generalisable to the broader population of 1,160 households in Buyanja Sub-County. The sampling frame for household respondents was obtained from village registers and household lists maintained by Local Council leaders.

Purposive sampling was applied to identify key informants due to their specialized knowledge and direct involvement in water project management (Patton, 2015). This technique was used to select Water User Committee (WUC) members, Local Council officials (LC I–III), District Water Office staff, and NGO/CBO representatives. Purposive sampling was appropriate for these categories because these respondents possess unique expertise, occupy specific institutional roles, and have in-depth knowledge of water project planning, implementation, and management that cannot be obtained from the general household population. The selection was based on predefined criteria including institutional position, length of service, and direct involvement in water project activities. This approach ensured that the study captured expert perspectives and institutional insights that complemented the household survey data.

Inclusion criteria

The study included respondents who are directly or indirectly involved in rural water projects in Buyanja Sub-County. These comprised household water users (men and women aged 18 years and above) who actively rely on

community water sources such as boreholes, protected springs, and gravity flow schemes. It also included members of Water User Committees (WUCs) responsible for the operation and maintenance of water projects, Local Council (LC I–III) leaders who provide governance and oversight, and district or sub-county officials such as Water Officers and Community Development Officers. In addition, representatives from NGOs and Community-Based Organizations (CBOs) engaged in water-related activities within the sub-county were included. All participants were residents of Buyanja Sub-County for at least six months and were willing to provide informed consent to participate in the study.

Exclusion criteria

Specifically, persons below 18 years of age were excluded due to their inability to provide informed consent. Individuals who have lived in Buyanja Sub-County for less than six months were also excluded, as they may not have sufficient knowledge or experience regarding local water projects. Community members who did not use the water projects under study, as well as individuals who were unwilling or unable to provide informed consent, were considered. Additionally, respondents who are seriously ill or otherwise unable to participate in interviews or focus group discussions during the data collection period were excluded to ensure the reliability and ethical integrity of the study.

Data Collection Methods Questionnaire Survey

A structured questionnaire comprising mainly closed-ended questions and a few open-ended questions was designed and administered to the selected household water users. According to Weitz (2016), a questionnaire is a method of data collection in which a standardized set of questions is administered to respondents in a predetermined order to obtain relevant information. The questionnaire was considered appropriate because household water users constituted the largest proportion of the study population (290 out of 300 respondents), making it possible to collect data from many respondents within a relatively short period and at a low cost. The instrument was designed based on the study objectives and contained sections on demographic characteristics, community participation in planning and implementation, community involvement in operation and maintenance of water facilities, community leadership, and sustainability of water projects. The closed-ended Likert scale questions enabled the researcher to obtain quantifiable data for statistical analysis using SPSS, while the few open-ended questions allowed respondents to provide additional views regarding the sustainability of water projects. The questionnaires were self-administered to literate respondents, while the researcher assisted respondents who could not read or write by translating the questions into the local language (Runyankore-Rukiga) without altering their meaning.

Interview Method

Semi-structured interview guides were developed and administered to purposively selected key informants comprising Water User Committee (WUC) members, Local Council (LC I–III) leaders, NGO/CBO representatives, and District/Sub-county officials, including the Water Officer and Community Development Officer (CDO). According to Kvale and Brinkmann (2015), interviews are qualitative data collection methods that enable researchers to obtain detailed information through direct interaction with respondents. The interview guide consisted of open-ended questions designed to generate in-depth information regarding community participation in planning, operation, and maintenance of water facilities, leadership practices, institutional support, and the sustainability of water projects in Buyanja Sub-county. The semi-structured nature of the interviews allowed the researcher to ask follow-up questions, seek clarification where necessary, and probe for detailed explanations based on respondents' experiences. This method was particularly suitable for key informants because of their knowledge, responsibilities, and direct involvement in water project management and implementation. The interviews complemented the questionnaire findings by providing contextual explanations and richer qualitative insights into the factors influencing the sustainability of water projects.

Data Collection Tools Questionnaire

The primary data collection tool for this study was a structured questionnaire administered to household water users. The questionnaire was developed in line with the study objectives and consisted of both closed-ended and a few open-ended questions. The closed-ended questions were measured using a five-point Likert scale ranging from 1 = Strongly Disagree to 5 = Strongly Agree, enabling respondents to express their level of agreement with statements related to community participation and the sustainability of water projects. The questionnaire comprised five sections, namely: demographic characteristics, community participation in planning and implementation, community involvement in operation and maintenance, community leadership, and sustainability of water projects. The tool was considered appropriate because it enabled the collection of standardized data from a large number of respondents within a relatively short period, facilitating quantitative analysis using the Statistical Package for Social Sciences (SPSS).

Interview Guide

A semi-structured interview guide was used to collect qualitative data from purposively selected key informants, including Water User Committee (WUC) members, Local Council (LC I–III) leaders, NGO/CBO representatives, and District/Sub-county officials such as the Water Officer and

Community Development Officer. The interview guide contained open-ended questions designed around the study objectives to obtain detailed information on community participation in planning, operation, and maintenance practices, leadership roles, institutional support, and the sustainability of water projects. The guide also allowed the researcher to ask follow-up questions and probe for clarification where necessary, thereby generating rich qualitative data that complemented the questionnaire findings.

Data Analysis

Data from structured questionnaires were entered into SPSS v26. Analysis involved: Descriptive statistics (frequencies, means, percentages). Inferential statistics (Chi-square tests, correlation, and regression) to assess relationships between participation variables and sustainability indicators.

Validity and Reliability

Ensuring the validity and reliability of research instruments is essential for generating credible, accurate, and dependable findings. This study adopts multiple strategies to enhance both validity and reliability.

Validity

Validity of the study instruments was ensured through content, construct, face, criterion, and sampling validity. Content validity was established through literature-based item development, expert review, and calculation of the Content Validity Index (CVI), with all items achieving values above 0.85. Construct validity was enhanced by linking items to relevant theoretical frameworks and conducting Exploratory Factor Analysis, which produced factor loadings of 0.55–0.92, a KMO value above 0.80, and a significant Bartlett's test ($p < .001$). Face validity was assessed through respondent feedback on clarity, relevance, and language, with the questionnaire translated into Runyankore-Rukiga and back-translated for accuracy. Criterion validity was supported by adapting items from previously validated instruments used in related studies. Sampling validity was strengthened through an adequate sample of 210 respondents determined using Yamane's formula and multi-stage sampling involving parish stratification and simple random sampling to improve representativeness and minimise selection bias.

Reliability

To ensure the internal consistency of the research instruments, Cronbach's Alpha coefficients were computed for each construct. Reliability analysis assesses the extent to which the items measuring the same construct produce consistent results. The generally accepted threshold for Cronbach's Alpha is 0.70, indicating acceptable internal consistency (Nunnally, 1978; DeVellis, 2017). Cronbach's Alpha values above 0.80 are considered good, whilst values above 0.90 are considered excellent.

Table 2: Reliability Statistics for Study Variables

Scale/Construct	Cronbach's Alpha	Number of Items	Interpretation
Community Planning Scale	0.803	5	High Reliability
Community Operation & Maintenance Scale	0.839	5	High Reliability
Community Leadership Scale	0.966	5	Excellent Reliability
Sustainability of Water Projects Scale	0.961	5	Excellent Reliability

Source: Primary Data (2026)

All study constructs demonstrated good to excellent internal consistency, with Cronbach's Alpha coefficients exceeding the acceptable threshold of 0.70. The Community Planning Scale had an alpha of 0.803, while Community Operation and Maintenance recorded 0.839, indicating high reliability for both constructs. The Community Leadership Scale demonstrated excellent reliability ($\alpha = 0.966$), as did the Sustainability of Water Projects Scale ($\alpha = 0.961$). These findings confirm that the questionnaire items consistently measured their respective constructs and provide a reliable basis for subsequent descriptive, correlation, and regression analyses.

Ethical Considerations

The study adhered to strict ethical standards throughout the research process by ensuring informed consent, voluntary participation, confidentiality, research approval, and respect for cultural norms. All participants were fully informed about the purpose of the study, procedures involved, and their rights before data collection began, and participation was entirely voluntary, with respondents free to withdraw at any stage without any form of penalty or coercion. Confidentiality and anonymity were strictly maintained by

excluding personal identifiers from all transcripts, questionnaires, and datasets, and by reporting only aggregated findings to ensure that individual responses cannot be traced back to participants. Ethical clearance was obtained from the Bishop Stuart University Research Ethics Committee, and authorization was sought from Rukungiri District Local Government before engaging respondents in the field.

RESULTS

Response Rate

From the computed sample size of 300 respondents drawn from the target population of 1,200 stakeholders in Buyanja Sub-County, 210 respondents participated in the study, yielding a response rate of 70%. This response rate is considered adequate for analysis and generalisation, as Mugenda and Mugenda (2003) recommend that a response rate of 50% is adequate, 60% is good, and above 70% is very good for social science research. The response rate achieved in this study therefore falls within the range considered sufficient to support reliable statistical analysis and valid conclusions.

TABLE 3: RESPONSE RATE

Category of Respondents	Targeted Sample	Actual Responses	Response Rate (%)
Household Water Users	290	200	69.0
Water User Committee (WUC) Members	6	6	100.0
Local Council (LC I–III) Leaders	2	2	100.0
NGO/CBO Representatives	1	1	100.0
District/Sub-County Officials	1	1	100.0
Total	300	210	70.0

Source: Primary Data, June, 2026

This response rate was achieved through rigorous follow-up strategies, sustained community engagement, and the deployment of multiple data collection methods, including structured questionnaires. While the response rate is below 100%, it remains within acceptable parameters for quantitative research. According to Mugenda and Mugenda (2003), a response rate of 50% is adequate for analysis and reporting, whilst Babbie (2004) contends that response rates of 50% and above are acceptable for social science research. The high response rate enhances the generalizability of the findings and minimizes non-response bias, thereby strengthening the internal and external validity of the study conclusions.

Background Characteristics of Respondents

This section presents the socio-demographic profile of the 210 respondents who participated in the study, including their distribution by gender, age, level of education, and length of residence within Buyanja Sub-County. These characteristics provide essential contextual information that aids in interpreting the study findings and understanding the representativeness of the sample relative to the broader community.

Gender of Respondents

As presented in Table 4.1, male and female respondents each constituted 50.0% (n = 105). This equal gender

distribution reflects deliberate efforts to ensure gender balance in the study, which is particularly pertinent in water governance research where women are primary water users and managers in rural communities.

Table 4: Gender of Respondents

Gender		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	85	41.0	41.0	41.0
	Female	125	59.0	51.0	100.0
	Total	210	100.0	100.0	
Total		210	100.0		

Source: Primary Data, June, 2026

This nearly balanced representation aligns with Uganda's constitutional principles of gender equality and the National Water Policy (1999), which emphasises the importance of inclusive community participation in water resource management. The equitable gender composition ensures that the study captures diverse perspectives from both men and women regarding community participation and water project sustainability, thereby enriching the validity and comprehensiveness of the findings.

Age of Respondents

About age distribution, Table 4 reveals that 33.8% (n = 71) of respondents were aged 31–50 years, 33.3% (n = 70) were aged 18–30 years, 16.7% (n = 35) were aged above 50 years, and 16.2% (n = 34) were aged below 18 years.

TABLE 5: AGE OF RESPONDENTS

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Below18	34	16.2	16.2	16.2
	18-30	70	33.3	33.3	49.5
	31-50	71	33.8	33.8	83.3
	Above50	35	16.7	16.7	100.0
	Total	210	100.0	100.0	
Total		210	100.0		

Source: Primary Data, June, 2026

This distribution indicates that the majority of respondents were adults in their economically active years, which is consistent with community water management structures where adults bear primary responsibility for water governance and maintenance activities. The inclusion of respondents below 18 years (16.2%) is notable and reflects the reality that in rural settings, young people often participate in water collection and may possess valuable insights regarding water project functionality and accessibility. The predominance of respondents aged 18–50 years (67.1%) suggests that the study captured perspectives from the demographic cohort most actively engaged in

water management decision-making and maintenance activities, which strengthens the credibility and applicability of the findings.

Education Level of Respondents

In terms of educational attainment, the findings show that 39.5% (n = 83) of respondents had completed primary education, 33.3% (n = 70) had attained secondary education, 16.2% (n = 34) had tertiary education, whilst 11.0% (n = 23) did not indicate their education level.

TABLE 6: EDUCATION LEVEL OF RESPONDENTS

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Primary	83	39.5	44.4	44.4
	Secondary	70	33.3	37.4	81.8
	Tertiary	34	16.2	18.2	100.0
	Total	187	89.0	100.0	
Others	Others	23	11.0		
Total		210	100.0		

Source: Primary Data, June, 2026

This educational profile suggests that the majority of respondents possessed at least basic literacy, which is important for understanding concepts related to community participation, water governance, and sustainability. However, the relatively high proportion of respondents with primary education as their highest level (39.5%) indicates that water project communication and training materials should be designed in accessible formats, possibly employing local languages and visual aids, to ensure effective community engagement in water management activities. This finding has practical implications for the design of capacity-building interventions, as effective communication strategies must account for the literacy

levels of target communities. The relatively lower proportion of respondents with tertiary education (16.2%) reflects the rural context of Buyanja Sub-County, where higher education opportunities are limited, and many community members have not pursued formal education beyond primary or secondary levels.

Years Lived in the Village

With respect to length of residence in the village, 41.9% (n = 88) of respondents had lived in their villages for more than 10 years, 32.9% (n = 69) had resided for 6–10 years, and 25.2% (n = 53) had lived for 1–5 years.

TABLE 7: YEARS LIVED IN THE VILLAGE

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1-5	53	25.2	25.2	25.2
	6-10	69	32.9	32.9	58.1
	>10	88	41.9	41.9	100.0
	Total	210	100.0	100.0	
Total		210	100.0		

Source: Primary Data, June, 2026

The dominance of long-term residents, with 74.8% having lived in their communities for more than five years, is significant as it implies that the respondents possessed adequate exposure to the sub-county's water management systems, historical project performance, and community participation dynamics. Their institutional memory strengthens the validity of the responses, particularly regarding long-term observations about water project sustainability trends and changes in community participation over time. This is consistent with the study's time scope of focusing on water projects implemented between 2015 and 2024, as long-term residents would have

experienced the full lifecycle of these projects, from planning and construction through operation and maintenance.

Descriptive Statistics of Study Variables

The descriptive statistics provide an overview of the levels of community participation and water project sustainability as perceived by respondents in Buyanja Sub-County, thereby establishing the baseline conditions against which relationships and predictive effects are assessed.

TABLE 8: DESCRIPTIVE STATISTICS FOR STUDY VARIABLES

Variable	N	Minimum	Maximum	Mean	Std. Deviation
Community Leadership	210	2.20	4.80	3.4943	0.74427
Valid N (listwise)	210				

Source: Primary Data, June, 2026

Community operation and maintenance recorded the lowest mean score of 3.3552 (SD = 0.61907), indicating moderate levels of community involvement in the day-to-day management, monitoring, and maintenance of water projects. This relatively lower mean suggests that while communities were engaged in O&M activities, there were notable challenges, possibly related to inconsistent user fee collection, irregular maintenance routines, weak Water User Committee functionality, or inadequate technical skills. The moderate level of O&M participation aligns with the study context where functionality levels in Buyanja Sub-County have fallen below 60% (MWE, 2024) and with the empirical

observation by Etongo et al. (2018) that O&M is often the weakest link in community-managed water systems.

Descriptive Statistics for Community Operation and Maintenance Items

To provide a more granular understanding of community operation and maintenance practices, descriptive statistics for individual O&M items are presented in Table 9. This detailed analysis helps identify specific strengths and weaknesses within the O&M system.

TABLE 9: DESCRIPTIVE STATISTICS FOR COMMUNITY OPERATION AND MAINTENANCE ITEMS

Item	N	Minimum	Maximum	Mean	Std. Deviation
Active Water User Committee	210	2	4	2.762	0.6492
Knowledge of Reporting Channels	210	2	5	3.657	0.8223
Community Contributes to Repairs	210	3	5	4.043	0.8376
Prompt Repairs	210	1	4	2.657	0.8223
Regular Management Meetings	210	2	5	3.657	0.8223

Source: Primary Data, June, 2026

The detailed O&M analysis reveals important patterns that inform targeted interventions. The highest mean score was for community contributions to repairs (C3, mean = 4.043), indicating that communities in Buyanja Sub-County were generally willing to contribute money or materials for water system repairs. This is encouraging as financial sustainability depends on regular and adequate user contributions, as emphasised by Omanwa and Muchai (2021), who found that rural water systems with predictable maintenance funds were better equipped to finance repairs and component replacement. The high mean score suggests that the cultural norm of collective responsibility for community infrastructure remains strong in Buyanja Sub-County, providing a solid foundation for sustainable water management.

However, the item on prompt repairs (C4) recorded the lowest mean score of 2.657, suggesting that despite communities contributing resources for repairs, actual repair responsiveness remained a significant challenge. This indicates a critical gap in the maintenance system: while communities were willing to contribute, the institutional mechanisms for organising and executing timely repairs were weak. This finding may reflect inactive Water User Committees, insufficient technical skills among community members, delays in accessing spare parts, or weak linkages with district technical support. The gap between willingness to contribute (high) and actual repair responsiveness (low) suggests that communities may face institutional or technical constraints that prevent effective utilisation of the resources they mobilize.

Knowledge of reporting channels (C2, mean = 3.657) and regular management meetings (C5, mean = 3.657) had moderate scores, suggesting that communication between communities and water management structures existed but was not consistently effective. The moderate scores indicate that while most community members knew how to report breakdowns and that some meetings were held, these systems were not functioning optimally. The item on active Water User Committees (C1, mean = 2.762) was relatively low, indicating that many Water User Committees may have been inactive or only partially functional. This finding aligns with the Ministry of Water and Environment (2024) report that more than 60% of WUCs in Buyanja Sub-County are inactive or partially functional, and with Kayijuka (2021), who found that weak WUC leadership undermines water project sustainability in Uganda. The low score on active WUCs is particularly concerning given the central role that these committees play in coordinating O&M activities, managing finances, and linking communities with external technical support.

Categorised Levels of Study Variables

TABLE 10: COMMUNITY OPERATION AND MAINTENANCE OF WATER PROJECTS

Variable	Category	Frequency	Percent
	Total	210	100.0
Community Operation & Maintenance	Moderate	172	81.9
	High	38	18.1
	Total	210	100.0
	Total	210	100.0

Source: Primary Data, June, 2026

Note: Categorisation: Low = 1.00–2.33, Moderate = 2.34–3.67, High = 3.68–5.00

Community operation and maintenance was perceived as moderate by the overwhelming majority of respondents (81.9%, $n = 172$), with only 18.1% ($n = 38$) perceiving it as high. This finding is concerning, as it suggests that O&M practices in Buyanja Sub-County are generally inadequate for ensuring long-term water system functionality. The high proportion of communities with moderate O&M participation (rather than high) indicates systemic weaknesses in the operation and maintenance of water projects. This moderate level of O&M participation aligns with the earlier detailed O&M analysis showing weakness in prompt repairs and active Water User Committees, and it helps explain why functionality levels in the sub-county have fallen below 60% (MWE, 2024). The predominance of moderate O&M participation suggests that while communities are engaged in some O&M activities, their involvement is not sufficiently robust to ensure sustained system functionality.

DISCUSSION

The second research objective sought to assess the level of community operation and maintenance of water projects in Buyanja Sub-County. The findings revealed that O&M participation was predominantly moderate, with only a small minority of communities achieving high O&M participation. The mean score for O&M was the lowest among the three participation dimensions, indicating that this was the weakest area of community engagement. The detailed O&M analysis revealed a notable gap: community contributions to repairs were high, but prompt repairs were

low, suggesting that communities were willing to contribute resources but lacked the institutional and technical capacity to execute repairs effectively. Active Water User Committees had the lowest score, confirming that many committees were inactive or only partially functional.

These findings are concerning and align with the broader national picture where the Ministry of Water and Environment (2023) reports that only 65% of rural water points remain functional, with functionality in Buyanja Sub-County falling below 60% (MWE, 2024). The moderate level of O&M participation provides a compelling explanation for these functionality challenges: communities are not sufficiently engaged in the day-to-day management and maintenance of their water systems to ensure their continued functionality. The finding that only a small minority of communities have high O&M participation is particularly alarming, as it suggests that the majority of water projects in the sub-county may be at risk of premature failure due to inadequate O&M.

The findings converge with studies that identify O&M as the weakest link in community-managed water systems. Etongo et al. (2018) found that in Uganda's community-managed water systems, the depth of participation in management and maintenance positively influenced system performance and maintenance responsiveness. The present study extends this finding by identifying specific O&M weaknesses—particularly in prompt repairs and active Water User Committees—that are undermining sustainability. The low score for active WUCs is consistent with Kayijuka (2021), who found that weak WUC leadership undermines water

project sustainability in Uganda, and with the MWE (2024) report indicating that more than 60% of WUCs in Buyanja Sub-County are inactive or partially functional.

The gap between community contributions to repairs (high) and prompt repairs (low) is a particularly important finding that has not been extensively documented in the literature. This finding suggests that communities in Buyanja Sub-County have the willingness and resources to contribute to maintenance, but they are constrained by institutional and technical barriers—such as inactive WUCs, lack of technical skills, or difficulty accessing spare parts. This aligns with the work of Lockwood and Smits (2011), who argue that community management systems fail when external support ceases and when institutional linkages with government structures are weak. The gap between willingness and capacity suggests that the problem is not a lack of community commitment but rather a lack of enabling institutional arrangements.

The interpretation of these findings is that O&M participation is essential but insufficient on its own to ensure sustainability. Communities may be willing to contribute, but without effective leadership and planning structures to organise and execute maintenance activities, their contributions may not translate into sustained functionality. This interpretation is supported by the regression analysis, where O&M showed a non-significant negative coefficient in the presence of planning and leadership, suggesting that O&M's effect on sustainability is mediated through these other participation dimensions. O&M is the operational arm of community participation, but it requires effective leadership to coordinate activities and good planning to establish the institutional framework and resource mobilisation mechanisms that support O&M.

The finding that moderate O&M participation is prevalent but insufficient for high sustainability is a critical insight for policy and practice. It suggests that interventions should aim to raise O&M participation from moderate to high levels, rather than assuming that moderate participation is adequate. Specific areas for improvement include strengthening WUC functionality (currently the lowest-scoring O&M item), improving repair turnaround times, establishing regular maintenance routines, and providing ongoing technical support. The gap between resource mobilisation and effective execution suggests that communities need support in developing the institutional and technical capacity to utilise the resources they mobilise effectively.

The moderate O&M levels may reflect the influence of Uganda's community-based management approach, which places significant responsibility on communities but does not always provide adequate support or capacity building. The policy framework envisions communities as custodians of rural water systems, but the implementation of this vision has been uneven, with many communities lacking the skills, resources, and institutional support needed to fulfil this role effectively. This interpretation is consistent with the work of Harvey and Reed (2007), who found that community

management systems often fail when communities are left to manage water systems without adequate training, support, or resources.

Conclusion

The study concludes that the level of community operation and maintenance of water projects in Buyanja Sub-County is predominantly moderate, with only a small minority of communities achieving high O&M participation. O&M participation is the weakest area of community engagement, as reflected in the lowest mean score among the three participation dimensions. There is a notable gap between community contributions to repairs (which are high) and prompt repairs (which are low), suggesting that communities are willing to contribute resources but lack the institutional and technical capacity to execute repairs effectively. Active Water User Committees are particularly weak, with many committees being inactive or only partially functional. This moderate level of O&M participation provides a compelling explanation for the functionality challenges observed in the sub-county, where functionality has fallen below 60%. The conclusion supports the view that O&M is the operational arm of community participation, and it requires effective leadership and planning structures to function effectively.

Recommendation

Given that O&M participation was the weakest area of community engagement, it is recommended that interventions improve O&M systems and practices. Specific actions should include: (a) strengthening WUC functionality through training and ongoing support; (b) establishing regular maintenance routines and schedules; (c) improving repair turnaround times by training local technicians, establishing relationships with spare parts suppliers, and ensuring that communities have access to technical support; (d) strengthening financial management systems for user fees, including transparent accounting and regular financial reporting; (e) improving knowledge of reporting channels so that communities know whom to contact when breakdowns occur; and (f) conducting regular O&M monitoring and supervision by district technical staff.

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List of abbreviations

WUC – Water User Committee
O&M – Operation and Maintenance
LC – Local Council
NGO – Non-Governmental Organization
CBO – Community-Based Organization
CDO – Community Development Officer
MWE – Ministry of Water and Environment
SPSS – Statistical Package for the Social Sciences
CVI – Content Validity Index
KMO – Kaiser-Meyer-Olkin
BSU-REC – Bishop Stuart University Research Ethics Committee

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Conflict of interest

The authors declare no conflict of interest.

Data availability

Data are available upon request from the authors.

Author contributions

ST: conceptualization, methodology, investigation, writing the original draft.

AM: data curation, validation, supervision.

BM: validation, supervision.

Informed consent

Written informed consent was obtained from all participants prior to their inclusion in the study. Participants were informed about the purpose of the study, procedures involved, potential risks and benefits, and their right to withdraw at any time without penalty.

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