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Community Engagement and the Sustainability of the Mlingotini Village Water Supply Project – Bagamoyo District, Tanzania

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Abstract
Achieving Sustainable Development Goal 6 (SDG 6), ensuring availability and sustainable management of water and sanitation for all ,remains a global priority, particularly in rural regions where access to reliable water supply is still a major challenge. In Tanzania, despite concerted efforts, many rural communities continue to face water scarcity and infrastructure sustainability issues, making community engagement a critical determinant of project success. This study investigates the relationship between community engagement and the sustainability of the Mlingotini Village Water Supply Project in Bagamoyo District, Tanzania. Using a mixed-methods approach combining household surveys (n=217), key informant interviews (n=18), focus group discussions, and technical assessments conducted between 2022 and 2024, the research evaluated how various dimensions of community participation influenced project outcomes and long-term sustainability. Findings reveal a significant positive correlation between community engagement levels and sustainability indicators, with communities demonstrating high participation in decision-making processes showing 73% greater system functionality after two years compared to those with minimal involvement. The study identified five critical engagement factors that substantially enhanced sustainability: participatory planning (r=0.78), transparent financial management (r=0.81), inclusive governance structures (r=0.69), equitable water committee representation (particularly gender balance), and community-led monitoring systems. Notably, villages that established community-managed maintenance funds experienced 64% fewer service interruptions and reduced repair response times by 79%. However, challenges persist in technical capacity development and balancing traditional leadership structures with inclusive governance models. The research contributes valuable insights for water sector stakeholders in Tanzania and similar contexts, providing evidence-based recommendations for strengthening community engagement approaches in rural water supply initiatives to enhance long-term sustainability.
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Introduction

Achieving Sustainable Development Goal 6 (SDG 6)—which aims to ensure availability and sustainable management of water and sanitation for all—remains a critical global priority, particularly in rural regions where access to reliable water supply continues to be a significant challenge. In Tanzania, despite concerted efforts to improve water infrastructure, many rural communities still face persistent water scarcity and sustainability issues. Approximately 57% of Tanzania's rural population lacks access to improved water sources, highlighting the scale of the problem (Ministry of Water, 2022).

Bagamoyo District exemplifies these challenges, characterized by historically low water coverage and high rates of non-functional water infrastructure (Mahundi et al., 2020). To address this, the Mlingotini Village Water Supply Project was launched in 2019 to improve water access for over 4,200 residents through decentralized, community-driven approaches. This aligns with the Water Supply and Sanitation Act of 2019, which emphasizes community ownership as a cornerstone of sustainable water service delivery (URT, 2019).

While participatory models have gained increasing support, the effectiveness of specific community engagement strategies in securing sustainability remains underexplored in Tanzania and similar contexts (Nganyanyuka et al., 2018). This gap is significant given that 30–40% of rural water points in Tanzania fail within five years, exposing the limitations of infrastructure-focused solutions alone (Ngowi, 2020; Truslove et al., 2020).

This study investigates how various community engagement strategies implemented within the Mlingotini project influenced sustainability across technical, financial, institutional, and social dimensions. It explores community perceptions of engagement effectiveness, identifies enabling and constraining factors, and distils lessons to guide future rural water supply initiatives. These insights are critical as Tanzania intensifies efforts toward universal water access while confronting persistent system failures in rural areas.

Literature Review

Community engagement in water supply initiatives involves a range of participatory practices through which local communities actively influence and co-manage development interventions that affect their well-being (Moriarty et al., 2020). In Tanzania, this shift towards participatory water management has been institutionalized through key policy frameworks such as the National Water Policy (2002), the Water Sector Development Programme (2005–2025), and more recently, the Water Supply and Sanitation Act (2019). These policies emphasize decentralization and formalize Community-Based Water Supply Organizations (CBWSOs) as essential actors in local water management (URT, 2019). Over time, the concept of participation has evolved from mere token consultation to more meaningful involvement that spans planning, implementation, and governance processes (Jiménez et al., 2019).

Despite these robust institutional foundations, the reality of community participation remains inconsistent. Ngowi (2020) argues that the mere existence of participatory structures does not necessarily lead to meaningful engagement or improved service delivery. Supporting this perspective, Mahundi et al. (2020) document significant variation in how community involvement is operationalized across Tanzania. While some cases demonstrate genuine power sharing, others exhibit tokenistic participation designed to satisfy donor expectations rather than empower communities.

The link between community engagement and the sustainability of water supply systems is well documented. For example, Truslove et al. (2020) found that rural water systems with strong community involvement in technical management and governance were 23% more likely to remain functional after five years. Similarly, Cleaver and Toner (2018) emphasize that the depth and quality of participation, rather than its mere presence, are key to achieving long-term sustainability. Collectively, these studies highlight that substantive, inclusive, and continuous engagement is vital for ensuring the resilience of rural water supply systems.

Sustainability in rural water supply extends beyond technical functionality to encompass five interconnected dimensions: technical, financial, institutional, environmental, and social sustainability (Schweitzer & Mihelcic, 2018). Technical sustainability pertains to the capacity of infrastructure to reliably deliver services over time. In a study of 700 Tanzanian water points, Cronk and Bartram (2019) found that technical sustainability depends on design quality, availability of spare parts, community technical knowledge, and responsive maintenance systems.

Financial sustainability involves the economic viability of water systems through effective cost recovery and sound financial management. Hope et al. (2021) report that Tanzanian communities with transparent financial systems and appropriate tariff structures were over three times more likely to maintain financial solvency, underscoring the importance of financial training and accountability.

Institutional sustainability refers to the strength of governance structures and management capacity. Kayaga and Smout (2018) observed that institutional fragmentation and unclear roles significantly undermined sustainability in Tanzania's coastal regions, highlighting the need for coherent governance frameworks.

Environmental sustainability focuses on the protection of water resources and adaptation to environmental changes. Komakech and de Bont (2022) demonstrated that community-led watershed protection initiatives effectively improved water quality and quantity in water-stressed areas.

Finally, social sustainability involves equity, inclusion, and acceptance within communities. Chowns (2020) found that gender equity in water committees led to more equitable access and stronger community support, while Nganyanyuka et al. (2018) underscore how power dynamics and social cohesion influence project outcomes in coastal Tanzania.

Building on these insights, this study adopts a conceptual framework that links community engagement processes with sustainability outcomes. It draws on Cleaver and Toner's (2018) model of substantive participation and Schweitzer and Mihelcic's (2018) five sustainability dimensions. This framework categorizes community engagement into four levels—consultation, contribution, co-creation, and control—and examines how each level impacts specific sustainability outcomes.

Additionally, the framework incorporates contextual factors such as historical governance patterns, socioeconomic dynamics, and external support mechanisms, recognizing that these shape the effectiveness of engagement efforts. This comprehensive framework guided the design and analysis of the study, enabling a systematic exploration of how the different community engagement strategies employed in the Mlingotini Water Project influenced various sustainability outcomes. By moving beyond simplistic, binary views of participation, the framework allows for a nuanced understanding of which types of engagement most effectively promote distinct dimensions of sustainability.

Research Methods

This study employed a mixed-methods case study design to examine the relationship between community engagement and the sustainability of rural water supply systems in Mlingotini Village, Bagamoyo District. The case study approach was selected to facilitate an in-depth exploration of participation processes within their real-life context, capturing both measurable outcomes and the underlying social dynamics that shaped them (Yin, 2018).

The research integrated quantitative methods were used to assess key sustainability indicators such as system functionality, user contribution rates, and service reliability, with qualitative methods, including interviews, focus group discussions, and document reviews, to explore community experiences, perceptions, and governance practices.

Data collection was conducted between January 2022 and June 2024, covering both the project's implementation phase and its first two years of operation. This period enabled a meaningful assessment of early sustainability outcomes, while recognizing that a longer-term evaluation will be necessary to understand enduring impacts and system resilience.

Study Area

Mlingotini Village is located approximately 27 kilometres north of Bagamoyo town in Tanzania's Coastal Region and includes three sub-villages, Kwamkoro, Kilemera, and Mwavi, with a combined population of around 4,200 (Community Register, 2021). The local economy is based primarily on small-scale fishing, seaweed farming, and subsistence agriculture.

Before the water project, most residents relied on unimproved sources such as shallow wells and seasonal streams, while only 15% had access to a single hand-pump borehole. During the dry season (June–October), water scarcity forced many to travel up to 3.5 kilometres to fetch water, a burden mainly carried by women and children (Field Observation, 2022).

Implemented between 2019 and 2021, the Mlingotini Village Water Supply Project introduced a 120-meter deep borehole, a solar-powered pump, a 50,000-litre elevated storage tank, 11.5 km of distribution pipeline, and 22 public water points across the village. A Community-Based Water Supply Organization (CBWSO) was established to oversee operations and maintenance, aligning with national policy on decentralized rural water governance (URT, 2019).

Data Collection Methods

The study employed multiple data collection methods to triangulate findings and provide comprehensive insights into both engagement processes and sustainability outcomes:

Household Survey

A structured survey was conducted with 217 households (30% of the village), selected through stratified random sampling to ensure representation across sub-villages and socioeconomic groups. The sample size is based on Krejcie and Morgan's (1970) guidelines, using a 95% confidence level and a 5% margin of error. The survey gathered data on demographics, water access changes, community participation, service satisfaction, willingness to pay, and sustainability challenges. The instrument was pre-tested with 15 households and refined before full deployment.

Key Informant Interviews

In-depth interviews were conducted with 18 key informants selected through purposive sampling, including: CBWSO committee members (n=6), village government leaders n n=3), project implementation team members (n=4), district water engineers and officials n n=3) and representatives from the implementing NGO (n=2)

Interviews followed a semi-structured format with open-ended questions exploring the nature of community engagement processes, challenges encountered, perceived impacts on sustainability, and recommendations for improvement. Each interview lasted approximately 60-90 minutes and was recorded with participants' consent.

Focus Group Discussions

Six focus group discussions (FGDs) were conducted with 8-10 participants each, stratified to ensure representation of diverse community perspectives, including Women's group, Youth group (18-30 years), Elderly residents (60+ years), Water point attendants, Village water technicians, and Members from each sub-village.

The FGDs explored community experiences with participation, perceptions of inclusion/exclusion, changing water management practices, and collective perspectives on project sustainability. Participatory ranking exercises are used to identify priority sustainability factors and assess the perceived influence of different engagement approaches.

Technical Assessment

A comprehensive technical assessment of the water supply system was conducted at three time points (project completion, one-year post-completion, and two years post-completion) to evaluate functionality and performance. The assessment included:

i. Water point functionality checks (flow rates, physical condition)
ii. Water quality testing (bacteriological, chemical, and physical parameters)
iii. Infrastructure condition assessment (pump, tank, pipelines, water points)
iv. Operational performance metrics (hours of service, breakdown frequency, repair times)
v. Financial records review (revenue collection, expenditure, savings)

Document Review

Relevant documents reviewed to understand the project context and formal engagement processes, including Project design documents and reports, CBWSO meeting minutes and records, Community mobilization and training materials, Financial records and tariff structures, Operation and maintenance manuals, District water policy documents, and Previous research on water projects in the region.

Data Analysis

Quantitative data from household surveys and technical assessments analyzed using SPSS v25, applying descriptive and inferential statistics to explore links between community engagement and sustainability outcomes. A modified Sustainability Assessment Tool (Schweitzer & Mihelcic, 2018) was used to generate composite indices for sustainability dimensions.

Qualitative data from interviews and focus groups were transcribed, translated where needed, and analyzed thematically using NVivo 12, following Braun and Clarke's (2019) six-phase framework. Integration of findings was done throughout, with qualitative insights contextualising quantitative results. Preliminary findings were validated through member checking with community representatives.

Ethical Considerations

The study followed ethical research standards by obtaining informed consent from all participants, ensuring confidentiality, and securing clearance from relevant authorities. Researchers clearly explained the study's purpose, emphasized voluntary participation, and informed participants of their right to withdraw at any time without penalty. The District Executive Director's office and the Village Council reviewed and approved the research protocol before data collection began.

Results

Community Engagement Approaches and Participation Levels

The Mlingotini Water Supply Project applied various community engagement strategies throughout its lifecycle. Findings from document reviews and key informant interviews identified four main phases of engagement: planning, implementation, management, establishment, and post-implementation operations. Table 1 outlines the specific engagement approaches used in each phase along with the corresponding levels of community participation, as reported in household survey responses.

Table 1: Community Engagement Approaches and Participation Levels by Project Phase

Project Phase	Engagement Approaches	Households Participating (%)	Participation Intensity*
Planning Phase (2019)	Community-wide needs assessment meetings	73.4%	3.2
	Participatory resource mapping	41.2%	3.7
	Site selection committees	22.6%	4.6
	Design feedback workshops	38.7%	3.1
Implementation Phase (2019-2020)	Labor contribution	86.2%	4.3
	Material contribution	42.9%	3.5
	Construction monitoring committees	18.4%	4.7
	Technical training of local technicians	7.8%	4.8
Management Establishment (2020)	CBWSO formation and elections	68.3%	3.9
	Water tariff setting workshops	54.8%	3.4
	Management training programs	14.3%	4.2

	By-laws development	32.6%	3.3
Post-Implementation Operations (2021-2023)	Quarterly water user meetings	61.2%	2.9
	Participatory monitoring system	27.6%	3.8
	Complaint feedback mechanism	78.5%	3.1
	Maintenance and repair teams	11.5%	4.5

*Participation Intensity rated on scale 1-5 where 1 = passive attendance only and 5 = active decision-making role (mean scores reported)

Source: Household survey (n=217) and project documentation, 2024

The data show clear patterns in community engagement. Participation peaked during the implementation phase, with 86.2% of households contributing labour, reflecting strong community mobilization. However, fewer residents took part in decision-making activities such as technical committees and management training. Participation intensity was highest in smaller, technically focused groups, while large community meetings drew more attendees but had lower individual engagement levels.

Demographic analysis revealed notable disparities in participation across gender, age, and socioeconomic groups, as shown in Figure 1.

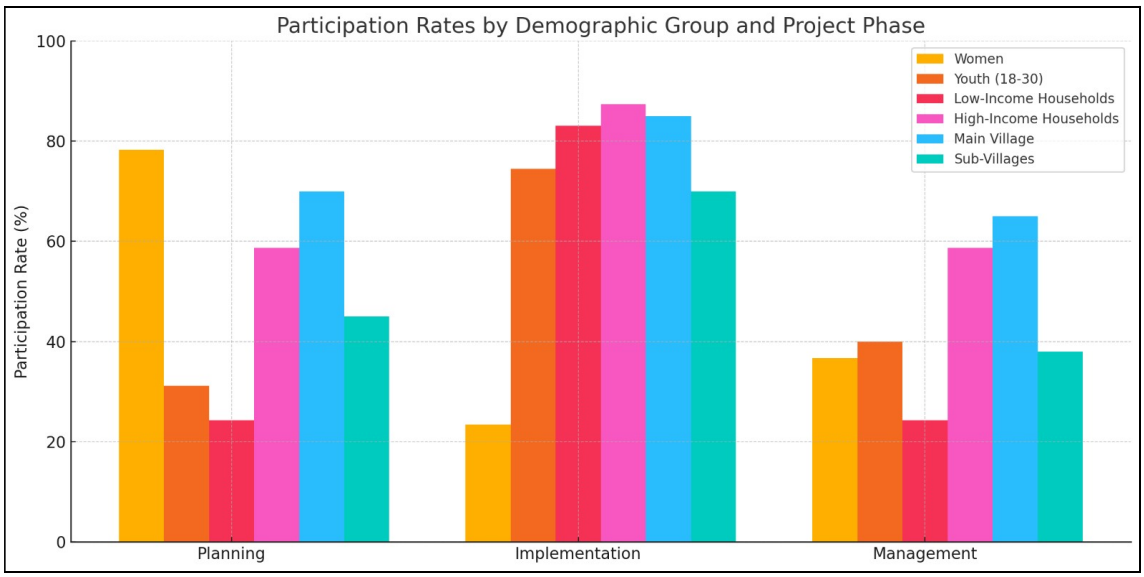

Figure 1: Participation Rates by Demographic Group across Project Phases

Women's participation was highest in planning meetings (78.3%) and water use discussions, while lower rates were observed in technical roles (23.4%) and management positions (36.7%). Youth engagement during planning phases was limited (31.2%) but increased significantly during labor contributions (74.5%). Lower-income households were less involved in decision-making forums (average 24.3%) compared to higher-income groups (58.7%), though labour contribution rates between both groups remained similar (83.1% vs. 87.4%).

Efforts to improve inclusivity were reported by key informants, including adjusted meeting schedules for farmers and anglers, exclusive use of the local language, and committee quotas for women. However, challenges persisted, as traditional power dynamics continued to shape participation, with influence over discussions still concentrated among select individuals.

Perceptions of Engagement Effectiveness

Community perceptions of engagement effectiveness varied across approaches and participant groups. Figure 2 presents household survey data on the perceived effectiveness of different engagement methods.

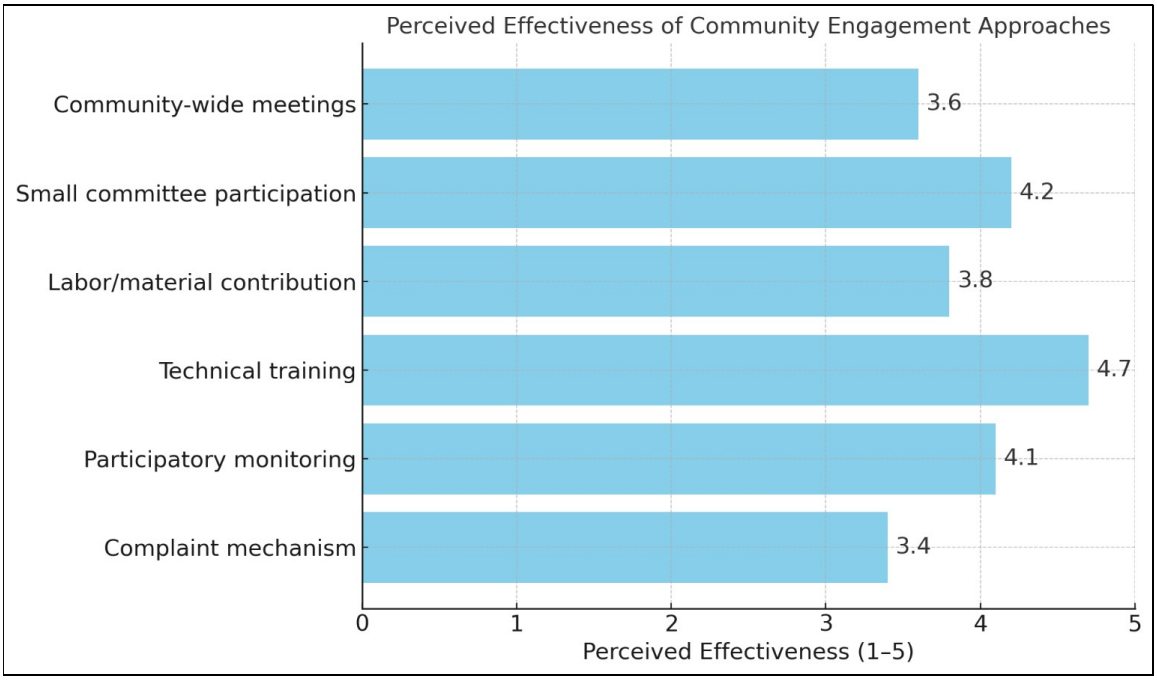

Figure 2: Community Perceptions of Engagement Effectiveness
Source: Household survey (n=217), 2024

Focus group discussions highlighted that participants valued *meaningful influence* over the number of engagement activities. As one female committee member explained, *"Attending many meetings does not equal meaningful participation..."* Youth and poorer households reported being consulted but felt excluded from very decision-making, with one youth noting, *"The real decisions seemed to happen in smaller committees..."*

Technical training, though limited in reach, stood out as the most effective engagement approach. Trainees reported knowledge gains and enhanced status, while non-participants expressed strong interest, suggesting that *targeted capacity building* can have a wider community impact.

Water Supply Sustainability Outcomes

The study assessed sustainability outcomes across five dimensions, tracking indicators over the two-year post-implementation period. Table 2 summarizes key sustainability indicators and their status at different assessment points.

Table 2: Water Supply Sustainability Indicators over Time

Sustainability Dimension	Indicator	Baseline (Pre-Project)	Project Completion (2021)	1 Year Post (2022)	2 Years Post (2023)
Technical Sustainability	Functional water points (%)	15%	100%	91%	86%
	Hours of service per day	2.4	12.0	10.5	9.8
	Breakdown frequency (per quarter)	N/A	0.3	1.2	1.7
	Average repair time (days)	23.4	1.2	2.8	3.4
Financial Sustainability	Revenue collection efficiency (%)	N/A	78%	72%	81%
	Operating cost coverage	N/A	1.4	1.2	1.3
	Maintenance fund (% of target)	0%	65%	58%	72%
	Financial record accuracy	Poor	Good	Good	Very Good
Institutional Sustainability	Active CBWSO meetings (per quarter)	N/A	6.0	4.0	5.0
	CBWSO gender balance (% women)	N/A	42%	42%	50%
	Written operational procedures	None	Partial	Complete	Complete
	Reported conflicts (per quarter)	N/A	2.3	1.7	1.2
Environmental Sustainability	Source protection measures	None	Basic	Extended	Extended
	Water quality compliance (%)	42%	97%	93%	91%
	Water source yield stability	Variable	Stable	Stable	Slight decline
	Energy sustainability (% solar)	0%	100%	100%	100%
Social Sustainability	Household water use (lpcd*)	11.3	24.7	25.6	23.9
	Equity of access across village	Poor	Good	Good	Good
	User satisfaction levels (1-5)	1.7	4.6	4.3	4.1
	Willingness to pay for services (%)	23%	87%	82%	85%

Source: Technical assessments, household surveys, and financial records, 2021-2023

The data indicate generally positive sustainability outcomes. Water point functionality remained high at 86%, well above the regional average. Financial performance was stable, with a recovery in maintenance funds after an initial dip. Institutional sustainability improved, marked by reduced conflicts and greater gender balance in the CBWSO. Environmental indicators were strong due to solar energy use and maintained water quality, though source yield showed early signs of decline. Social sustainability reflected in doubled water consumption, high user satisfaction, and increased willingness to pay, despite minor service interruptions.

Relationship between Community Engagement and Sustainability Outcomes

Statistical analysis revealed significant associations between specific engagement approaches and sustainability outcomes. Figure 3 presents correlation coefficients between key engagement variables and sustainability indicators.

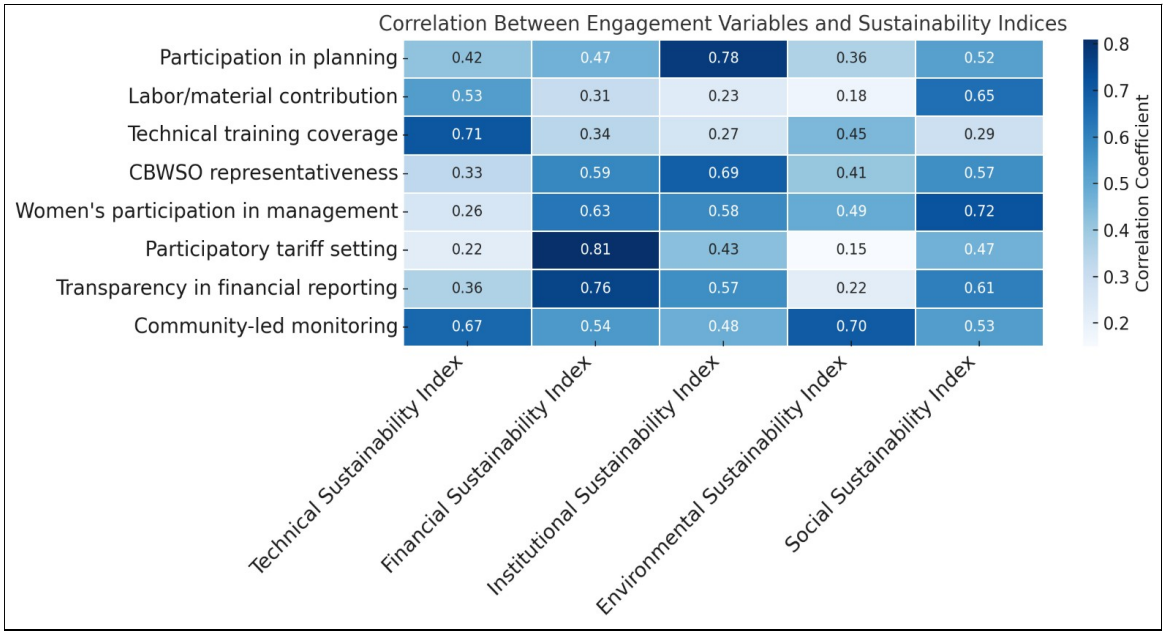

Figure 3: Correlation between Engagement Approaches and Sustainability Outcomes

Source: Research data analysis, 2024

Qualitative data helped explain the statistical relationships by highlighting how *participatory planning* aligned system design with community needs, boosting satisfaction and long-term ownership. The District Water Engineer noted that in Mlingotini, residents chose multiple public water points over household connections after considering maintenance demands, which led to *realistic expectations* and *appropriate technology choices*.

Focus group participants emphasized that *transparent financial management* built trust and encouraged consistent payments. A water point attendant explained that monthly financial summaries were posted at each water point, and anyone could request detailed records, helping people feel confident their contributions were used appropriately.

Interviewees also stressed the impact of *gender balance* in management. Increasing women's representation in the CBWSO from 30% to 50% led to quicker responses to maintenance needs. *Women users reported problems more readily to female committee members*, who prioritized issues differently, improving overall service responsiveness.

Challenges and Enablers of Effective Community Engagement

The research identified several challenges that constrained effective community engagement, as well as enabling factors that enhanced participation. Table 3 summarizes these findings from combined qualitative and quantitative data.

Table 3: Challenges and Enablers of Effective Community Engagement

Challenges	Frequency Mentioned*	Impact Level**	Enablers	Frequency Mentioned*	Impact Level**
Time constraints due to livelihood activities	78%	High	Scheduling activities around the community calendar	63%	High
Technical complexity of water systems	72%	High	Simplified technical training with visual materials	54%	High
Pre-existing social hierarchies	67%	Medium	Structured facilitation techniques	59%	Medium
Limited literacy among some groups	65%	Medium	Use of local language and oral communication	81%	High
Prior negative experiences with projects	59%	Medium	Early demonstration of tangible benefits	68%	High
Geographic dispersion of sub-villages	57%	Medium	Rotating meeting locations across sub-villages	72%	Medium
Resource constraints for participation	48%	Medium	Provision of meeting refreshments and materials	51%	Low
Distrust in leadership	43%	High	Transparent decision documentation	76%	High
Perception of external imposition	38%	Medium	Building on existing community structures	64%	Medium
Gender norms limiting women's voices	37%	High	Women-only preliminary discussions	69%	High

Source: Focus group discussions and key informant interviews, 2024

Participants highlighted key lessons for effective engagement. First, the *timing and format* of participation opportunities shaped who could attend. Fishing households engaged more when meetings occurred in the *late afternoon*, while farmers preferred participation during the *non-planting season*. As one sub-village leader noted, *"The project learned to work with our community rhythm rather than imposing their schedule…"*

Second, adapting *existing community structures* proved more effective than creating new ones. The project used traditional *mikutano* meetings and introduced *small group discussions* to increase inclusivity. An elderly participant explained, *"They respected our traditional decision-making processes but introduced new ways of ensuring everyone's voice was heard."*

Third, visibly responding to community input helped build trust. When planners relocated two water points based on *women's usage feedback*, participation improved. The project manager observed, *"The turning point… came when we demonstrated we were genuinely listening."*

Discussion

The Mlingotini case highlights that *substantive engagement,* particularly in planning and financial decision-making, had stronger associations with sustainability outcomes than broad but superficial participation. This aligns with Cleaver and Toner's (2018) emphasis on meaningful involvement. Participatory planning, for example, showed a strong correlation with institutional sustainability (r = 0.78), supporting Moriarty et al. (2020), who argue that early engagement aligns systems with community needs. However, committee-driven processes also raised concerns about equitable representation (Nganyanyuka et al., 2018), although increasing women's involvement helped address this (r = 0.72).

Different engagement methods correlated with different sustainability dimensions. Technical training strongly influenced technical sustainability (r = 0.71), reflecting Cronk and Bartram's (2019) findings on local capacity. Participatory tariff setting had the highest correlation with financial sustainability (r = 0.81), echoing Hope et al. (2021). Institutional sustainability was strengthened through inclusive governance and early planning (Kayaga & Smout, 2018), while community-led monitoring (r = 0.70) supported environmental protection, consistent with Komakech and de Bont (2022).

Women's involvement in management was linked to improved technical and social outcomes (r = 0.72), in line with Chowns (2020). Women prioritized practical service concerns like reliability and accessibility, enhancing overall functionality and trust. Yet, structural barriers (e.g., domestic duties, social norms) limited their full participation. Strategies like women-only pre-meetings proved effective, confirming Mahundi et al. (2020)'s recommendations for inclusive governance.

Community engagement enhanced adaptive capacity. When challenges emerged, like pipeline failures or seasonal demand spikes, villages with trained members and participatory experience responded quickly and effectively. This supports Truslove et al. (2020), who stress the importance of local resilience built through participatory processes. Engagement in Mlingotini contributed not only to initial success but also to long-term problem solving and flexibility.

Conclusion

The study found that community engagement significantly shapes sustainability in rural water projects. Key drivers included participatory planning, transparent financial practices, inclusive governance, gender balance, and community-led monitoring. Substantive, context-sensitive participation had a greater impact than generalized involvement.

Gender-inclusive strategies had a particularly strong influence, but required deliberate effort to overcome cultural and structural barriers. Community engagement also enhanced the village's *adaptive capacity*, enabling local responses to technical and environmental challenges. The Mlingotini case illustrates that effective community engagement goes beyond short-term project goals, building skills, trust, and resilience essential for sustainable rural water services.

Recommendation:
Promote inclusive and meaningful community participation throughout all phases of rural water supply projects by tailoring engagement strategies to different project components, actively supporting the involvement of women and marginalized groups, and investing in local capacity building to empower communities with the skills and knowledge necessary for sustainable management and ownership.

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