

The Influence of Internal Governance Practices on the Sustainability of Community-based Water Supply Projects in Arumeru District, Tanzania

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Abstract

This paper examines the factors influencing the sustainability of community-based water supply (CBWS) projects in Arumeru District, Tanzania. A cross-sectional research design was employed to assess the contributions of CBWS organizations to project sustainability. Out of the 30 CBWS projects, 19 serving at least 25 households with piped water connections were purposively selected, and 399 household heads were randomly sampled for participation in the study. The data were generated through surveys conducted between December 2024 and March 2025, and analysed using descriptive statistics, Chi-square tests, and binary logistic regression. The findings suggest that the efficiency of internal governance mechanisms plays a crucial role in enhancing the sustainability of CBWS projects. In particular, effective conflict management, well-functioning reporting systems, and stakeholder participation in setting water tariffs were positively associated with improved sustainability outcomes. The results underscore the critical importance of strengthening participatory governance practices, particularly in conflict resolution, performance reporting, and inclusive decision-making on water tariffs. These results contribute to policy and practice aimed at enhancing the resilience and sustainability of rural water supply projects in Tanzania.

Keywords: *governance practices, sustainability, community-based, water supply, projects.*

1. Introduction

Ensuring the sustainability of water supply projects remains central in safeguarding public health and sustaining livelihoods worldwide. Despite sustained global investments in water infrastructure, approximately one in three people still lack safe drinking water (WHO, 2019). Therefore, a persistent gap exists between infrastructure provision and long-term service functionality. Across many low- and middle-income countries, water supply systems frequently deteriorate, operate intermittently, or collapse entirely due to weak institutional capacity, inadequate financing, and governance deficiencies (Water Aid Tanzania, 2009; WHO, 2011; Eliamringi & Kazumba, 2017; Kilonzo & George,

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2017; Nti et al., 2019; Alam, 2022). These challenges are particularly acute in Sub-Saharan Africa (SSA), and parts of Latin America, where systemic constraints continue to undermine sustainable water resource management (Water Aid Tanzania, 2009; Machado et al., 2019; Nti et al., 2019). In SSA, approximately 36% of water supply schemes are non-functional (WHO, 2011); while only about 66% of rural hand pumps remain operational (World Bank, 2017, 2018). Tanzania reflects similar concerns: over 30% of rural water supply points are reportedly non-functional; and nearly one-quarter of newly installed schemes fail within two years of construction (URT, 2002; 2020).

Recognizing the governance dimensions of water sustainability, international policy discourse has progressively emphasized community-based management approaches. For instance, the International Conference on Water and the Environment (Dublin, 1992) underscored water as a finite resource requiring participatory and decentralized management (Mugumya, 2013; Kabogo et al., 2017). Subsequent global platforms—including the International Conference on Freshwater (2001) and the World Water Forums (2000, 2003)—further institutionalized the role of community organizations in promoting sustainable water supply systems (GWP, 2012). These global commitments have influenced national reforms aimed at decentralizing water governance, and enhancing local accountability.

Moreover, water sector reforms in Tanzania have progressively transferred management responsibilities to community-level organizations through policy and legal frameworks, including the National Water Policy (2002) and subsequent water supply and sanitation legislations (URT, 2002, 2019a, 2020). These reforms sought to enhance efficiency, accountability, and continuity of service delivery by empowering community-based institutions. Various organizational forms have subsequently emerged, including water user associations, village water committees, and community-owned water supply organisations (COWSOs) (Fierro et al., 2017; Anselm, 2022; Luvinga, 2025). However, the coexistence of multiple entities with overlapping mandates has often generated coordination challenges, duplication of roles, and weak institutional clarity (Mwendamseke, 2016; Fierro et al., 2017; Mahoo, Simukanga & Kashaga, 2018). Moreover, limited technical, financial, and managerial capacity have constrained the effectiveness of these organizations, contributing to persistent functionality problems (ADB, 2016; Katomero et al., 2017).

Despite decentralization efforts, challenges related to coverage gaps, water source depletion, and system non-functionality, persist. Rural water service continuity remains limited, and the number of non-functional water points has increased substantially in recent years (Stephano, 2016; URT, 2020). Empirical studies consistently attribute these sustainability failures to weak

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community participation, inadequate monitoring and coordination mechanisms, and insufficient financial and technical capacities within local management structures (Fierro et al., 2017; Katomero et al., 2017; Kilonzo & George, 2017; Mahoo, Simukanga & Kashaga, 2018; Martinsen, 2018; Anselmi, 2021).

In response to these challenges, Tanzania introduced a revised community management framework in 2019 through the establishment of community-based water supply organizations (CBWSOs), under the Water Supply and Sanitation Act No. 5 of 2019. This reform aimed to address the shortcomings observed in earlier community-based arrangements by clarifying mandates, strengthening legal authority, and enhancing institutional oversight (URT, 2019a; 2019b; 2020). CBWSOs were granted formal powers to own and manage water infrastructure, set tariffs, enforce compliance, and collaborate with stakeholders. Supported by the Rural Water Supply Agency (RUWASA), the number of registered CBWSOs has increased substantially, reflecting renewed institutional commitment to community-based governance (URT, 2020).

However, despite these structural reforms, limited empirical attention has been devoted to examining how CBWSOs' internal governance practices influence the sustainability of community-based water supply projects (CBWSPs). In particular, evidence remains scarce regarding whether strengthened legal mandates and institutional restructuring have translated into improved functionality and long-term service outcomes. This study, therefore, investigates the influence of CBWSOs' internal governance practices on the sustainability of water supply projects in Arumeru District, Arusha Region, Tanzania.

2. Context and Methods

This section describes the methodology used in the study. It describes the study area and its contexts, followed by the research design, sample and sampling methods, data collection, and analysis techniques.

2.1 Study Area

The data for this paper were derived from a broader study conducted in Arumeru District, Arusha Region, Tanzania, with a specific focus on community-based water supply projects (CBWSPs). Although the initial intention was to include all 30 CBWSPs operating within the district, preliminary field assessment revealed that several projects did not have active household water connections. Consequently, the analysis was restricted to 19 CBWSPs that provided piped water to at least 25 households. This selection criterion was consistent with the study's household-based sampling frame, and ensured the availability of eligible respondents, particularly heads of households.

The Arumeru District is characterized by semi-arid conditions and ecologically sensitive terrestrial ecosystems. The local economy is predominantly based on agriculture and livestock keeping—livelihood activities that, while vital for socio-economic wellbeing, contribute to environmental degradation and heightened climate-related vulnerabilities. These environmental pressures intensify stress on water resources, and increase the risk of water insecurity (Allegretti & Greene, 2022). Water infrastructure and settlement patterns in the district are largely concentrated along the slopes of Mount Meru, the principal source of domestic water supply. This geographic dependence heightens exposure to climate-related risks, including droughts, flooding, and rising temperatures: all of which are driven by both local land-use practices and broader global environmental changes. Moreover, Arumeru holds strategic importance for regional water security, as the Mount Meru catchment supports major water supply schemes serving Arusha City, and neighbouring districts such as Monduli.

2.2 Research Design, Sampling and Sample Size

This study employed a cross-sectional research design, which enabled a one-time assessment of the sustainability of CBWSPs in Arumeru District. A cross-sectional study design was appropriate for this study in the collection of quantitative data from the sampled population at a single point in time. This design enabled the study to collect enough data in a timely manner, which was useful in explaining the influence of CBWSO practices on the sustainability of water supply projects in the Arumeru district. A purposive sampling technique was initially used to select 19 out of 30 CBWSPs in the area, focusing exclusively on projects with at least 25 households that had piped water connections. From these selected CBWSPs, household heads were randomly chosen from the households served by the projects. A proportionate sampling approach was used to determine the number of respondents from each of the selected CBWSPs, based on the number of households with piped water connections within each project. Finally, simple random sampling was employed to select household heads from the identified households in each CBWSP.

According to records obtained at the RUWASA office in Arumeru district, the total population of household beneficiaries from the CBWSPs in Arumeru district was 7690 (RUWASA-Arumeru, 2024). Since the population of water user households was known, a simplified formula for estimation of a sample size for a known population, as provided by Israel (2012), was used to estimate the sample size, as shown in equation (1).

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

Where, n is the sample size; N is the population size (7690); and E is the desired precision rate, which is 0.05 (5%) for this study.

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From equation (1) and the data above, the sample size was estimated as follows:

$$n = \frac{7690}{1 + 7690 (0.05)(0.05)} = 381$$

Accordingly, a total of 399 respondents were surveyed during data collection, exceeding the minimum threshold; and ensuring sufficient representation for statistical analysis.

2.3 Data Collection

The data were collected between December 2024 and March 2025 from 19 purposively selected community-based water supply projects operating under the supervision of the Rural Water Supply and Sanitation Agency (RUWASA) in Arumeru District. The quantitative data were collected using a structured questionnaire administered via a survey. Prior to the main data collection, the questionnaire was pretested to confirm its clarity and relevance; and then administered to 399 household heads. This quantitative survey design supports systematic measurement and comparison across households. Notwithstanding this, however, the results should be interpreted as statistical associations based on self-reported responses, and may not fully capture the contextual explanations that a qualitative inquiry can provide.

2.4 Data Analysis

The collected data were analysed quantitatively using descriptive statistics, Chi-square tests of association, and binary logistic regression. Descriptive statistics were employed to summarize the key characteristics of the respondents and study variables, including frequencies and percentages. The Chi-square test was used to examine the association between internal governance practices of CBWSOs and the sustainability status of CBWSPs. This step identified governance variables that were statistically significant in their association with project sustainability.

Subsequently, a binary logistic regression was employed to assess the predictive influence of internal governance practices on the likelihood of CBWSP sustainability. Logistic regression is appropriate when the dependent variable is dichotomous and allows estimation of the probability of an outcome given multiple explanatory variables (Abonazel & Ibrahim, 2018). In this paper, the model was used to evaluate how variations in governance practices affect the odds of CBWSP sustainability in Arumeru District. The binary logistic regression model is specified as:

$$Y_i = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \dots + \beta_n X_n + \varepsilon_i$$

Where, Y_i is a dependent variable; and $X_1, X_2 \dots X_n$ are the independent variables.

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In the case under consideration, *Y* denotes sustainability of CBWSPs; and *X_i* are the explanatory variables.

- α = Intercept
- β_1, \dots, β_n = Regression coefficient
- ε_i = Error term
- X_1 = Installation of water supply (Dummy: 1= effectively done, 0=Otherwise)
- X_2 = Repair and maintenance (Dummy: 1= Timely repaired and maintained 0 = Otherwise)
- X_3 = Mobilization of stakeholders meetings (Dummy: 1= Mobilization effectively conducted, 0=Otherwise)
- X_4 = Mobilizations of new customers (Dummy: 1= effectively done, 0 = Otherwise)
- X_5 = Participatory price-setting for water (Dummy: 1= Participatory, 0 = Otherwise)
- X_6 = Managing water conflicts (Dummy: 1= effectively managed, 0 = Otherwise)
- X_7 = Water right management (Dummy: 1= effectively managed, 0= Otherwise)

The independent variables in Table 1 depict the internal governance practices of CBWSOs that are hypothesized.

Table 1: Independent Variables

Variable	Assumption	Measurement
X_1 = Installation of water supply systems (Dummy)	It is expected that an effectively installed water supply system will ensure sustained access to clean and safe water services	1= Water supply systems effectively installed, 0= Not effectively installed
X_2 = Repair and maintenance (Dummy)	It is expected that timely repair and maintenance will increase the functionality of water supply system and continuity of water supply	1= Repair and maintenance are timely conducted, 0= Not timely conducted
X_3 = Mobilization of stakeholders' meetings (Dummy)	It is expected that stakeholders meeting will increase awareness, inclusivity and engagement in water supply management	1= stakeholders mobilization effectively conducted, 0= Not effectively mobilized
X_4 = Mobilizations of new customers (Dummy)	It is expected that effective mobilization of new customers will increase water supply coverage and financial revenues	1= New customers effectively Mobilized, 0= Not effectively mobilized
X_5 = Participatory price-setting for water (Dummy)	It is expected that stakeholders' participation in setting prices' will increase community commitment to pay water bills, as well as ownership of the program, which are important aspects for the sustainability of water supply projects	1= Price determination is participatory, 0= Not participatory

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X_6 = Managing water related conflicts (Dummy)	It is expected that resolving conflicts with regard to water issues will influence the unified efforts and commitments in management of water resources	1= Water related conflicts are effectively managed, 0= Water related conflicts are not effectively managed
X_7 = Water right management	It is likely to increase sustainability by legalizing the water use in the community.	1= Water right effectively managed, 0= Not effectively managed

2.4.1 Instrumentation

The data analysis was conducted using the Statistical Package for the Social Sciences (SPSS) version 20, complemented by Microsoft Excel for preliminary data management. Prior to estimating the binary logistic regression model, diagnostic tests were performed to assess model adequacy and goodness-of-fit. The results indicate that the model was appropriately specified and suitable for examining the determinants of sustainability among CBWSPs.

The Hosmer-Lemeshow goodness-of-fit test produced a Chi-square value of 80.057, with a significance level of $p = 0.052$. Since the p-value exceeds the 0.05 threshold, the null hypothesis of good model fit cannot be rejected; suggesting that the model adequately fits the observed data.

The model’s explanatory power was assessed using the Nagelkerke pseudo R^2 statistic. The obtained value of 0.249 indicates that approximately 24.9% of the variance in CBWSP sustainability is explained by the independent variables included in the model. While pseudo R^2 values in logistic regression are typically modest, this level of explained variance demonstrates meaningful predictive capacity in the context of social and institutional research.

Furthermore, the omnibus test of model coefficients yielded a Chi-square value of 15.341 ($p < 0.001$), indicating that the set of independent variables collectively contributes significantly to predicting project sustainability. The overall classification accuracy of the model was 64.2%, demonstrating a moderate ability to correctly predict sustainability outcomes among the sampled projects. The summary in Table 2 shows the model classification and goodness-of-fit for the study.

Table 2: Binary Regression Analysis Model Classification and Fitting

Model fit information: Hosmer & Lemeshow	Chi-square=80.057; p-value = 0.052
Model adequacy: pseudo R-square	Nagelkerke = 24,9%
Omnibus test of model coefficients	Chi-square = 15.341; p-value = 0.000)
Model classification	Overall = 64.2%

Source: Survey 2024

3. Results and Discussion

3.1 Social Demographic Characteristics of Respondents

As presented in Table , the majority of the respondents were married (75%; $n = 300$), followed by those who were single (17.8%; $n = 71$). The predominance of married participants may reflect their heightened responsibility for household welfare, including securing water access to meet family needs such as food preparation, hygiene, and childcare (Façanha, 2019). This suggests that household responsibilities may influence engagement with community-based water supply initiatives.

Table 3: Demographic Characteristics of Respondents

Variable	Categories	Frequency	
		(N=399)	Percentage
Sex	Male	153	38.3
	Female	246	61.7
Marital Status	Single	71	17.8
	Married	300	75.2
	Widowed	17	4.3
	Divorced	11	2.8
Education Level	Informal education	19	4.8
	Adult education	5	1.3
	Primary school	237	59.4
	Secondary School	101	25.3
	Vocation training	3	0.8
	College level	24	6.0
Age	University Level	10	2.5
	18–30Yrs	63	15.8
	31–40Yrs	111	27.8
	41–50Yrs	75	18.8
	51–60yrs	60	15.0
	61–70yrs	54	13.5
	Above 70 yrs	36	9.0

Source: Survey 2024

In terms of educational attainment, most respondents had completed primary education (59.4%; $n = 237$), followed by secondary education (25.3%; $n = 101$). A smaller proportion had attained college or university education (9.3%; $n = 37$), while 6.1% ($n = 21$) had received informal or adult education. Overall, the sample is largely composed of individuals with primary and secondary education, indicating a moderately literate beneficiary population. Educational attainment plays a significant role in shaping planning, and managerial, financial, and technical decision-making capacities within CBWSPs, and thus has important implications for project sustainability.

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With respect to age distribution, respondents aged 31–40 years constituted the largest group (27.8%; $n = 111$), followed by those aged 41–50 years (18.8%; $n = 75$). Only (9%, $n = 36$) were above 70 years of age. Overall, (61.6%, $n = 246$) of the respondents were between 31 and 60 years old, representing the economically active and household-responsible segment of the population. This age profile suggests that a substantial proportion of the participants were directly engaged in family welfare and livelihood activities, which may increase their interest in, and commitment to, sustainable water service provision.

3.2 Association between Internal Governance Practices and Sustainability of Community-Based Water Supply Projects

As presented in Table 44, the associations between the independent variables and project sustainability were analysed using the Chi-square test of association, with corresponding p-values reported to determine statistical significance. The findings on the efficiency of CBWSP reporting systems indicate a significant Chi-square of around 20.3%, and a significant p-value (0.000). This can suggest that there is a significant association between the efficiency of reporting systems and the sustainability of CBWSPs. Therefore, an efficient reporting system is more likely to be associated with sustainable outcomes of water supply projects.

Table 4: Chi-square Test of Association Results

Variable	Response	Overall Sustainability		Test of Association	
		Un-sustainable	Sustainable	Chi-square	P-value
Efficient installation of water systems	Otherwise	40	74	0.039	0.843
	Efficient	103	182		
Efficient repair and maintenance	Otherwise	16	3	20.299	.000*
	Efficient	127	253		
Efficient management of conflicts	Otherwise	38	11	42.265	.000*
	Efficient	105	245		
Efficient organization of meetings	Otherwise	57	111	0.461	0.497
	Efficient	86	145		
Efficient mobilization of customers	Otherwise	59	96	0.546	0.460
	Efficient	84	160		
Efficient participation of beneficiaries in price-setting	Otherwise	91	109	16.275	.000* ^b
	Efficient	52	147		
Efficient water right management	Otherwise	16	48	3.895	.048*
	Efficient	127	208		

Source: Survey 2024

The efficiency in conflict management with a Chi-square of 42.265 and a p-value of 0.000 indicates a very strong and significant association between efficiency in conflict management and sustainability of CBWSPs. This

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indicates that more efficient conflict management practices have a positive influence on the sustainable outcome of CBWSPs.

The findings show significant results on the association between sustainability and the participation of the stakeholders, particularly the beneficiaries, in setting prices for water use. The participation of beneficiaries in price-setting has a Chi-square of 16.275 and a p-value of 0.000, which indicates a significant and very strong association between beneficiaries' participation in price-setting and the sustainability of water supply projects. This bears an implication that involving participants in price-setting is more likely to be linked to the sustainability of water supply projects. The efficiency in water rights management has a Chi-square of 3.895, and a p-value of 0.048. Since the p-value is just below 0.05, there is a significant association between efficiency in water rights management and the sustainability of CBWSPs.

The variables efficiency installation of water supply system (Chi-square 0.039 and p-value = 0.843), efficiency in meeting organizations (Chi-square 0.461 and p-value = 0.497), and efficiency in mobilization of new customers (Chi-square 0.546 and p-value = 0.460): all have a p-value which is greater than 0.05. This suggests that there is no significant association between efficiency in the installation of water supply systems, efficiency in the organization of meetings, efficient mobilization of new customers, and the sustainability of CBWSPs in Arumeru district.

3.3 Predictors of Sustainability of Community-based Water Supply Projects

A binary logistic regression model was used to assess the relationship between several independent variables and the binary outcomes of the dependent variable. The findings summarized in Table shows a positive coefficient ($B = 1.976$, and $p = 0.010$); and an exponent coefficient ($\text{Exp}(B) = 7.212$) on efficiency reporting systems for CBWSPs. This indicates that a one-unit increase in an efficient reporting system increases the odds of sustainability of CBWSPs by 7.21 times, and the effect is statistically significant with a p-value of less than 0.05.

The coefficients $B = 2.522$, a p-value $p = 0.000$, and an exponential coefficient $\text{Exp}(B) = 12.457$ on the CBWSPs efficiency in conflict management are an indication of a strong and significant effect that the independent variable has on the sustainability of CBWSPs. The findings show that one unit increase in efficiency in conflict management increases the odds of sustainability of CBWSPs by 12.46 times, and such a relation between variables is very significant with a p-value of 0.000, which is less than 0.001, showing a very strong relation. The findings on the efficiency of stakeholders' participation in price-setting for a unit of water show a coefficient index of $B = 0.681$ and a p-value of 0.006, and an exponential coefficient $\text{Exp}(B) = 1.977$. The efficiency in

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participation nearly doubles the odds of sustainability (Exp (B) = 1.977), and the relation between the variables is statistically significant, as signified by the p-value ($p = 0.006 < 0.01$).

Table 5: Binary Logistic Regression Analysis Results

	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
							Lower	Upper
Efficient installation of water systems	-0.344	0.321	1.149	1	0.284	0.709	0.378	1.330
Efficient repair and maintenance	1.976	0.770	6.576	1	0.010**	7.212	1.593	32.645
Efficient management of conflicts	2.522	0.495	25.987	1	0.000***	12.457	4.723	32.853
Efficient organization of meetings	-0.363	0.292	1.544	1	0.214	0.696	0.392	1.233
Efficient mobilization of customers	0.064	0.304	0.044	1	0.833	1.066	0.588	1.934
Efficient participation of beneficiaries in price-setting	0.681	0.249	7.487	1	0.006***	1.977	1.213	3.220
Efficient water right management	-1.673	0.476	12.368	1	0.000***	0.188	0.074	0.477
Constant	-4.005	1.088	13.540	1	0.000***	0.018		

Source: Survey 2024

The efficiency in water rights management has a coefficient value $B = -1.673$, a p-value of 0.000, and an exponential coefficient of (Exp (B)) 0.188. This result indicates a significant negative effect of efficient water rights management on the sustainability of CBWSPs. The increase in efficiency of water rights management decreases the odds of sustainability ($p < 0.001$), with the odds reduced by 81.2% (Exp (B) = 0.188).

Efficient installation of water systems has the coefficient index $B = -0.344$, showing the negative direction and strength of the relationship between variables: a p-value of 0.284, and an exponential coefficient index of 0.709. The findings indicate that the odds of sustainability decrease slightly with efficiency in water supply systems, but the effect is not statistically significant, given that the p-value is greater than 0.05. The findings on the efficiency of CBWSOs in the organization of stakeholders' meeting shows that $B = -0.363$, a p-value of 0.214, and an exponential coefficient value of 0.696. The efficiency in the organization of meetings decreases the odds of sustainability, but this effect is not significant since the p-value obtained is 0.214, which is greater than 0.05.

The findings on the efficiency of CBWSOs in the mobilization of new customers show a coefficient index of $B = 0.064$, a p-value of 0.833, and an exponential

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coefficient index of 1.066. These findings indicate that there is no significant relation between efficient mobilization of new customers and the sustainability of CBWSPs since the p-value is greater than 0.05.

The Chi-square analysis revealed strong and statistically significant associations between the sustainability of CBWSPs and several internal governance and operational factors. These factors included efficiency in reporting systems, repair and maintenance practices, conflict management, beneficiary participation in tariff setting, and water rights management. Among these, efficiency in repair and maintenance demonstrated a highly significant association with sustainability ($p < 0.001$), underscoring the central role of routine operational practices in ensuring uninterrupted service delivery. Regular maintenance not only prevents system breakdowns, but also enhances user confidence in the reliability of the water supply services (Mfinanga & Kaswamila, 2014; Kilonzo & George, 2017).

Conflict management was also found to be significantly associated with sustainability ($p < 0.001$), indicating that unresolved disputes within communities, or between water users and management committees, can undermine service reliability and collective ownership. Ineffective handling of conflicts may lead to non-compliance with agreed rules, reduced willingness to pay tariffs, and weakened cooperation among users. The presence of effective conflict resolution mechanisms, therefore, appears to be essential for maintaining trust, social cohesion, and shared responsibility in the management of CBWSPs.

Similarly, beneficiary participation in tariff setting showed a strong and statistically significant association with sustainability ($p < 0.001$). This finding highlights the importance of inclusive and participatory decision-making processes in enhancing users' willingness to pay; thereby improving cost recovery, and strengthening the financial viability of CBWSPs (Keesiga & Kayaga, 2018). When users are involved in determining tariffs, they are more likely to perceive charges as fair and justified, which in turn promotes compliance and long-term sustainability. These findings are consistent with Behailu et al. (2016), who emphasize the critical role of CBWSOs and key stakeholders in managing water supply infrastructure to achieve sustainable outcomes.

Efficiency in water rights management was also significantly associated with sustainability ($p = 0.048$), suggesting that governance arrangements regulating access to, and use of, water resources play an important role in shaping project outcomes. Clear, transparent, and well-communicated water rights frameworks can help minimize disputes and support equitable water distribution among users. However, other factors—such as efficiency in system installation, organization of meetings, and mobilization of new customers—did

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not show statistically significant associations with sustainability. This suggests that while infrastructure development and administrative activities are necessary components of project implementation, they are insufficient on their own to guarantee sustainable outcomes in the absence of effective post-installation management and reliable service provision.

The binary logistic regression analysis further reinforced these findings by identifying key predictors of sustainability. Efficient installation of water systems, combined with continuous repair and maintenance practices, significantly increased the likelihood of sustainable outcomes, particularly when supported by well-functioning reporting mechanisms that enhance accountability, and enable timely responses to system failures. Conflict management emerged as the strongest positive predictor, increasing the odds of sustainability by more than twelve times. This highlights the central role of effective governance structures and community cohesion in sustaining water supply services over time.

Participation in tariff-setting also significantly increased the odds of sustainability, confirming the importance of user involvement in financial decision-making processes and increased willingness to pay for water services (Kayaga et al., 2019). In contrast, efficiency in water rights management exhibited a significant negative effect on sustainability. This finding suggests that overly rigid or exclusionary enforcements of water rights, such as restrictive allocation practices, may reduce social acceptance and weaken community support for CBWSPs. As argued by Kahimba and Niboye (2019), strong institutional frameworks that incorporate fair, transparent, and participatory practices are essential for reducing water-related conflicts, which is a critical condition for the sustainability of CBWSPs. Consequently, administering water rights as a response to water scarcity should be guided by participatory governance frameworks that balance regulation with fairness and inclusiveness.

Overall, the study identifies efficient reporting systems, effective conflict management, and participatory tariff-setting as the most influential positive predictors of sustainability; while efficiency in water rights management emerged as the only significant negative predictor. Factors such as system installation, organization of meetings, and customer mobilization were not significant predictors, reinforcing the view that sustainable outcomes depend more on ongoing governance capacity and operational effectiveness than on initial implementation efforts alone.

Previous studies indicate that nearly a quarter of water supply systems in Tanzania fail within two years of operation (Mwendamseke, 2016; Stephano, 2016; Fierro et al., 2017). This evidence suggests that the installation of water supply systems must be accompanied by effective monitoring and evaluation

mechanisms, as well as robust repair and maintenance practices, to ensure long-term sustainability. Customer mobilization appears to have a limited influence on sustainability in the study area, possibly because the capacity of many CBWSPs to expand water supply is increasingly constrained. Similarly, the organization of community meetings was not found to be significant, contrasting with earlier studies, such as by Kavina (2018), which argue that well-organized stakeholder meetings are critical for promoting participation, transparency, and accountability. This discrepancy may reflect contextual differences or declining community engagements once systems are operational, further emphasizing the need for adaptive and context-sensitive governance approaches in CBWSPs (Anselm, 2022).

4. Conclusion

The study reveals that the efficiency of CBWSPs on some factors significantly influences their sustainability in Arumeru District. Key factors with strong positive and statistically significant effects include the efficiency of reporting systems, conflict management mechanisms, and stakeholder participation in water-pricing. In contrast, while efficiency in water rights management also exhibited a statistically significant association, its relationship was unexpectedly negative, suggesting a negative association, perhaps due to overly rigid enforcement or exclusionary practices that reduce the odds of sustainability. The CBWSPs' efficiency on some factors—such as installation of water systems, meeting organization, and customer mobilization—did not show statistically significant relationships with sustainability outcomes. These findings emphasize the need for strengthening internal governance systems, particularly in conflict resolution, reporting, and inclusive decision-making; while reconsidering the proper approach to water rights enforcement with a participatory and transparent frameworks that ensure community awareness and enhance—rather than hold back—the sustainability of CBWSPs.

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