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The Influence of Socio-Demographic Characteristics on Community Participation in Water Resource Management in Tanzania: A Case of Water User Associations along Wami–Ruvu Basin

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Abstract
Community participation in water resource management remains a key policy objective in Tanzania, yet evidence on how socio-demographic characteristics shape participation across management processes remains limited. This study examined the influence of socio-demographic factors on community participation in water resource management among Water User Associations (WUAs) in the Wami–Ruvu Basin, Tanzania. A cross-sectional research design was employed, involving 385 WUA members selected from a population of 5,546 registered members using multistage sampling. Data were collected through household questionnaires, focus group discussions, and key informant interviews. Quantitative data were analysed using descriptive statistics, chi-square tests, and binary logistic regression, while qualitative data were analysed thematically. The findings indicate that participation varied significantly across socio-demographic groups and water management stages. Occupation was a strong predictor of participation, with crop farmers more likely to participate in identification (OR = 2.075, p = 0.002) and planning (OR = 2.160, p = 0.001). Men were more likely to participate in implementation (+5.0 percentage points, p = 0.012) and evaluation (+7.0 percentage points, p < 0.001) than women. Education significantly influenced monitoring, where respondents with certificate-level education or higher were 13.8 percentage points more likely to participate (p = 0.020). Divorced or separated respondents consistently showed lower participation across all stages. The regression model explained 68.6% of participation variation (Nagelkerke R^2 = 0.686). The study concludes that community participation in water resource management is socially differentiated, requiring targeted and inclusive interventions to address persistent inequalities and strengthen sustainable water governance.

Introduction
Water scarcity, degradation, and unequal access remain major global concerns despite extensive international efforts to promote sustainable and participatory water governance. The 2024 UN World Water Development Report indicates that more than two billion people experience severe water stress,

while global water demand is expected to increase by 30% by 2050 (UNESCO, 2024; UN-Water, 2024; FAO, 2023). International policy frameworks such as the Dublin Principles, Agenda 21, the Paris Agreement, and the 2030 Agenda for Sustainable Development emphasise community participation as a key principle for effective water governance. However, participation remains uneven because water problems are not only hydrological but also social, reflecting inequalities in who participates, whose knowledge is recognised, and who influences decisions (Agarwal, 2023; Goergen et al., 2025).

In Europe, participatory water governance is supported by legal instruments such as the Aarhus Convention and the EU Water Framework Directive, yet socio-demographic inequalities continue to affect participation. Studies from Spain, Poland, and Hungary show that men and highly educated professionals often dominate planning and evaluation processes, while rural women, migrants, older citizens, and low-income groups face barriers to meaningful participation (OECD, 2024; UNESCO, 2023; Goergen et al., 2025). Similar patterns are observed in Asia, where gendered norms often restrict women to implementation roles such as canal maintenance, while men dominate identification, planning, and evaluation committees (Singaraju et al., 2025; UN Women, 2024). Education and occupation also shape participation because literacy and technical competence are often required for leadership and monitoring roles (Agarwal, 2023; UNESCO, 2024; Boelens, 2008).

Across Sub-Saharan Africa, Integrated Water Resources Management and Water User Associations were introduced to improve local decision-making, but participation often reflects existing social hierarchies. Studies in Kenya, Uganda, and Malawi show that men and wealthier farmers frequently dominate identification and planning, while women and youth are often limited to implementation roles (Dungumaro and Madulu, 2003; Komakech and van der Zaag, 2011; Mdee, 2017; Nkiaka et al., 2022; World Bank, 2024). In South Africa, commercial farmers have continued to exert greater influence over Water User Associations and basin-level governance than historically disadvantaged smallholders, despite equality-oriented reforms (Kemerink et al., 2013; Méndez-Barrientos et al., 2018). Age, marital status, education, and occupation further affect participation because leadership legitimacy and technical participation are often shaped by social status, household structure, and access to resources (Aleu et al., 2022; UNESCO, 2024).

Tanzania has established Water User Associations as important institutions for community participation in water resource management. The National Water Policy of 2002, Water Resources Management Acts of 2009 and 2022, and basin plans promote participation through Basin Water Boards and WUAs (URT, 2009; 2022). These frameworks expect communities to participate in identification, planning, implementation, monitoring, and evaluation of water activities. However, participation within WUAs remains inadequate and unequal, with men, educated elites, and economically stable groups often dominating decision-making and technical roles, while women, youth, and less-educated members remain underrepresented (Kabogo et al., 2017; Nyamulo, 2024; Rwechungura, 2025; Pandu, 2024).

The Wami–Ruvu Basin is one of Tanzania's most important water systems, supporting agriculture, livestock, industry, and household needs. Nevertheless, it faces water scarcity, pollution, weak institutional coordination, conflicts among users, biodiversity loss, and limited enforcement of basin management plans (Hofmann, 2022; World Bank, 2024). Although WUAs were created to promote participatory governance, their effectiveness is limited by uneven participation across management processes. Existing studies have mainly focused on hydrology, institutional reforms, and conflict resolution, while limited attention has been given to how socio-demographic factors influence participation across identification, planning, implementation, monitoring, and evaluation (Hofmann, 2022). Therefore, this study examines how sex, age, education, marital status, occupation, and

household size influence community participation in water resource management within the Wami–Ruvu Basin.

Theoretical Framework

The study is grounded in Participatory Development Theory, associated with Robert Chambers, which views participation as a continuous and empowering process through which community members contribute meaningfully to development activities. The theory argues that development should not be externally imposed but should be co-created with communities through their involvement in identification, planning, implementation, monitoring, and evaluation (Chambers, 1983). It also recognises that participation is socially differentiated and influenced by characteristics such as sex, age, education, occupation, and marital status. These characteristics determine who participates, how they participate, and at which stage they exercise influence.

Although the theory has been widely applied, critics argue that participatory processes can be manipulated by dominant groups, thereby marginalising vulnerable voices. Despite this limitation, the theory remains useful for examining how participation varies among different groups. Empirical studies by Rasool (2024), Chattopadhyay (2022), Mponela et al. (2023), and Shunglu et al. (2022) support the view that genuine participation promotes development effectiveness and equity. Based on this theoretical lens, the study assumes that socio-demographic characteristics influence individuals' depth and consistency of participation in water governance. The null hypothesis states *that socio-demographic characteristics, including age, sex, education, occupation, marital status, and household size, do not significantly influence participation in water resource management processes.*

Methodology

Study area and design

The study adopted a cross-sectional research design to assess how socio-demographic factors influence community participation among WUA members in the Wami–Ruvu Basin. This design enabled the researcher to capture participation patterns at one point in time and statistically examine associations between characteristics such as education, occupation, marital status, and participation. However, although the design was appropriate for examining associations, it could not establish causality or capture changes in participation over time.

Sample and Sampling procedures

The study was conducted in the Wami–Ruvu Basin, one of the nine officially recognised river and lake basins in mainland Tanzania. The basin consists of the Wami and Ruvu river systems, both draining into the Indian Ocean. The Wami River covers approximately 44,233 km², while the Ruvu River covers about 17,843 km². Together, the basin extends across approximately 66,899 km² and supports an estimated population of 10.6 million people (URT, 2022).

The target population comprised members of Water User Associations operating within the Wami–Ruvu Basin. A total of 385 WUA members were selected using Cochran's formula, based on a total WUA population of 5,546, a 95% confidence level, a 5% margin of error, and an estimated participation proportion of 0.5. A multistage sampling procedure was used. First, the Wami–Ruvu Basin was purposively selected because of its strategic importance in water resource management. Second, four WUAs were randomly selected, two from the Wami Catchment and two from the Ruvu Catchment (DAWASA and World Bank, 2015). Third, twelve wards were randomly selected, with three wards from each WUA. Fourth, two villages were randomly selected from each ward, making 24 villages. Finally, households were selected using simple random sampling, and data were collected from household heads as the unit of observation. Proportional allocation was used to distribute the sample across the selected WUAs as indicated in Table 1.

Table 1: Distribution of sample size based on Water user Association

Catchment	Name of WUA	Population of registered WUA members	Sample
Ruvu	Ngerengere Chini	830	58
	Ngerengere juu A	358	25
Wami	Miyombo	2,918	202
	Mkindo	1,440	100
Total		**5,546**	**385**

Note: The sample size for each selected ward and village were determined proportionally

Methods of data collection

The study used both primary and secondary data. Primary data focused on levels of participation and socio-demographic characteristics, while secondary data were obtained from Wami–Ruvu Basin reports, WUA documents, the National Water Policy of 2002, the Water Resources Management Act No. 11 of 2009, and the Water Sector Development Programme 2006-2025. Data were collected through household surveys, focus group discussions, and key informant interviews. Household survey data were collected using a structured questionnaire with closed-ended and open-ended questions. The questionnaire was pre-tested before the main data collection among WUA members who were not included in the final sample. The pre-test assessed clarity, wording, relevance, flow, and time required for administration. Content validity was ensured through expert review by supervisors and specialists in water resource management and community development, while reliability was checked through internal consistency of participation-related items.

Five Focus Group Discussions were conducted with WUA members selected according to their involvement, knowledge, and experience in water resource management. The selection considered diversity in sex, age, occupation, education level, and marital status. Each FGD had six to eight participants, a size considered suitable for active discussion (Bryman, 2004). Key informant interviews were also conducted with representatives from the National Water Board, Wami–Ruvu Basin Water Board, Catchment and Sub-catchment Committees, and WUA leaders. These interviews were guided by a semi-structured interview guide and were used to support and explain the quantitative findings.

Methods of data analysis

Data analysis was conducted using STATA version 17 after cleaning, validation, and coding. Descriptive statistics, including frequencies and percentages, were used to summarise respondents' characteristics and participation patterns. Chi-square tests were used to assess associations between socio-demographic variables and participation processes. Binary logistic regression was then applied to examine the influence of socio-demographic factors on participation. The independent variables included age, sex, marital status, occupation, education level, household size, and years of WUA membership. Participation in water resource management processes was treated as the dependent variable and was measured separately for identification, planning, implementation, monitoring, and evaluation. The general form of the binary logistic model is:

$$ln\left(\frac{p_i}{1-p_i}\right) = \alpha_0 + \beta_1 x_1 + \cdots + \beta_k x_k + \varepsilon \quad \text{.....1}$$

Where: -

$\alpha_0 = constant\ of\ the\ equation$

β_1 *to* β_k = *coefficients of the independent (predictor, response) variables*

$x_1 \ldots x_p = Independent\ variables$

The model specification was:

$$ln\left(\frac{p_i}{1-p_i}\right) = \beta_0 + \beta_1 Age + \beta_2 Sex + \beta_3 Educ + \beta_5 MarStat + \beta_6 Occup + \beta_7 HHSize + WUAm + \varepsilon$$

..... 2

Where:

Logit (pi) = ln (odds(event), that is the natural log of the odds of an event occurring,
p_i = prob (event), that is the probability that the event will occur,
1-p_i = prob (non-event), that is the probability that the event will not occur
Age = Age of the respondent in years
Sex = Sex of the respondent (male = 1, 0 = otherwise)
Educ = Education in years of schooling
MarStat = Marital status (married =1, 0 = otherwise)
Occup = Occupation (1 = Farming, 0 = Otherwise)
HHSize = Household size in number
WUAm = WUA membership in years.
ε = error term.
β = Unstandardised coefficients.

Ethical consideration

Ethical considerations were observed throughout the study. Ethical clearance was obtained from Moshi Cooperative University, and permission was sought from the Wami–Ruvu Basin Water Board, local government authorities, and WUA leaders. Participants were informed about the purpose of the study, their role, and the use of the data. Informed consent was obtained, participation was voluntary, and respondents were free to withdraw at any stage. Confidentiality and anonymity were maintained by excluding names and personal identifiers from the analysis and reporting, while collected data were securely stored and used only for academic purposes.

Results

Socio-Demographic Characteristics and Processes of Community Participation

The cross-tabulation results showed that participation varied across socio-demographic groups and water management processes. Female and male participation patterns were relatively similar across identification, planning, implementation, monitoring, and evaluation. The chi-square value for sex was 6.90 with p = 0.33, indicating no statistically significant association between sex and participation in the general cross-tabulation (Table 2). Education also showed no significant association with participation, although certificate holders had relatively higher involvement in monitoring.

Table 2: Cross-tabulation socio-demographic and processes of Community Participation (n = 385)

	Processes of community Participation in water resource management					
Characteristic/Processes	**Identification**	**Planning**	**Implementation**	**Monitoring**	**Evaluation**	**Chi² (p-value)**
Sex						6.90 (0.33)
Female	56 (23.93)	57 (24.36)	43 (18.38)	58 (24.79)	20 (8.28)	
Male	24 (15.89)	31 (20.53)	28 (18.54)	50 (33.11)	18 (11.91)	
Education						16.00 (0.593)
No formal	8 (30.77)	5 (19.23)	4 (15.38)	7 (26.92)	2 (7.7)	
Primary	52 (19.26)	61 (22.59)	49 (18.15)	81 (30)	27 (10.0)	
Secondary	19 (25)	20 (26.32)	16 (21.05)	15 (19.74)	6 (7.9)	
Certificate+	1 (7.69)	2 (15.38)	2 (15.38)	5 (38.46)	3 (23.07)	
Married						10.71 (0.098)
Yes	49 (21.03)	55 (23.61)	34 (14.59)	65 (27.9)	30 (12.88)	
No	31 (20.39)	33 (21.71)	37 (24.34)	43 (28.29)	8 (5.27)	
Crop farming						39.97 (<0.001
Yes	49 (21.03)	55 (23.61)	34 (14.59)	65 (27.9)	30 (12.88)	
No	31 (20.39)	33 (21.71)	37 (24.34)	43 (28.29)	8 (5.27)	
Age						9.64 (0.647)
18 - 35	33 (20.37)	41 (25.31)	31 (19.14)	43 (26.54)	14 (8.63)	
36 - 55	36 (21.05)	36 (21.05)	30 (17.54)	53 (30.99)	16 (9.35)	
56+	11 (21.15)	11 (21.15)	10 (19.23)	12 (23.08)	8 (15.39)	

Note: values in parentheses are frequencies

Community Participation Processes in Water Resources Management

Model Diagnostics and Checks

The chi-square value for education was 16.00 with p = 0.593. Marital status showed a weak but non-significant trend, with married participants slightly more active in identification and monitoring, while unmarried participants showed higher participation in implementation. The chi-square value for marital status was 10.71 with p = 0.098. Age was also not significantly associated with participation, with a chi-square of 9.64 and a p-value of 0.647. However, crop farming status was statistically significantly associated with participation, with a chi-square of 39.97 and $p < 0.001$. This indicates that occupation, particularly crop farming, was an important factor influencing participation in water resource management.

The logistic regression model showed strong explanatory power. The model produced a −2 Log Likelihood value of 242.257. The Cox and Snell R-Square was 0.477, suggesting that about 47.7% of the variation in participation was explained by the predictors. The Nagelkerke R-squared was 0.686, indicating that the model explained approximately 68.6% of the variation in the dependent variable.

For the identification process, occupation, marital status, and WUA experience were the most important predictors. Crop farmers were significantly more likely to participate than un-employed respondents, with an odds ratio of 2.075 and a marginal effect of 18.3 percentage points (p = 0.002). Livestock keepers were also more likely to participate, with a marginal effect of 14.8 percentage points, although this was only marginally significant (p = 0.099). WUA experience had a significant positive effect, with each unit increase in experience raising the probability of participation by 4.5 percentage points (p = 0.021) (Table 3). In contrast, respondents who were deserted, divorced, or separated were significantly less likely to participate than married respondents, with a marginal effect of −14.0

percentage points (p = 0.002). Sex, age, education, and household size did not substantially influence participation in identification. Qualitative findings supported these results, showing that household responsibilities, cultural norms, and low confidence in formal meetings limited women's participation.

Table 3: Socio-Demographic Predictors of Participation in Identification Process: Logistic Regression Results

Variable	Category	B	Exp(B)	Sig.	Marginal effect
Sex	Male (vs Female)	0.04	1.041	0.582	+1.0
Age	36–55 (vs 18–35)	0.00	1.000	0.960	0.0
	56+ (vs 18–35)	-0.10	0.905	0.452	-2.5
Education	Primary (vs No formal)	0.09	1.094	0.530	+2.3
	Secondary (vs No formal)	-0.09	0.914	0.602	-2.3
	Cert/Diploma/Degree (vs No formal)	0.31	1.363	0.205	+7.8
Marital status	Single (vs Married)	0.08	1.083	0.418	+2.0
	Deserted/Div/Separated (vs Married)	-0.56	0.571	0.002	**-14.0**
	Widowed (vs Married)	0.05	1.051	0.777	+1.3
	Cohabiting (vs Married)	-0.07	0.932	0.683	-1.8
Occupation	Employed (vs Un-employed)	0.27	1.310	0.446	+6.8
	Crop farming (vs Un-employed)	0.73	2.075	0.002	**+18.3**
	Livestock Keeper (vs Un-employed)	0.59	1.804	0.099	+14.8
	Self-employed (vs Un-employed)	0.21	1.234	0.369	+5.3
Household size	Medium (vs Small)	0.06	1.062	0.548	+1.5
	Large (vs Small)	-0.04	0.961	0.701	-1.0
Experience in WUA	Continuous	0.18	1.1975	0.021	+4.5

In the planning process, occupation and marital status again emerged as important predictors. Crop farmers were 19.3 percentage points more likely to participate than un-employed respondents (p = 0.001), while livestock keepers were 18.5 percentage points more likely to participate (p = 0.040). Respondents who were divorced, separated, or deserted were 10.8 percentage points less likely to participate than married respondents (p = 0.007). Male respondents were slightly more likely to participate than females, but the effect was not statistically significant. Education showed only a modest effect, with certificate, diploma, or degree holders 5.5 percentage points more likely to participate than those without formal education (Table 4). Household size and WUA experience had little influence on planning participation. Qualitative evidence indicated that household chores, cultural expectations, and limited confidence prevented many women from fully engaging in planning meetings.

Table 4: Socio-Demographic Predictors of Participation in Planning Process: Logistic Regression Results

Variable	Category	B	Exp(B)	Sig.	Marginal Effect
Sex	Male (vs Female)	0.12	1.127	0.116	+3.0
Age	36–55 (vs 18–35)	-0.01	0.990	0.921	-0.3
	56+ (vs 18–35)	0.00	1.000	0.977	0.0
Education	Primary (vs No formal)	0.10	1.105	0.491	+2.5
	Secondary (vs No formal)	-0.13	0.878	0.423	-3.3
	Cert/Diploma/Degree (vs No formal)	0.22	1.246	0.375	+5.5
Marital status	Single (vs Married)	0.04	1.041	0.663	+1.0
	Deserted/Divorced/Separated (vs Married)	-0.43	0.651	0.007	-10.8
	Widowed (vs Married)	0.06	1.062	0.741	+1.5
	Cohabiting (vs Married)	-0.09	0.914	0.573	-2.3
Occupation	Employed (vs Un-employed)	0.69	1.994	0.058	+17.3
	Crop farming (vs Un-employed)	0.77	2.160	0.001	+19.3
	Livestock Keeper (vs Un-employed)	0.74	2.096	0.040	+18.5
	Self-employed in other activities (vs Un-employed)	0.34	1.405	0.159	+8.5
Household size	Medium (vs Small)	0.00	1.000	0.960	0.0
	Large (vs Small)	-0.04	0.961	0.680	-1.0
Experience in WUA	Continuous	0.06	1.062	0.845	+1.5

In the implementation process, sex, marital status, occupation, and WUA experience significantly influenced participation. Male respondents were 5.0 percentage points more likely to participate than female respondents ($p = 0.012$), suggesting that men were more involved in implementation activities, possibly because of greater mobility, decision-making power, and the physical nature of some tasks. Respondents who were deserted, divorced, or separated were 11.3 percentage points less likely to participate than married respondents ($p = 0.005$). Crop farmers were 16.0 percentage points more likely to participate than un-employed respondents ($p = 0.006$), reflecting their direct dependence on water for agricultural production. WUA experience also had a positive effect, with each unit increase increasing participation probability by 3.9 percentage points ($p = 0.018$) (Table 5). FGDs confirmed that women were often unable to participate in implementation due to domestic duties and cultural restrictions, while men and farmers participated more consistently.

Table 5: Socio-Demographic Predictors of Participation in Water Resource Implementation: Logistic Regression Results

Variable	Category	B	Exp(B)	Sig.	Marginal Effect
Sex	Male (vs Female)	0.20	1.221	0.012	**+5.0**
Age	36–55 (vs 18–35)	0.04	1.041	0.661	+1.0
	56+ (vs 18–35)	0.05	1.051	0.702	+1.3
Education	Primary (vs No formal)	0.01	1.010	0.972	+0.3
	Secondary (vs No formal)	-0.14	0.869	0.412	-3.5
	Cert/Diploma/Degree (vs No formal)	0.29	1.336	0.250	+7.3
Marital status	Single (vs Married)	0.12	1.127	0.202	+3.0
	Deserted/Divorced/Separated (vs Married)	-0.45	0.638	0.005	**-11.3**
	Widowed (vs Married)	0.07	1.073	0.698	+1.8
	Cohabiting (vs Married)	-0.05	0.951	0.756	-1.3
Occupation	Employed (vs Un-employed)	0.20	1.221	0.591	+5.0
	Crop farming (vs Un-employed)	0.64	1.896	0.006	**+16.0**
	Livestock Keeper (vs Un-employed)	0.35	1.419	0.341	+8.8
	Self-employed in other activities (vs Un-employed)	0.33	1.391	0.176	+8.3
Household size	Medium (vs Small)	0.00	1.000	0.966	0.0
	Large (vs Small)	-0.09	0.914	0.412	-2.3
Experience in WUA	Continuous	0.154	1.166	0.018	+3.9

In the monitoring process, age and education became more important. Table 6 shows that respondents aged 36–55 were 3.0 percentage points less likely to participate than those aged 18–35 ($p = 0.016$), while those aged 56 and above were 5.5 percentage points less likely to participate ($p = 0.006$). Education also became significant: certificate, diploma, or degree holders were 13.8 percentage points more likely to participate in monitoring than those without formal education ($p = 0.020$). Gender continued to matter, with men 6.3 percentage points more likely to participate than women ($p = 0.002$). Crop farmers were 16.0 percentage points more likely to participate than un-employed respondents ($p = 0.004$), while livestock keepers had a 15.8 percentage point higher likelihood, though marginally significant ($p = 0.069$). Divorced, separated, or deserted respondents were 12.8 percentage points less likely to participate than married respondents ($p < 0.001$). Household size and WUA experience had minimal influence. Qualitative findings showed that women faced practical barriers, including cultural restrictions and a lack of suitable protective clothing for field monitoring. Basin officials also emphasised the need for youth participation in monitoring to ensure sustainability.

Table 6: Socio-Demographic Predictors of Participation in Monitoring Process: Logistic Regression Results

Variable	Category	B	Exp(B)	Sig.	Marginal Effect
Sex	Male (vs Female)	0.25	1.284	0.002	+6.3
Age	36–55 (vs 18–35)	-0.12	0.887	0.016	-3.0
	56+ (vs 18–35)	-0.22	0.803	0.006	-5.5
Education	Primary (vs No formal)	0.19	1.209	0.168	+4.8
	Secondary (vs No formal)	0.03	1.030	0.866	+0.8
	Cert/Diploma/Degree (vs No formal)	0.55	1.733	0.020	+13.8
Marital status	Single (vs Married)	0.09	1.094	0.314	+2.3
	Deserted/Divorced/Separated (vs Married)	-0.51	0.600	<0.001	-12.8
	Widowed (vs Married)	0.13	1.139	0.446	+3.3
	Cohabiting (vs Married)	-0.11	0.896	0.465	-2.8
Occupation	Employed (vs Un-employed)	0.40	1.492	0.249	+10.0
	Crop farming (vs Un-employed)	0.64	1.896	0.004	+16.0
	Livestock Keeper (vs Un-employed)	0.63	1.878	0.069	+15.8
	Self-employed in other activities (vs Un-employed)	0.33	1.391	0.142	+8.3
Household size	Medium (vs Small)	-0.05	0.951	0.587	-1.3
	Large (vs Small)	-0.16	0.852	0.119	-4.0
Experience in WUA	Continuous	0.06	1.062	0.845	+1.5

In the evaluation process, the effects of sex, age, education, marital status, and occupation were most pronounced. Male respondents were 7.0 percentage points more likely to participate than females ($p < 0.001$). Respondents aged 36–55 were 3.5 percentage points less likely to participate than those aged 18–35 ($p = 0.012$) (Table 7), while those aged 56 and above were 5.8 percentage points less likely ($p = 0.004$). Education strongly influenced participation, with certificate, diploma, or degree holders 12.8 percentage points more likely to participate than those without formal education ($p = 0.020$). Crop farmers were 12.0 percentage points more likely to participate ($p = 0.020$), and livestock keepers were 24.3 percentage points more likely to participate than un-employed respondents ($p = 0.003$). Divorced, separated, or deserted individuals were 8.0 percentage points less likely to participate than married respondents ($p = 0.033$). Household size and WUA experience remained largely insignificant. Qualitative evidence confirmed that women and marginalised groups faced cultural and practical barriers, particularly in evening monitoring and formal evaluation meetings. However, women-only forums and youth inclusion programmes were identified as useful ways of improving participation.

Table 7: Socio-Demographic Predictors of Participation in Evaluation Process: Logistic Regression Results

Variable	Category	B	Exp(B)	Sig.	Marginal effects
Sex	Male (vs Female)	0.28	1.323	<0.001	+7.0
Age	36–55 (vs 18–35)	-0.14	0.869	0.012	-3.5
	56+ (vs 18–35)	-0.23	0.795	0.004	-5.8
Education	Primary (vs No formal)	0.04	1.041	0.752	+1.0
	Secondary (vs No formal)	0.01	1.010	0.943	+0.3
	Cert/Diploma/Degree (vs No formal)	0.51	1.665	0.020	+12.8
Marital status	Single (vs Married)	0.14	1.150	0.114	+3.5
	Deserted/Divorced/Separated (vs Married)	-0.32	0.726	0.033	-8.0
	Widowed (vs Married)	0.15	1.162	0.348	+3.8
	Cohabiting (vs Married)	-0.13	0.878	0.385	-3.3
Occupation	Employed (vs Un-employed)	0.21	1.234	0.511	+5.3
	Crop farming (vs Un-employed)	0.48	1.616	0.020	+12.0
	Livestock Keeper (vs Un-employed)	0.97	2.638	0.003	+24.3
	Self-employed in other activities (vs Un-employed)	0.35	1.419	0.107	+8.8
Household size	Medium (vs Small)	0.01	1.010	0.857	+0.3
	Large (vs Small)	-0.12	0.887	0.216	-3.0
Experience in WUA	Continuous	0.34	1.428	0.081	+8.8

Overall, the findings show that socio-demographic characteristics influence participation differently across the stages of water resource management. Occupation and marital status were consistently important, while sex, education, and age became more influential in the later stages of monitoring and evaluation. Household size and WUA experience showed limited or inconsistent effects, although WUA experience mattered in identification and implementation.

Discussion

The finding that men participated more in implementation, monitoring, and evaluation is consistent with studies from Ghana, South Africa, and East Africa, which show that women are often present in water institutions but less active in decision-making and technical stages due to domestic workloads, mobility constraints, and social norms. However, Scarlett et al. (2021) found a contrasting pattern in stormwater management, in which women were more willing to participate because they felt more vulnerable to environmental problems. This suggests that women's participation may increase when they perceive direct risks or when institutional conditions support their involvement.

Education was especially important in monitoring and evaluation. Respondents with certificates, diplomas, or degrees participated more than those without formal education, suggesting that technical literacy increases confidence and ability to engage with reports, rules, and monitoring information. This finding is consistent with Scarlett et al. (2021), who found that education improves confidence and understanding in environmental governance. However, Dong et al. (2023) observed only a weak relationship between public participation and environmental governance outcomes, suggesting that formal knowledge does not always translate into stronger engagement. In some cases, educated individuals may rely more on formal institutions than direct community action.

The lower participation of divorced, separated, or deserted respondents suggests that marital status affects social legitimacy, economic stability, and the ability to participate in community activities. However, some studies show that marginalised women may participate more actively when they organise collectively. Eaton et al. (2021a) found that women-only spaces improved women's confidence and participation in water governance, while Maeder et al. (2024) showed that marginalised women in Peru used cooperatives to challenge unequal power relations and gain

influence in environmental governance. Similarly, Eaton et al. (2021b), Errico (2021), and related studies show that exclusion can encourage collective engagement when support networks are available.

The strong participation of crop farmers and livestock keepers supports the view that people whose livelihoods depend directly on water have stronger incentives to engage in water management. Fredrick and Ahmad (2023) found that farmers and livestock keepers participated more actively in agricultural development projects because their livelihoods were directly affected. Masifia and Sena (2017) also reported that farmers, pastoralists, and livestock keepers were more involved in Water User Associations because water is central to their production systems and household survival. Similarly, Mfinanga et al. (2024) found that agro-pastoral and livestock-keeping households were more responsive to changes in water availability because water directly affected their income and livelihood security.

However, dependence on water does not always guarantee participation. Jaglin (2002) argued that when participation is linked to cost recovery, low-income households may be disadvantaged because participation shifts financial burdens onto the poor rather than empowering them. Mayo and Nkiwane (2013) similarly found that some users were willing to participate in rural water supply projects but were constrained by their inability to pay water charges. Leahy et al. (2024) identified financial constraints, distance, and travel time as major barriers to water access and participation, while Majuru et al. (2016) showed that poor households often incur high coping costs to secure water, reducing their capacity to engage consistently.

The finding that older respondents participated less in monitoring and evaluation is consistent with studies showing that younger people are often more mobile, physically active, and comfortable with repeated field activities. Roba-Gamo et al. (2021) found that younger household heads were more likely to participate in watershed monitoring and maintenance because of their greater physical capacity and willingness to adopt new practices. Naji et al. (2023) also found that younger people participated more actively in environmental management because they were more adaptable and willing to engage in labour-intensive and technical activities. Fredrick and Ahmad (2023) similarly reported that youth were more involved in project monitoring and implementation in Tanzania.

Nevertheless, contrary evidence suggests that older people may participate more actively because they possess greater experience, authority, and local knowledge. Agarwal (2001) argued that older members often have a stronger influence in community resource governance because they command social respect and legitimacy. Boelens (2008) also found that elders often play leading roles in traditional water management systems because of their knowledge of local water systems and customary rules. Roba-Gamo et al. (2021) similarly reported that older farmers may participate actively when they hold strong positions within community institutions.

Qualitative findings showed that larger households faced time and labour constraints that limited consistent participation, particularly among women. This supports UNESCO (2024), which links domestic workloads to lower community engagement. Participants from larger families often delegated attendance to others, reducing continuity in decision-making. The study also revealed that women's participation was constrained by household responsibilities, fear of dismissal, lack of confidence, cultural restrictions, and the absence of appropriate field clothing for monitoring activities. These barriers show that participation is not only a matter of formal membership but also depends on social norms, household roles, and institutional support.

Conclusion

The study concludes that community participation in water resource management within WUAs is strongly shaped by socio-demographic characteristics. Sex, education, marital status, occupation, and age significantly influenced participation, particularly in the later stages of monitoring and evaluation, whereas household size had limited influence. Participation was uneven, with women, less-educated members, divorced or separated individuals, and un-employed respondents consistently underrepresented. Crop farmers and livestock keepers were more likely to participate because of their direct dependence on water resources. Overall, participation in WUAs is socially structured rather than uniform, reflecting broader inequalities within rural water governance. Therefore, inclusive water management requires targeted strategies that address social, cultural, economic, and institutional barriers.

The Basin Water Board should design targeted strategies to support socially vulnerable groups who remain underrepresented in WUA activities. Special attention should be given to women, divorced, separated, and widowed individuals, as well as less-educated members and un-employed respondents. Flexible participation mechanisms should be introduced to accommodate household responsibilities, time constraints, and social barriers.

Basin and district officials should provide training and education to strengthen confidence and skills in monitoring and evaluation, particularly among members with limited formal education. Since technical literacy improves participation in later stages, capacity-building programmes should focus on practical skills, water monitoring, record keeping, and decision-making. Farmers and livestock keepers should also be actively engaged because their livelihoods depend directly on water resources, making them natural stakeholders in sustainable water governance.

Gender-sensitive strategies are necessary to ensure women's inclusion throughout the water management process. These may include women-only forums, flexible meeting times, safe spaces for participation, appropriate field equipment for women, and awareness campaigns to challenge restrictive cultural norms. Sustained community engagement also requires clear feedback mechanisms and incentives so that participants can see the value of their involvement across all stages, including identification, planning, implementation, monitoring, and evaluation.

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