Journal of Research and Rural Planning
Volume 14, No. 1, Winter 2025, Serial No. 48, Pp. 45-64
eISSN: 2783-2007 **ISSN: 2783-2791**
http://jrrp.um.ac.ir

Original Article

Analyzing Determinants of Community Participation in Rural Water Project Planning in Simiyu Region, Tanzania: A Logit Model Approach

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Abstract
Purpose- Access to safe and clean water remains a critical global concern, especially in rural areas of developing countries where infrastructural and institutional limitations are prevalent. In Tanzania, particularly in the Simiyu Region, water insecurity is further compounded by limited community participation in the planning stages of rural water projects. While participatory approaches are widely advocated to improve sustainability and responsiveness of such initiatives, there remains limited empirical evidence on the socio-economic and institutional factors influencing household-level participation. The main purpose of this research is to analyze the determinants of community participation in rural water project planning in Simiyu region, Tanzania by employing a Logit Model Approach.
Design/Methods/Approach- This study addresses this gap by analyzing the determinants of community involvement using a logit regression model, drawing from data collected through a cross-sectional survey of 217 respondents. The sample was derived using Yamane's (1967) formula, and a mixed sampling technique was applied to ensure representativeness across demographic and socio-economic groups. Structured questionnaires were employed for data collection, and the resulting data were analyzed using descriptive statistics and logistic regression methods.
Findings- The results revealed that several variables significantly influence participation. These include age (marginal effect = 0.116, $p < 0.05$), gender (0.098, $p < 0.05$), occupation—particularly among those engaged in livestock keeping (0.161, $p < 0.05$) and small businesses (0.177, $p < 0.05$)-as well as income level. Additionally, community awareness (0.247, $p < 0.05$) and prior experience with development initiatives (0.175, $p < 0.05$) were strong positive predictors. Cultural norms were found to influence gendered participation, with male respondents more likely to be involved in decision-making processes.
Practical implications- These findings emphasize the importance of integrating gender-sensitive and participatory planning approaches to ensure alignment with local needs and to promote sustainability.
Original/Value- The study recommends targeted policy interventions including community capacity-building, equitable policy frameworks, and strengthened local governance mechanisms to foster inclusive participation. Institutionalizing participatory approaches and promoting gender equity will be crucial in enhancing community ownership, improving project outcomes, and ensuring long-term water security in rural Tanzania.
Key Words- Community participation, Rural water projects, Sustainability, Gender equity, Socio-economic factors.

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How to cite this article:
Rwechungura, F. A. (2025). Analyzing determinants of community participation in rural water project planning in Simiyu Region, Tanzania: A Logit Model Approach. *Journal of Research & Rural Planning, 14*(1), 45-64.
http://dx.doi.org/10.22067/jrrp.v14i1.2505-1136

Date:
Received: 01-05-2025
Revised: 05-06-2025
Accepted: 14-06- 2025
Available Online: 14-06-2025

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1.Introduction

Access to safe and clean water continues to be a major challenge globally, particularly in rural areas of developing countries like Tanzania. Every year, millions of people die due to using unsafe water, inadequate sanitation, and poor hygiene, with children and young women in rural communities being the most affected groups (WHO, 2019; UNICEF, 2021). To address this issue, various water projects have been implemented by governments and non-governmental organizations (NGOs) around the world. However, the sustainability of these initiatives is often questioned, primarily due to inadequate community involvement (Bakari & Mbunda, 2022). Community participation is considered essential for the long-term success of rural water supply projects in developing countries (Kabote & Mwamfupe, 2020). However, many of these projects fail because of poor community engagement, particularly during the planning phase (Mgulo & Kamazima, 2022). This lack of community involvement leads to projects that do not meet the needs of the community, ultimately undermining their sustainability (Ntibona et al., 2023).

In developing countries like Tanzania, community participation in rural water projects is a significant concern. Despite its recognized importance for the sustainability of these projects, many faces persistent challenges related to inadequate community involvement (Murongo & Theopista, 2021; Priyan & Nyabakora, 2023). For example, in Simiyu Region, only about 20% of the urban population and 40% of the rural population have access to clean drinking water (Ndungu & Karugu, 2019). This situation is worsened by the region's dependence on the Simiyu River, which has become seasonal due to climate change, resulting in unreliable water supply and increased vulnerability to droughts and floods (Lubini & Adamowski, 2013). The insufficient participation of the community in the planning and management of water projects further contributes to their failure and lack of sustainability (Bakari & Mbunda, 2022).

Research by Sei (2016) and Mgulo and Kamazima (2022) suggests that the effectiveness of community participation is hindered by various factors, including governance structures and a lack of awareness within the community. Many rural water projects in Tanzania have historically been designed and implemented without adequate input from local communities, leading to a mismatch between projects and the needs of the beneficiaries. This disconnection not only reduces the sense of ownership among community members but also results in poor maintenance and management of water supply systems once external support is withdrawn (Asbetsadik et al., 2025) . Therefore, understanding the dynamics of community participation is crucial for developing strategies that ensure the sustainability of water supply projects in the region. Previous studies emphasize that ineffective participation often leads to project failure, highlighting the need for interventions that empower communities and involve them in decision-making processes (Murongo & Theopista, 2021; & Macharia et al., 2023). The ongoing challenges related to community participation in Simiyu Region call for further research into the factors that influence engagement and the sustainability of water supply projects. Identifying barriers to participation and understanding the local context can help stakeholders design strategies to enhance sustainability and improve the quality of life for communities (Bakari & Mbunda, 2022; Mgulo & Kamazima, 2022;).

This study aims to identify and analyze the socio-economic and institutional factors that influence community participation in the planning of rural water projects in Simiyu Region, Tanzania. Using a logit model approach, the study explored how factors such as age, gender, occupation, education level, income, cultural norms, and policy frameworks impact community engagement in project planning. The results contribute to the development of strategies to improve community participation, enhance the sustainability of water supply projects, and promote equitable development in rural water management.

Simiyu Region, located in northern Tanzania, faces significant challenges related to water scarcity and poor access to clean water. Despite various government and NGO-led rural water projects, many of these initiatives suffer from low levels of community involvement, especially during the planning stages (United Republic of Tanzania [URT], 2020). This lack of participation often leads to projects that fail to meet the needs of local populations, undermining their relevance and

sustainability. Previous research has identified several factors that influence community participation, including socio-economic aspects (e.g., income, education, and occupation), demographic characteristics (e.g., age and gender), institutional factors (e.g., local governance structures), and cultural norms (Cleaver & Toner, 2006). However, the interactions between these factors are not well understood, especially in the context of rural Tanzania. Simiyu provides a unique case study due to its diverse socio-economic conditions and dependence on agriculture and pastoralism, which are heavily affected by water availability. There is, however, a lack of empirical researches that quantitatively analyzes these factors, particularly using methods like the logit model to assess their influence on community participation in planning rural water projects. The use of a logit model is an effective approach to address this gap. Logit models are designed to analyze binary outcomes, such as whether or not individuals participate in water project planning. This method allows researchers to quantify the likelihood of participation based on various factors, providing actionable insights for policymakers and development practitioners (Gujarati & Porter, 2009). Additionally, the logit model can help identify key leverage points for increasing community engagement, which is critical for improving the design and implementation of rural water projects in Simiyu and similar regions.

2. Research Theoretical Literature

Community participation in rural water project planning has been widely studied in the development literature. It is recognized as a critical component of sustainable rural water supply systems, as it enhances project ownership, accountability, and long-term success (Harvey & Reed, 2007). However, despite its acknowledged importance, various empirical studies reveal significant challenges and gaps in understanding the determinants of community participation. This literature review synthesizes key findings from empirical research, focusing on socio-economic, demographic, institutional, and cultural factors that determine community participation in rural water project planning. The review also highlights methodological approaches, including the use of logit models, to analyze these determinants and discusses their relevance to the Simiyu Region of Tanzania.

2.1. The Importance of Community Participation in Rural Water Projects

Community participation is integral to the success of rural water projects. Studies have shown that projects involving local communities during the planning phase are more likely to achieve sustainability and meet the specific needs of beneficiaries (Narayan, 1995). For example, Isham and Kähkönen (2002), in their cross-country analysis of rural water projects in India, Indonesia, and Sri Lanka, found that community involvement significantly improves project outcomes. They argued that participation fosters a sense of ownership among community members, thereby enhancing the likelihood of proper maintenance and long-term functionality of water facilities.

Similarly, in sub-Saharan Africa, Harvey and Reed (2007) emphasized that community engagement in water project planning is a cornerstone of sustainability. They observed that projects lacking adequate community input often suffer from neglect, mismanagement, and rapid deterioration. In the Tanzanian context, a study by Komakech et al., (2011) highlighted that involving communities in water project planning leads to more equitable resource allocation and better alignment with local priorities. However, they also noted that participation levels are often hindered by socio-economic and institutional barriers, which require further exploration.

2.2. Socio-Economic Determinants of Community Participation

Socio-economic factors such as income, education, and occupation play a crucial role in determining community participation in rural water project planning. Studies have consistently shown that wealthier and more educated individuals are more likely to engage in community initiatives. For example, Sara and Katz (1997) found that in Latin America, households with higher income levels were more likely to contribute financially and actively participate in water project planning, as wealthier individuals often have more disposable income and time. Education also influences participation; Kayaga et al., (2013) found that in Uganda, higher education levels positively affected involvement in water project planning, as educated individuals better understand the benefits of participation and can express their needs.

Similarly, Abebe and Bogale (2014) observed that in rural Ethiopia, households with higher education were more involved in water user associations, which play a critical role in project planning and management. However, income and education are often linked with other socio-economic factors, such as gender. In many African contexts, women, who are the primary users and managers of water resources, face barriers to participation due to limited access to education and decision-making opportunities (Cleaver, 1999). This underscores the need for gender-sensitive approaches to enhance community engagement in water project planning.

2.3. Demographic Determinants of Community Participation

Community participation is a cornerstone of successful development interventions, particularly in rural water projects. This literature review critically evaluates empirical research on how demographic factors affect community participation in planning and implementing rural water development projects.

Gender as a Determinant of Community Participation- Studies show that gender plays a crucial role in shaping participation in development projects. Women often face barriers to participation due to traditional gender roles, household duties, and limited access to resources such as land and education (Mohanty et al., 2018). For example, Agarwal (2001) found that in South Asia, women's involvement in forest management committees was lower than men's, driven by socio-cultural restrictions and time constraints. Women, who are primary users and managers of water resources, are also underrepresented in water-related decision-making processes (Nigussie, et al., 2018) This exclusion limits the integration of their needs in planning. Studies like Kayser et al., (2019) indicate that projects with female participation in planning and management are more sustainable and effective. However, cultural norms in patriarchal societies often exclude women from formal decision-making. In Kenya, Coulter et al., (2019) highlighted how cultural expectations reduce women's involvement in community water committees. Yet, interventions designed to empower women have shown positive results. Kumar et al. (2016) demonstrated that providing childcare during meetings increased women's participation in rural India. Furthermore, women's groups have proven to foster collective action, improving their leadership and involvement in community projects (Kabeer, 2015). Overall, gender remains a key factor influencing participation in development initiatives.

2.4. Household Size and Structure

Household size and structure influence participation by determining the availability of labor and other resources. Larger households often have more members available to contribute to development activities, especially in labour-intensive projects (Adhikari & Goldey, 2010). However, larger households may also face resource constraints, limiting their ability to participate in financial contributions or attend meetings. The role of household heads is also significant, as male-headed households tend to dominate community decision-making in patriarchal societies, while female-headed households may face barriers due to social stigma or lack of resources (Hickey (2004) .

2.5. Age and Community Engagement

Age plays a significant role in shaping participation in community projects. Research shows that younger individuals are more inclined to engage in physically demanding tasks, while older individuals often take on advisory or decision-making roles due to their experience and wisdom (Khan et al., 2020). In rural Kenya, Mudege et al., (2008) observed that middle-aged adults were more involved in agricultural development than the youth, who often migrated to cities for employment. However, younger people typically lack the decision-making authority that elders hold in rural communities (Mutua & Kiruhi 2021). Older individuals tend to dominate planning processes, seen as guardians of local knowledge and traditions. On the other hand, studies like that of Gebrehiwot et al., (2017) highlight how younger individuals contribute innovation and energy, especially in projects involving technology, such as solar-powered water pumps. Still, a generational divide often sidelines youth perspectives in decision-making. Additionally, age-related factors, such as declining physical health in older adults and competing responsibilities for younger individuals, impact their level of participation. Cultural norms, particularly in patriarchal societies, further influence involvement, with younger individuals sometimes excluded from decision-making due to respect for elders (Adhikari & Goldey, 2010).

Education and Literacy- Education attainment is widely recognized as a critical enabler of community participation, simply because higher levels of education can empower community members to engage more meaningfully in discussions and planning processes (Krchnak, 2005). Literate individuals are better able to understand technical details of projects and voice their concerns effectively. Empirical studies demonstrate that individuals with higher levels of education are more likely to participate in development interventions because they are better equipped to understand project goals, communicate effectively, and access information (Mansuri & Rao, 2013). For instance, a study in Ethiopia by Tekalign and Mersha (2020) found that educated individuals were more likely to participate in community water planning activities. Likewise, in a study of irrigation projects in Ethiopia, Tesfaye et al., (2016) found that educated farmers were more likely to adopt improved irrigation techniques and actively participate in community meetings. Conversely, researchers also noted that high levels of illiteracy in rural areas with low literacy rates can serve as a barrier to participation, particularly in technical or bureaucratic processes, often leaving marginalized groups dependent on elite decision-makers, perpetuating inequitable power dynamics. Interventions that provide educational components, such as training programs, have been shown to mitigate this gap by empowering less-educated participants (Ozoh et al., 2019).

Economic Status and Participation- Income and socioeconomic status also play a pivotal role in determining community participation. Higher-income households often have greater access to resources, enabling them to contribute financially and logistically to development projects. Economic status influences participation through financial and time resources available to community members. For instance, Shrestha et al., (2013) reported that wealthier households in Nepal were more likely to engage in collective action for community forestry initiatives. Wealthier individuals often contribute financially to projects, granting them more decision-making authority (Baah et al., 2021). In contrast, low-income households may face opportunity costs by prioritizing survival activities, that limit their ability to participate, such as losing daily wages to attend meetings (Mansuri & Rao, 2013). For example, a study conducted by Nkolola & Phiri, 2025) in rural Zambia revealed that financial contributions to water projects often become a barrier for poorer households, leading to their exclusion from planning processes. This economic disparity undermines the inclusivity and sustainability of interventions. However, targeted interventions, such as compensating participants for lost income or incorporating flexible schedules, have been effective in encouraging participation among economically disadvantaged groups (Mudege et al., 2008).

Cultural and Social Norms- Cultural and social norms significantly influence participation in development initiatives, with factors like ethnicity, kinship, and governance structures shaping who gets involved. In diverse communities, ethnic divisions often result in exclusion or unequal participation (Grootaert & Narayan, 2004). For example, in Senegal, Platteau and Gaspart (2003) found that dominant ethnic groups tended to control decision-making, sidelining minorities. In Nepal, caste-based discrimination limits participation in water projects, marginalizing lower-caste groups (Kalikotay 2022). Cultural views on collective action also vary: Kurebwa (2020) noted that while traditional leadership in Zimbabwe sometimes facilitates participation, it can also silence dissenting voices. Social capital-defined as community networks and relationships-plays a crucial role in participation. In Nepal, Lam (1998) found that higher social capital led to increased involvement in water management. Communities with strong social ties are more likely to engage in collective planning. However, traditional power structures can exclude marginalized groups, such as women and ethnic minorities, from decision-making (Adams et al., 2018). In Uganda, ethnic homogeneity was linked to greater cooperation in water management projects, underscoring the role of shared cultural identity in fostering collective action (Muriuki et al., 2011). Addressing these issues requires culturally sensitive, inclusive approaches.

2.6. Intersectionality of Demographic Factors

Empirical studies emphasize that demographic factors often intersect, creating complex dynamics. For instance, women from lower-income or marginalized ethnic groups face compounded barriers to participation (Kebede et al., 2023). .

Similarly, younger, educated individuals may experience pushback from older, traditional leaders, particularly in male-dominated settings. Intersectional approaches in studies such as those by Mungai et al., (2017) highlight that addressing a single demographic factor in isolation is insufficient for promoting inclusive participation. Holistic approaches that consider intersecting identities are essential for equitable development planning.

The literature shows that demographic determinants-particularly gender, age, education, income, and cultural norms-profoundly influence community participation in rural water project planning. Addressing these factors through inclusive strategies is essential for fostering meaningful and sustainable participation. Future research should focus on longitudinal studies and intersectional analyses to better understand the complexities of demographic influences.

2.7. Institutional Determinants of Community Participation

Institutional factors, including governance structures, leadership, and access to information, significantly influence community participation. Empirical studies have shown that strong local governance and transparent leadership are crucial for fostering community engagement. For instance, in Ghana, Marks et al., (2014) found that communities with well-functioning water user committees were more likely to participate in project planning and management. These committees serve as a bridge between community members and external stakeholders, facilitating communication and coordination.

Access to information is another critical institutional factor. A study by Adank et al. (2013) in Burkina Faso revealed that communities with better access to information about water projects were more likely to participate in planning activities. Information dissemination helps to build trust and ensures that community members are aware of their rights and responsibilities. However, the effectiveness of information-sharing mechanisms often depends on the capacity and commitment of local leaders.

In the Tanzanian context, poor governance and weak institutional frameworks have been identified as major barriers to community participation. For example, Richards (2019) noted that corruption and lack of accountability among local officials undermine trust and discourage community engagement in water projects. Addressing these institutional challenges is essential for enhancing participation and ensuring the success of rural water initiatives.

2.8. Cultural and Social Determinants of Community Participation

Cultural norms and social dynamics significantly influence community participation, especially in rural areas where traditional practices shape collective action. For example, Cleaver (1999) highlighted that in some African societies, communal activities rooted in cultural traditions can either encourage or obstruct involvement in water projects. Social capital, which refers to the networks and relationships within a community, also plays a crucial role. Lam (1998) found in Nepal that higher social capital correlated with greater community participation in water resource management. Communities with strong social ties are better equipped to mobilize resources and plan collectively. However, cultural and social factors can create barriers, such as traditional hierarchies that marginalize groups like women, youth, and ethnic minorities, limiting their decision-making power (Adams et al., (2018). Overcoming these barriers requires culturally sensitive approaches that promote inclusivity and equity. The literature emphasizes the importance of community participation in rural water project planning and identifies various socio-economic, demographic, institutional, and cultural factors influencing participation levels. Despite valuable insights, significant gaps remain, especially in the Tanzanian context. Quantitative methods, such as logit models, offer a promising way to address these gaps. Focusing on the Simiyu Region, this research could contribute to improving community engagement in rural water projects and inform sustainable water management strategies.

2.9. Summary of Background and Direction Chosen in The Upcoming Research Compared to Past Research

Access to clean water remains a critical global challenge, particularly in rural regions of developing countries such as Tanzania. Although numerous water supply projects have been launched to address this issue, many fail due to inadequate community participation in the planning phase. In the Simiyu Region, where water scarcity is exacerbated by climate change and

institutional limitations, community engagement remains notably low. Previous studies have highlighted socio-economic and institutional barriers-including gender disparities, income, education, and governance-as key obstacles to effective participation. However, much of the existing literature has lacked rigorous, context-specific empirical analysis, particularly in northern Tanzania.

This study addresses this gap by employing a logit regression model to investigate the socio-economic and institutional determinants of community participation in rural water project planning in Simiyu. Unlike earlier research, which was largely descriptive, this study adopts a quantitative, evidence-based approach to identify significant predictors of engagement. The upcoming research thus moves beyond general assumptions to provide data-driven insights into the dynamics of participation. It aims to inform more inclusive and sustainable water management strategies by integrating variables such as community awareness, gender norms, and prior planning experience into policy design.

The conceptual framework (Figure 1) for this study integrates insights from the theoretical foundations and organizes the determinants of community participation into four broad categories: socio-economic factors, demographic factors, institutional factors, and cultural factors. These categories provide a structured approach to analyzing the determinants of participation in rural water project planning in the Simiyu Region, Tanzania.

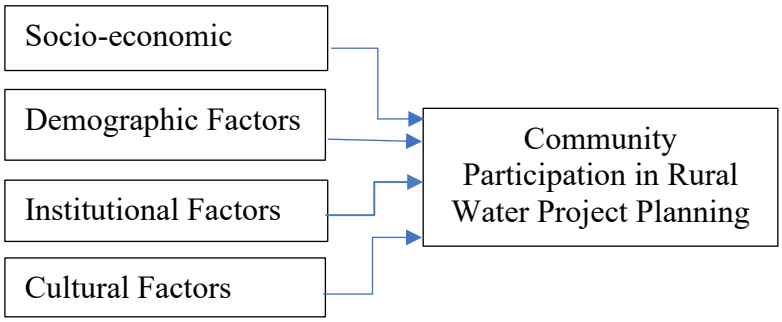

Figure 1. conceptual framework for determinants of Community Engagement in Rural Water Project Planning in Simiyu

Source: Study Design, 2024

3. Research Methodology

3.1 Geographical Scope of the Research

This study was conducted in Simiyu Region in Tanzania. Simiyu Region is located North of Tanzania and South East of Lake Victoria, lying between Latitude 2^0 1" and 4^00" South of Equator and between Longitude 33^03" and 35^0 1" East of Greenwich. The region covers an area of 23,807.7 square kilometers and has the population of 2,140,497 (1,034,681 Males and 1,105,816) with population growth rate of 3.1percent per annum (NBS, 2023). Clean and safe water accessibility in the Region is estimated to cover 59% of the regional population whereas in Rural Area it is estimated to be 55.2% and in urban areas is estimated to be 62.8%.

The study used cross-sectional research design to collect data from a cross-section of the all households in the study area where water development projects have been taking place. Data were collected from ten wards in Simiyu Region (See Figure the Map of Simiyu Region) which included Sapiwi, Nguliati, Matongo, Ibulyu, Mwasubuya (from Bariadi District), Seng'wa, Sukuma (from Maswa District), Nyaluhande, Kiloleli (from Busega District), and Mwamtani (from Itilima District).

Figure 2. Map of Simiyu region showing all district under the region
Source: SIG, 2017

3.2 Methodology

These wards were purposively selected due to the presence of ongoing or completed water projects. The study employed mixed sampling methods whereby Simiyu Region was purposively selected from Tanzania's 30 regions, with the wards selected purposively based on their involvement in water development projects. Table 1 presents the distribution of wards per district and the corresponding number of households.

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Table 1. Number of Wards Selected

District	Wards	Selected Wards*	Total Households
Maswa	26	2	3,774
Bariadi	26	5	15,035
Busega	15	2	5410
Itilima	22	1	1713
Total			25,932

Due to the fact that, the number of Wards selected per District was varied as well as the corresponding households, this also had an implication on the number of households per ward to be selected to participate in the research. In order to achieve at the total number of households required (determined sample size) and in order to avoid biasness, the Random Probability Proportional to Size Sampling (RPPS Sampling) technique, also known as Probability Proportional to Size (PPS) sampling technique was employed in this situation to determine the number of households to be involved in the study based on the size of the population per ward. According to Yu, (2019), Lohr, (2019) and Cochran, (1977), random probability proportional to size sampling (RPPS) is a sampling procedure where the probability of selection is chosen randomly proportional to the size of the units in the population. They argue that, the probability of selecting a unit from the population is directly proportional to its size or a measure associated with it (e.g., population, or area). In this case larger units have a higher probability of being selected compared to smaller ones. Thus Wards with higher number of households have high probability of having more participating households and vice versa. In order to determine the number of households to be sampled per ward when using

Probability Proportional to Size (PPS) sampling, the sample size was allocated to each ward proportionally to the total number of households in that ward. Here is how the number of households to be selected per ward was determined.

Step 1: **Determining the Total Number of Households:** The total number of households were to be calculated by summing up the households across all six wards as follows:

Total Households = 3,774+15,035+5,410+1,713=**25,932HH** (See Table 2).

Step 2: **Determining the proportion of households in each Ward**: The proportion of households in each Ward was to be determined i.e. for each ward, the proportion of the total households it represents were determined by using the following approach:

$$Proportion\ for\ a\ Ward = \frac{Households\ in\ the\ Ward}{Total\ Households}$$

Step 3: **Allocation of sample size proportional to the Ward:** The researcher had to perform the allocation of sample size proportionally by multiplying the proportion for each Ward by the total sample size (217):

Sample Size for a Ward = Proportion for the Ward×217 (Total Sample Size)

Now by applying that formula, Table 2 presents the detailed calculation of households for each ward

Table 2. Determination of Sample Households Per Ward

Ward	Households (N_i)	Proportion (N_i/25,932)	Sample (217 x Proportion)
Maswa	3,774	$\frac{3,774}{25,932} = 0.1456$	0.1456 x 217 = 31.6 ≈ 32
Bariadi	15,035	$\frac{15,035}{25,932} = 0.5798$	0.5798 x 217 = 125.8 ≈ 126
Busega	5,410	$\frac{5,410}{25,932} = 0.2085$	0.2085 x 217 = 45.2 ≈ 45
Itilima	1,713	$\frac{1,713}{25,932} = 0.0661$	0.0661 x 217 = 14.3 ≈ 14

From Table 2, it was concluded that the rounded number of households to be sampled per Ward was as calculated in column 4.

The remaining task was to actually select the specific households to participate in the research from each Ward taking into account to number of households determined per Ward (See Table 2). The systematic sampling approach was applied within each ward to select the required households. This method ensured even coverage across the ward's household population and was both practical and efficient for this study's scenario. In order to apply systematic sampling, the following procedure was used. After obtaining the sampling frame from the Ward office, we were required to determine the sampling interval (k) as presented in Table 3, which was obtained by taking the total households in the ward (N_i) divided by the number of households to be sampled in that ward (n_i); thus

$k = \frac{Ni}{ni}$, For example, in Maswa Ward:

$k = \frac{Ni}{ni} = \frac{3,774}{32} \approx 118$

After determining the sampling interval for each ward, we had to determine the random start by **s**electing a random number between 1 and k (sampling interval number). This random start was the first household in the sample. Thereafter, we had to **s**elect every k-th household by **s**tarting from the random start and picked every k-th household until the sample size per ward was met (Refer Table 2).

Table 3. Sampling Interval per Ward

Ward	Total number of households	No. Of Households Sampled	Sampling interval (k)
Maswa	3,774	32	118
Bariadi	15,035	126	119
Busega	5,410	45	120
Itilima	1,713	14	122
	25932		

The sample was selected from the study population and was determined by using adjusted Yamane's formula (Adam, 2020). This formula was proposed for this study because of its ability to balance correctness with practicality. It was deemed useful because we had the finite population and we needed to account for desired precision levels, variability in the population, and sampling error. In this study, it was essential to specify the margin of error (e) that reflects the acceptable level of precision for the study, in this case a margin of error of 0.05 or 5% was desirable. Furthermore, according to Israel, G. D. (1992) and Yamane, T. (1967), this formula is particularly effective for populations that do not exceed 600 individuals which applies well for this study. In the view of the above, the sample size for this study was determined as follows: -

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

Where by
n = Sample size
N= Population size
e = Margin of error (desired level of precision at 0.05 or 5%)

Thus, $n = \frac{543}{1+543(0.05)^2} = \mathbf{217}$

The study population (N) is estimated to be 543 where by E = margin errors and the confidence level is 95%. Then the sample size was considered to be 217.

Data were analyzed using econometric (Logit l) Mode and descriptive analysis was used to supplement the former.

Logit model - The Logit Model, also known as the logistic regression model, was the statistical technique deemed appropriate to be used for analyzing data because the dependent variable (outcome) was binary or categorical i.e., households' decision to participate in planning or otherwise (Fredrick & Ahmad, 2023). Basically, the use of this model was to predict the probability of households to participate in planning as a function of one or more independent variables such as sex, age, occupation status, awareness, education level, income level, experience, household size, marital status, project policy community culture and government regulations (these were the predictor variables.

Furthermore, according to Ntibona et al., (2023), the model was usefully employed as it could simultaneously analyze the impacts of both continuous and categorical explanatory variables on the outcome variable which was either to participate in planning or otherwise. Referring to Fredrick & Ahmad, (2023) if the probability of participation was given by P_i, then the cumulative logistic distribution function was expressed as follows: -

$$P_i = E(Y = 1|X_i) = \frac{1}{1 + e^{-z}} \dots\dots\dots (1)$$

Where $Z = \beta_0 + \beta_1 X_1 + \beta_2 X_2$. Equation (1) can further be modified to; -

$$P_i = \frac{e^z}{1 + e^z} \dots\dots\dots\dots\dots\dots (2)$$

Given that the probability of participating in project planning is represented by P_i, the probability of not participating is represented by $(1 - P_i)$ which is given by the following equation.

$$1 - P_i = \frac{1}{1 + e^z} \dots\dots\dots\dots\dots\dots (3)$$

Dividing equation (2) to equation (3) gives the odds ratio $(P_i/(1 - P_i)$ which is given as: -

$$\frac{P_i}{1 - P_i} = \frac{\frac{e^z}{1 + e^z}}{\frac{1}{1 + e^z}} = e^z \dots\dots\dots\dots\dots\dots\dots (4)$$

By applying the natural logarithm to the left- and right-hand sides of equation (4) to aid estimation of the model, the equation translates into equation (5) which was used to estimate socio economic determinants and institutional factors for community participation in planning process for water projects as: -

$$ln\left[\frac{P_i}{1 - P_i}\right] = Z = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_{4+} \dots \beta_{12} X_{12+\mu_i} \dots\dots (5)$$

Whereby z is a binary indicator for participation P = decision to participation in planning for rural water project, (1-P) represents the decision not participate, βo = Constant, β1—β12 = Parameter estimates, and X_1=Age, X_2=Sex, X_3=Occupation status, X_4=Education levelX_5 = Income level X_6= Experience X_7 = Awareness X_8 = House hold size X_9=Marital Status X_{10}=Project Policy X_{12} = Community Culture and μ = is the error term.

Table 4. Measurement of the key variables

Variables	Measuring	Measurements scales	Expected Sign
Decision To Participate	Yi = 1, If one participates	Binary	+/-
	Yi = 0, If one does not participate		
Sex	Measured the sex orientation of participants	Categorical	+/-
	1 = Male, 0 = Female,		
Age	Measured number of years household head have	Continuous	+/-
Occupation	Measured the type of occupation the Head of Household has engaged in 1.= Agriculture	Categorical	+/-
	2.= Small business		
	3 = Livestock		
	4. = Civil servant 5 = others		
Awareness	Measured if individual is aware of the concept of participation or not	Categorical	+/-
	1=if aware and 0= If is not aware		
Education	Measured the level of formal education head of household has attained 1. Not formal education, 2. Primary education, 3. Secondary education, 4. Tertiary Education	Ordinal	
			+/-
Income	Measured the amount cash money the household head obtain in all sources of his/her income per year	Continuous	+/-
Household Size	Number of household members	Continuous,	+/-
Marital Status	Measured by the marital status of a household head	Categorical	+/-
	1.= Married, 2. = Never married		
	3.= Separate, 4. = Divorced, 5. = Widow		
	6.= Widower		
Experience	Measured the frequency of individual's involvement in the planning process of water projects	Continuous	+/-

4. Research Findings

4.1. Descriptive Statistics

In this section various demographic characteristics of the participating heads of households are presented in Table 5.

Table 5. Description of respondents' characteristics

Component	Attribute	Number of respondents	Percentage
Sex	Male	112	51.61
	Female	105	48.39
	Total	217	100%
Marital Status	Married	136	62.67
	Separated	32	14.75
	Unmarried	32	14.75
	Divorced	7	3.23
	Widow	7	3.23
	Widower	3	1.38
	Total	217	100%
Education Level	No education	25	11.52

Component	Attribute	Number of respondents	Percentage
	Primary education	64	29.49
	Secondary education	70	32.26
	Tertiary level	58	26.32
	Total	217	100%
Occupation status	Agriculture	49	22.58
	Small business	88	40.55
	Livestock keeping	55	28.34
	Civil Servants	35	16.13
	Total	217	100%
Awareness	Aware	199	91.71
	Not aware	18	8.29
	Total	217	100%
Experience	Have experience	161	74.19
	Not have experience	56	25.81
	Total	217	100%

Source: Research Data, 2024

The results in Table 5 of the demographic characteristics of respondents, indicate a well-balanced sample, with nearly equal gender representation (51.61% male, 48.39% female). The predominance of small business owners (40.55%) reflects the community's entrepreneurial spirit. While the high awareness rate (91.71%) suggests the effectiveness of previous outreach programs, and awareness campaigns made through public meetings, workshops and conferences, had positive impact on community members awareness about the concept of participation in project planning and its importance in project sustainability, though the minority unaware population (8.29%) highlights an area for targeted intervention. Notably, tertiary education's significant representation (26.32%) aligns with higher occupational roles such as civil service, emphasizing the role of education in upward mobility. These findings provide critical insights into tailoring future policies and interventions to the community's needs." The very impressive results are those on experience in participating in planning water projects. The highest proportion of 161 individuals (74.19%) with experience in projects planning its a good sign that participatory project planning is highly practiced in Simiyu Region, something that need to be encouraged. It was learnt that; this higher percentage of participating households being experienced in planning for development project was highly contributed by being involved in project planning process through force account system where by local people were involved in planning and implementing various development projects including rural water projects.

4.2. Determinants of Community Engagement in Rural Water Project Planning in Simiyu

The main aim of this study was to determine the factors responsible for households in Simiyu Region to participate or not in planning for rural water projects. In order to achieve this objective, participants were asked "to list all factors that could encourage or hinder particular households to participate in planning for rural water projects or otherwise." In order to be able to achieve this main aim of the project, that is when collected data were subjected to the Logit Model for analysis; we treated decision to participate in planning for rural water project as the outcome variable while a number of attributes were treated as predictor variables composed both of metric and non-metric variables. The results of this logistic regression analysis from STATA 15 are presented in Table 7.

Model specification test justifying the use of logistic regression

According to Gujarati & Patel's (2014) explanation of model specification, it has been suggested in his study that the model's specification is a crucial component of econometric analysis and that it must be appropriately stated. If this component is not examined, it could lead to biased or incorrect model specification. The link test command in STATA 15 was used to conduct the test in this investigation. When the dependent variable is related to the independent variables, this test looks for specific errors.

Table 6. Model specification test (Link test)

Number of observations = 217					
LR chi^2(2) = 76.51					
Prob> chi^2 = 0.0000					
Log likelihood = -16.801287				Pseudo R2 = 0.6948	
Participation	Coefficients	Standard Error	Z	P>|z|	[95% Conf. Interval]
hat	.9880531	.2607102	3.79	0.000**	.4770706 1.499036
_hatsq	-.0219741	.0918865	-0.24	0.811	-.2020683 .1581201

Source: (Field data, 2024).

The model specification test, is often conducted using a link test, to evaluate whether a regression model is correctly specified. In Table 6, the results of a link test are presented, showing coefficients, standard errors, and p-values for variables (hat and \text{_hatsq}). Once the estimates were obtained, the model specification error was calculated to see if the model accurately reflected the direction that the hypothesis suggested. Hypothesis null (H_O): Alternative hypothesis (H_1): the model is not well specified; the model is well specified.

Key Observations from the Results

1. Number of Observations (*n*):
   - n=217: Indicates a reasonable sample size for robust model testing.
2. LR Chi-Square and Pseudo R^2:
   - LR chi^2(2) =76.51, Prob > χ2 = 0.0000
     - A highly significant *p*-value (<0.05) indicates that the predictors, as a whole, explain a significant portion of the variance in the dependent variable.
   - Pseudo R^2=0.6948: Suggests the model explains approximately 69.48% of the variability in the dependent variable, which is a relatively strong fit for logistic regression.
3. Interpretation of Coefficients:
   - hat Coefficient **(**0.9880531**)**:
   - Statistically significant (*p*<0.000), with a positive coefficient indicating that the predicted values strongly correlate with the outcome variable.
   - \text{_hatsq} Coefficient (−0.0219741):
     - Not statistically significant (p=0.811>0.05), suggesting no evidence of omitted variable bias or incorrect functional form.
4. Confidence Intervals:
   - The confidence intervals for hat ([0.477,1.499]) exclude 0, reaffirming its significance.
   - The confidence intervals for \text{_hatsq} ([−0.202,0.158]) include 0, consistent with its lack of significance.

Interpretations:

1. Correct Model Specification:
   Since \text{_hatsq} is not significant (*p*>0.05), the model appears correctly specified. There is no strong evidence of functional form misspecification or omitted variable bias.
2. Good Model Fit:
   The high pseudo R^2 and significant LRχ^2 value indicate the model is well-fitted to the data.
3. Practical Implications:
   The strong significance of hat confirms that the model's predicted values are meaningful. Thus, researchers can confidently interpret the model's predictors' effects on the dependent variable.

Results from the analysis of the relationship between various predictor variables and the outcome variable (decision to participate in planning or otherwise) as described in equation 5, are presented in Table 7. The essence here was to be able to determine which among the predictor variables are actually the main determinants for community members in the research areas to participate in the planning of water projects or otherwise.

Table 7. Determinants of Community Engagement in Rural Water Project Planning in Simiyu.

Variables	**Coefficients**	**Marginal effects**
Age	1.133324	0.116483**
	(0.622487)	(0.063336)
Sex		
Male	0.953626	0.09805**
	(0.459935)	(0.04532)

Variables	Coefficients	Marginal effects
Marital status		
Separated	-0.20584 (0.544336)	-0.02212 (0.05898)
Unmarried	0.156184 (0.550932)	0.01527 (0.053278)
Divorced	-0.20919 (0.967205)	-0.0225 (0.107838)
Education		
Primary education	-1.19267 (0.746149)	-0.10615 (0.060631)
Secondary education	-1.02421 (0.747529)	-0.08682 (0.057193)
Tertiary level	-1.03535 (0.859878)	-0.08805 (0.080222)
Household size	0.046528 (0.050728)	0.004782 (0.005063)
Occupation		
Small business	1.453318 (0.593849)	0.161392** (0.059521)
Livestock	1.67837 (0.731766)	0.176897** (0.063613)
Awareness	2.340606 (0.840689)	0.246565** (0.083703)
Availability of Project policy		
	0.173716 (0.687231)	0.01731 (0.066045)
Culture and altitudes of people		
	-2.01349 (0.798464)	-0.21341 (0.081234)
Experience of the households on project		
	1.331405 (0.520125)	0.174588** (0.0828)
Constant	-5.61119 (2.459664)	
Observations	217	217

Source: Research Data Analysis output, 2024

The findings of this study provide valuable insights into community participation in planning process for sustainability of rural water project in Simiyu region. Results have important implications for water policymakers, government agencies (RUWASA)[2], and donors in ensuring the sustainability of the implemented rural water projects. In Table 7, the presented results highlight the determinants of community participation in the planning of water projects in Simiyu, focusing on variables such as age, gender, education, household size, occupation, awareness, and others. A detailed discussion of the findings is presented hereunder in the form of key findings and interpretations.

Demographics (Age and Sex)- Results in Table 7, shows that age significantly influences participation in water project planning, with older individuals showing a higher likelihood of involvement (marginal effect = 0.116, $p < 0.05$). This finding may stem from the stronger sense of responsibility and deeper connection to community needs observed in older individuals. These findings seem to be aligning with studies like Chifamba

2 RUWASA stands for Rural Water Supply and Sanitation Agency

(2013), which found age to be positively correlated with involvement in development initiatives. Furthermore, results show that, male individuals are significantly more likely to participate than females (marginal effect = 0.098, $p < 0.05$). This gender disparity could reflect sociocultural norms limiting female participation. These findings are consistent with those of Mugerwa et al., (2019) in African rural settings.

Education- The results from the analysis in Table 7 highlights that education levels (primary, secondary, and tertiary) are negatively correlated with participation in community water project planning. Specifically, the coefficients for education are -1.19267 (primary), -1.02421 (secondary), and -1.03535 (tertiary). The marginal effects are also negative but statistically insignificant (-0.10615, -0.08682, and -0.08805, respectively). These results align with the hypothesis that individuals with higher education levels may be less likely to participate in rural community initiatives due to migration to urban areas for employment opportunities or other pursuits that reduce their availability.

Contrastingly, studies like Hakim, (2020). emphasize the empowering role of education in promoting civic engagement. Their findings suggest that education equips individuals with critical thinking and problem-solving skills, enhancing their capacity to contribute to decision-making processes. This divergence in findings could stem from contextual differences, particularly regarding rural-urban dynamics and employment opportunities in Simiyu compared to other study settings.

Occupation- Drawing from Table 7, results shows that individuals engaged in small businesses and livestock farming are significantly more likely to participate (marginal effects = 0.161 and 0.177, respectively, $p < 0.05$). The marginal effects for small business engagement are 0.161 ($p < 0.05$), indicating a positive and statistically significant influence on participation in water projects. Similarly, for livestock farming, the marginal effect is 0.177 ($p < 0.05$), further supporting the observation that occupations reliant on natural resources are critical determinants of participation in planning for water projects. These findings demonstrate that individuals engaged in occupations tied to resource-dependent livelihoods perceive greater stakes in water projects. These findings are aligning with findings such as of Nchofoung & Ojong (2023) , which emphasize that resource-dependent livelihoods-such as agriculture, livestock farming, and small-scale business-create strong incentives for communities to engage in natural resource management initiatives, including water projects. This is because these groups are more vulnerable to resource scarcity and benefit directly from improved resource management. These findings are suggesting that, the reliance on natural resources for livelihoods suggests that water projects directly impact their income and productivity. Hence, individuals in these categories have higher incentives to participate in planning and implementation phases. Additional studies in community resource management reinforce the idea that individuals' engagement is driven by their dependence on and proximity to natural resources (e.g., Ostrom, 1990; Pretty, 2003).

Awareness and Experience- Based on the results presented in Table 7, it is shown that awareness is the most influential determinant, this is strongly supported by its significant marginal effect (0.247, $p < 0.05$). This highlights the importance of information access in promoting participation to various development initiative such as planning for rural water projects. To further substantiate this, several supporting points can be discussed:

Impact of Awareness on Participation: The analysis clearly indicates that awareness has the highest marginal effect (0.247). This suggests that individuals who are more aware of water project planning are significantly more likely to participate. Such a finding aligns with prior studies, like Isham and Kähkönen (2002), which argue that informed communities are more motivated to engage in collective action. Awareness facilitates understanding of benefits, fostering a sense of ownership and accountability.

Household Experience in Water Projects*:* The significant marginal effect of prior household experience (0.175, $p < 0.05$) further strengthens the role of previous exposure in shaping attitudes toward participation. This suggest that, households with prior experience in similar projects are likely to possess practical knowledge and are better equipped to understand the planning process, contributing to higher involvement.

Role of Sensitization Campaigns**-** Sensitization campaigns can play a pivotal role in addressing the

lack of awareness and experience. These campaigns should focus on delivering accessible and targeted information, emphasizing the value of community input in water project planning. For example, they could leverage tools like workshops, community meetings, or media outreach to bridge gaps in awareness.

Cultural Barriers and Attitudes**-** The negative effect of "culture and attitudes of people" (-0.213, $p < 0.05$) observed in the data emphasizes that certain cultural norms or perceptions can hinder participation. This underscores the need for tailored awareness campaigns that address cultural sensitivities and build trust in the planning process.

Broader Implications for Policy: Policies encouraging community participation must prioritize awareness-raising activities. Policymakers could incorporate strategies to disseminate project-related information broadly while drawing on households with experience to act as community advocates or role models.

Cultural Factors- The results in Table 7, shows that Cultural attitudes exhibit a significant negative influence (marginal effect = -0.213, $p < 0.05$), suggesting that certain cultural norms and perceptions act as barriers to participation. The findings indicates that the variable "Culture and attitudes of people" has a statistically significant negative coefficient (-2.01349) with a marginal effect of -0.213 ($p < 0.05$). This implies that cultural norms strongly discourage community participation in water project planning and is consistent with Cleaver's (2001) "culture of disengagement," where traditions and norms hinder collective actions. These marginal effect values are very significant in explaining this participating variable in the sense that, the marginal effect (-0.21341) indicates that for every unit increase in the negative cultural attitude, there is a 21.3% reduction in community participation probability. The p-value (<0.05) confirms the statistical reliability of this finding. Meaning that the more rural communities focus on honoring cultural values, there is a high likelihood of not participating in development initiatives. In relation to other variables, the results in Table 7, have further revealed that cultural attitudes are the most significant negative predictor among the variables analyzed. In comparison, education (e.g., secondary education, marginal effect = -0.08682) and marital status (e.g., divorced, marginal effect = -0.0225) have smaller and often statistically insignificant effects. On the other hand, variables such as "Awareness" (marginal effect = 0.2466, $p < 0.05$) and "Livestock occupation" (marginal effect = 0.1769, $p < 0.05$) positively influence participation. This contrast highlights the unique role of cultural attitudes as a barrier to participation, underlining their negative influence even amidst other enabling factors. Cleaver's (2001) argument that entrenched traditions and perceptions prevent effective community engagement aligns directly with the findings in this study. The significant marginal effect of cultural attitudes reinforces her assertion that cultural norms can create passive resistance to participatory approaches in development planning.

5. Discussion and Conclusion

The logistic regression model identified several key factors influencing community participation in rural development, including age, gender, occupation, awareness, household experience, and cultural attitudes. These findings provide valuable insights for policymakers and development practitioners aiming to boost community involvement. Age was positively correlated with participation, with older individuals more likely to engage due to their sense of responsibility to the community. Gender played a significant role, with men participating more than women, likely due to sociocultural norms limiting women's involvement in public decision-making. This highlights the importance of considering demographic factors in designing inclusive strategies for engagement. Unexpectedly, education showed a negative, though statistically insignificant, relationship with participation, possibly due to rural-urban migration or other socio-economic factors. Occupation was a stronger determinant, with individuals in small businesses or livestock farming more likely to participate, underscoring the importance of engaging resource-dependent livelihoods in water projects. Awareness emerged as the most influential factor, with individuals who were more informed about water project planning more likely to participate. Household experience with previous projects also positively influenced involvement. Conversely, cultural attitudes, particularly negative norms, acted as a barrier, with entrenched traditions discouraging participation.

This study suggests that, to improve community participation, policymakers should prioritize awareness-raising activities, such as community meetings and workshops, and focus on empowering women through gender sensitization programs. Efforts should also engage resource-dependent groups, like small business owners and farmers, to ensure their active involvement and enhance project sustainability.

Acknowledgments: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Authors' contributions: Being a single authored article, the author contributed 100% to the preparation of this article

Conflict of interest: The author declares no conflict of interest

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