



Education for Empowerment: Women's Involvement in Management of Borehole Water Projects in Garissa County, Kenya

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How to cite this paper: Hussein, F., Odek, A. and Wamüyü, T.W. (2025) Education for Empowerment: Women's Involvement in Management of Borehole Water Projects in Garissa County, Kenya. *Open Access Library Journal*, 12: e14110.
<https://doi.org/10.4236/oalib.1114110>

Received: August 12, 2025

Accepted: October 20, 2025

Published: October 23, 2025

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Abstract

Women's involvement in the management of water resources has the potential to generate significant societal benefits. However, their participation remains disproportionately low. This study examined the relationship between women's educational attainment and their involvement in the management of borehole water projects in Balambala Sub-County, Garissa County, Kenya. A total of 200 women and 2 key informants were sampled. Data collection involved questionnaires for the women and interviews with the key informants. Quantitative data were analyzed descriptively, while qualitative data were examined thematically. The study found that 66% of respondents perceived access to education as skewed in favour of males, and 70.9% reported that educational background was a key criterion for selecting leaders in local water projects. Binary logistic regression analysis showed a statistically significant relationship between educational level and leadership participation. Respondents with secondary education were 2.4 times more likely to hold leadership roles compared to those with no formal education (OR = 2.41, $P < 0.05$), while respondents with tertiary or university education were 3.7 times more likely (OR = 3.72, $P < 0.01$). These findings indicate that higher educational attainment substantially increases women's likelihood of participating in water governance. Therefore, promoting equal access to education for both genders is essential to address gender disparities in the management of borehole water resources.

Subject Areas

Hydrology, Sociology

Keywords

Education, Women, Water, Management, Balambala

1. Introduction

As water scarcity and conflict worsen due to rising water demand and climate change, management of water is becoming an increasingly crucial topic. International recognition has been drawn to the importance and centrality of women's involvement in management of local water projects. For instance, as far back as 1981, the United Nations Conference at Mar del Plata highlighted the importance of women's role in water-related development initiatives [1]. Similarly, the Dublin Principles established during the 1992 United Nations Conference on Environment and Development affirmed that women must play a significant role in the administration, provision, and preservation of water [2]. Furthermore, achieving Sustainable Development Goals (SDGs) 6 and 5, which focus on universal access to water and sanitation and on gender equality, depends on women's active participation in community water initiatives [3]. Despite the recognition of the need for women involvement, they remain under-represented at all levels of water management, from national institutions to local committees, with women accounting for not more than 17% of the overall workforce in the water sector [4].

The limited participation of women is occasioned by many socio-economic barriers among them, education [5]. A study on gender-responsive water project management in Kajiado also found that women are underrepresented on management committees; and that illiteracy in water resource management is one of the major constraints limiting their engagement [6]. Despite efforts made through global conventions and legal frameworks to ensure equal access to education for women, significant disparities persist in many countries, especially in low-income nations and those affected by conflicts. For instance, Afghanistan holds the record for denying women access to education and involvement in any kind of leadership. Since taking over leadership of the country in 2021, the Taliban government has completely isolated women and girls in education and consequently in employment across all sectors [7].

The situation is not any different regionally. In Ethiopia, Sherka examined women's participation in soil and water conservation (SWC) activities in Abeshege, southern Ethiopia, using a sample of 164 participants and 70 non-participants drawn from six purposively selected rural kebeles. The study found that education was a significant factor influencing women's participation in SWC [8]. It has been affirmed that while girls in that country have had increased opportunities to engage in education, their success is greatly hampered by socio-cultural issues especially the negative attitude towards girls' education coupled with the issue of gender-based division of labour. As such, few women are incorporated in Water Users Association (WUA) committees and even the few are often side-lined when it comes to decision making in the committees.

Studies conducted in Kenya echo global findings that link women's participation in water resource management to their educational attainment. For example, research in Kajiado West Sub County, Kajiado County found that among constraints to participation in water resources management, illiteracy—*i.e.* low edu-

cation—was cited as one major constraint. Thus, low education reduces the ability or capacity of women to be involved in meaningful decision-making [6]. More recently, similar issues have been noted in Laikipia and Marsabit Counties. According to community surveys, women in Laikipia continue to shoulder a large portion of the water-fetching burden, which restricts their ability to participate in decision making even as water infrastructure advances [9] [10]. In Marsabit, drought-driven water scarcity has been found to contribute to girls dropping out of school and increasing early marriages, placing constraints on women's time, education, and ability to engage in community governance [10].

There is limited evidence in recent sources to confirm exact levels of women's involvement in decision-making in water project management in Garissa County. This study therefore seeks to fill a critical gap by examining the influence of education on women's participation in the management of community borehole water projects, with a specific focus on Balambala Sub-County in Garissa County.

2. Methods

The study adopted a descriptive survey research design with quantitative and qualitative approaches. The study area was Balambala Sub-County of Garissa County in Kenya. The area is characterized by arid conditions and water provision is mainly reliant on borehole water for life sustenance. Garissa County also stands out as one of the regions in Kenya where education for girls is largely limited by cultural issues such as early marriages and nomadism [11]. As such, the area was deemed ideal for understanding the dynamics between education level and women involvement in management of community water supply projects [12].

The population under the study was formed by female water users connected to 20 community-managed boreholes and local administrators. From the water users, a sample of 200 women was drawn through systematic random sampling, where every fifth woman arriving at the kiosk on the day of data collection was selected. Two administrators were included as key informants through purposive sampling: the area chief and the sub-county director of education. The sample size of 200 matched the local Water Users Association (WUA) structure. This was because each borehole was approximately represented by a committee of 15 members, so 20 multiplied by 15 comprised of roughly 300 committee members.

Sampling 200 respondents offered a balanced statistical representativeness of users who were non-executive. This directed the study mainly towards everyday users rather than the smaller proportion of executive members. Statistically, the sample size of 200 gives a ± 6.9 percentage point margin of error at the 95% confidence level for values of prevalence around 50%, sufficient for community-level description but underpowered for many subgroup comparisons or more complex multivariable models.

The single-day, kiosk-based systematic sampling method was advantageous because it reduced selection bias by systematically sampling every 5th individual and is less impacted by seasonality because water collection patterns remain relatively

consistent throughout the day. In order to accommodate a flexible investigation of the risks, enumerators recorded the time of interview, village of the respondents, and borehole Identifications (IDs) to account for time of day, place and interviewer patterns.

Prior to the main survey, the questionnaire was piloted in Fafi Sub-County, a neighbouring area with socio-economic and cultural characteristics comparable to Balambala. Fifteen participants were involved in the pilot, which tested item clarity, sequencing, translation flow, and comprehension. Feedback from the pilot led to minor adjustments in wording and question order. Internal consistency of constructs was assessed using Cronbach's α and item-total correlations. Most constructs reported a reliability coefficient of Cronbach's $\alpha = 0.82$, which was above the 0.70 threshold, while two subscales were lower, with the weakest at $\alpha = 0.64$ ($n = 15$). Given the small pilot sample, these values were treated cautiously, but the items were retained to preserve theoretical coverage and content validity.

Data was collected during fieldwork via a structured questionnaire administered in a face-to-face fashion and through in-depth interviews with the key informants. To enable the researchers to be as inclusive as possible, translations into Somali were undertaken on the spot by trained enumerators. A total of 200 questionnaires were administered, 182 were satisfactorily completed and returned (response rate was 91 percent). The two planned key-informant interviews were undertaken hence the qualitative component was completed. Descriptive and inferential statistics were conducted on the quantitative data and thematic analysis on the qualitative interviews.

Ethical approval of the study was given by the St. Paul's University Research Ethics Committee. Subsequently, a research permit was issued for the study by the National Council for Science, Technology and Innovation (NACOSTI), and clearance for the study was given by the Garissa County Commissioner. Informed consent was received from all participants after they were informed about the purpose of the study, that participation was voluntary and that they could withdraw at any point and not be penalized. Anonymity was maintained by coding the instruments to conceal identities and to ensure confidentiality.

3. Results and Discussions

3.1. Access to Education vis-à-vis Gender

The study aimed to assess gender-based disparities in access to education within the study area. Respondents were asked whether boys and girls had equal opportunities to access educational resources and services. In addition, participants were prompted to indicate which gender, if any, was perceived to be more advantaged in terms of educational access. The responses were analyzed, and the findings are summarized in **Figure 1**.

From the captured data above, the majority of respondents (66%) were of the view that boys and girls did not have equal opportunities to attend school. These findings were in tandem with statistics in the larger Garissa County which shows

that boys make up 54.9% of school-going children in primary school while girls make up 45.1%. Even more alarming statistics are reported in secondary school where the proportion of boys stands at 57.1% and 42.9% for girls [11].

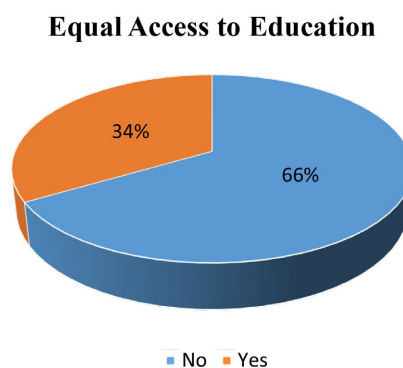


Figure 1. Gender and access to education.

In a follow-up question, respondents who responded by ticking ‘No’ in the previous question were asked which gender was more likely to attend school. The respondents overwhelmingly asserted that boys were more likely to attend school as compared to girls. This was further echoed in the interview with the Sub-County Director of Education who said:

The government has made education accessible to both boys and girls in all parts of the country. However, in this community, attaining gender parity in access to education has been a tall order. This is mainly due to cultural issues such as early marriages for girls.

The findings are also supported by the County Integrated Development Plan (CIDP), which clearly articulates that the transition rate for girls in the larger Garissa County is relatively low due to cultural issues such as nomadism and early marriages. They affirm the need for concerted campaigns to sensitize the communities on the need to educate girls [11].

3.2. Role of Education in Management of Water Projects

The study explored respondents’ perceptions regarding the influence of education on the selection of women into leadership positions within community water projects. Participants were presented with a series of statements assessing the perceived role of educational attainment in determining leadership opportunities for women. The responses were analysed, and the findings are summarized in **Table 1**.

The results presented in **Table 1** show that a significant majority of respondents (70.9%, n =129) agreed that educational background was considered when selecting candidates for leadership roles in water management projects. When asked whether education was the main consideration for selection to water management positions, a similarly significant majority (66.5%, n =121) of respondents agreed to it. Responses to the two questions affirmed that the sampled community valued

educational qualifications and often placed persons in leadership positions depending on their levels of education.

Table 1. Respondents' views on role of education in water management.

Statements	Yes		No	
	F	%	F	%
When choosing candidates for leadership roles in water management initiatives, educational background is taken into account	129	70.9	53	29.1
Education level is the main consideration in selecting those that manage water projects	121	66.5	61	33.5
Men and women with the same level of education stand equal chances in management of water projects	95	52.2	87	47.8
Women with higher levels of education are more likely than males to manage water projects	73	40.1	109	59.9
Uneducated men are often selected to manage water projects at the expense of educated women	101	55.5	81	44.5

However, considering that in the previous section, respondents pointed out that access to education was skewed in favour of the male gender, then women are likely to miss out on leadership positions on the basis of lack of education. Previous studies have often presented such scenarios where women were often left out of Water Users Association management committees or even side-lined in decision-making due to their education levels [8] [13]. This underscores the need for the community in question to take the education of the girl child much more seriously.

To further examine the relationship between educational attainment and perceived gender equality in leadership opportunities, follow-up questions were posed to respondents. The additional insights generated are analyzed and presented in **Table 1**. The study established that a majority of respondents (52.2%, n=95) were of the opinion that men and women with the same educational background had equal opportunities to manage water projects. Notably though, the margin here was relatively small.

However, when respondents were asked whether women with higher education were more likely than men to manage water projects, only 40.1% of the respondents supported the statement. 55.5% argued that uneducated men were often selected to manage water projects at the expense of more educated women. The findings in this section indicate that while education was valued and largely considered when selecting leaders to water management committees, traditional gender roles and biases still played a significant role in decision-making, potentially undermining efforts to promote women's involvement in leadership despite their educational achievements. Thus, the importance of addressing some of the retrogressive cultural issues that result in the discrimination of women.

Further, it was important to find out the role of education in enhancing leadership roles of women in the management of water projects. Using the Likert scale,

the respondents were given the opportunity to express their levels of agreement or disagreement with the statements provided. The responses were analysed and the information is presented in **Table 2** followed by a discussion of the results.

Table 2. Women literacy and management of water projects.

Statements	SA	A	D	SD
Literacy offers an opportunity to access information in water management	52 (28.6)	63 (34.6)	40 (22.0)	27 (14.8)
Literacy offers an opportunity to get involved in water management	50 (27.5)	66 (36.3)	41 (22.5)	25 (13.7)
Limited levels of education are associated with women's limited participation in water management projects.	44 (24.2)	68 (37.4)	39 (21.4)	31 (17.0)
Women are generally viewed as lacking abilities of making meaningful impacts due to lack of negotiating skills	60 (33.0)	61 (33.5)	35 (19.2)	26 (14.3)
Women are unable to integrate new technology and skills due to illiteracy	42 (23.1)	67 (36.8)	46 (25.3)	27 (14.8)

*figures that appear in parentheses are in percentages.

From **Table 2**, a substantial portion of the respondents, 28.6% strongly agreed and 34.6% agreed that literacy was essential for accessing information in water management. Similarly, 63.8% of the participants either strongly agreed or agreed that literacy enables involvement in water management. Similar sentiments were reported where 37.4% and 24.2% respectively agreed and strongly agreed that limited education results in limited participation in water projects' management. This broad consensus underscores the importance of education in facilitating participation in water-related projects. As such, enhancing literacy among women could lead to greater involvement and a more informed approach to managing water projects in the study area.

Table 2 further reveals that a majority of the respondents (33.5%) agreed while 33% strongly agreed that women often fell short of making meaningful contributions in management of water projects as a result of lacking negotiating skills. Similarly, 36.8% of the respondents agreed and another 23.1% strongly agreed with the opinion that women were unable to integrate new technologies and skills due to illiteracy. These survey findings were corroborated during qualitative interviews. One key respondent, the local chief, emphasized that:

In recent years, education was often a consideration when selecting members to water management committees. He added that women were more often than not left out of such committees when literacy was emphasized.

This convergence of quantitative and qualitative data suggests a plausible association between education and women's participation in leadership roles.

To examine this association statistically, a binary logistic regression model was estimated, with leadership participation as the dependent variable (1 = participated; 0 = did not participate) and educational level as the independent variable (categorized as none/primary, secondary, and tertiary/university). **Table 3** pre-

sents the results, providing evidence to support the relationship between higher education and increased likelihood of women's involvement in water project management.

Table 3. Logistic regression of educational level on leadership participation (N = 182).

Predictor (Education level)	B (SE)	Wald χ^2	OR (Exp (B))	95% CI for OR	P-value
No formal education (ref)	-	-	1	-	-
Secondary education	0.88 (0.42)	4.41	2.41	1.06 - 5.47	0.036
Tertiary/University education	1.31 (0.45)	8.48	3.72	1.55 - 8.92	0.004

Model statistics: χ^2 (2, N = 182) = 12.6, P = 0.002; Nagelkerke R^2 = 0.18; -2 Log Likelihood = 192.3.

This regression puts forward a positive relationship between educational level with leadership involvement which is statistically significant. Those respondents having secondary education were approximately 2.4 times more likely to occupy leadership positions compared with those having no formal education (OR = 2.41, P < 0.05). Those endowed with tertiary or university education were 3.7 times more likely to enter leadership participation (OR = 3.72, P < 0.01). Thus, these findings further underscore the role of education in enabling leadership while the model explains only 18% of the variance (Nagelkerke R^2 = 0.18), implying other social, cultural, or institutional factors influence women's participation.

These findings are corroborated by recent research on gendered water governance issues in arid zones. [14], for instance, emphasize that women's participation in water governance builds resilience against climate-induced water scarcity and that there is need to address gender narratives and institutional biases in order to promote equal participation. In a similar vein, [15] contend that, even with decades of policy and rights frameworks, women in Sub-Saharan Africa continue to be subject to structural barriers in water governance, as evidenced by discrimination favoring male leadership, access to technical skills, and extent of participation in projects pertaining to water. The findings illustrate that education raises the odds of women in leadership roles, but that it is not a singular factor and that education alone is not sufficient. Further steps need to combine education with changing deeply rooted gender norms, the promotion of equitable water governance, and equality of access to technical capacities and technologies.

4. Conclusions

This study investigated the link between women's participation in management of community borehole water projects and their level of educational attainment in Balambala Sub-County, Garissa County, Kenya. The findings reveal that access to education remains uneven, with cultural norms and socio-economic barriers disproportionately disadvantaging girls. Respondents consistently indicated that low levels of education among women significantly hinder their involvement in leadership and decision-making within community water governance structures.

While national policies and frameworks have made commendable strides towards achieving gender parity in education, the study highlights that substantial disparities persist in marginalized and arid regions. In Balambala Sub-County, entrenched patriarchal practices and limited educational infrastructure continue to limit women's ability to contribute effectively to the management of vital communal resources such as water.

These findings carry critical implications for policy and practice. First, efforts to enhance girls' access to and retention in education should be prioritized through targeted investments in school infrastructure, gender-sensitive curricula, and community sensitization campaigns. Second, integrating adult literacy and leadership training programs for women already engaged in community water projects could bridge immediate capacity gaps while long-term educational reforms take effect.

The study's recommendations align closely with several Sustainable Development Goals (SDGs), particularly SDG 4 (Quality Education), SDG 5 (Gender Equality), and SDG 6 (Clean Water and Sanitation). Ensuring equitable education for both genders is not only a matter of social justice but a strategic necessity for attaining sustainable development and inclusive governance. Empowering women through education enhances the resilience, accountability, and sustainability of community-based resource management, especially in climate-vulnerable regions like northern Kenya.

5. Limitations

Even though the study used systematic random sampling at borehole kiosks, and had a good rate of response consent, there were several limitations to the study that reduced the strength of its conclusions. Many of the data were self-reports, which possibly introduced recall errors and social-desirability bias, because even for questions related to personal engagement and decision-making, it was likely that our respondents overstated their participation. The use of face-to-face survey administration, along with language translation in real time by enumerators, may have introduced the prospect of interviewer effects and social-desirability reporting. Further, the responses were clustered within 20 boreholes, and therefore reduced the effective sample size and consideration of intra-cluster correlation.

The qualitative part of the study was limited to 2 key informants, which limited the diversity of perspectives on governance and diminished the utility of triangulation. The pilot study report included 15 participants in Fafi Sub County in order to substantiate clarity, but was too limited in size to acknowledge any level of site-level variation or produce stable reliability estimates. The mentioned limitations weakened the base of external validity and undermined any basis for causal inference, as the findings must be interpreted only as suggestive patterns not strong claims. That said, the study produced useful household-level evidence of women's participation in water governance in Balambala sub county and provides a platform for more rigorous and extensive research in the future.

Conflicts of Interest

The author declares no conflicts of interest.

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