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GENDER DIFFERENCE IN PREFERENCE FOR GAZETTED FOREST CONSERVATION AMONG SMALLHOLDER FOREST-ADJACENT FARMERS IN ELGEYO MARAKWET COUNTY, KENYA: BEST-WORST SCALING APPROACH

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ABSTRACT: *Gender differences in preference for forest conservation and management are crucial in developing effective, inclusive, and sustainable environmental interventions. Men and women prioritize issues differently due to their varied societal roles, responsibilities, and access to resources. However, little is known concerning these distinctive and important attributes as well as the overall contribution towards conserving and managing the fragile gazetted forest ecosystem. This paper assessed the gender difference in preference attributes under social, economic and environmental alternative scenarios among smallholder forest-adjacent farmers in Elgeyo Marakwet County, Kenya. We used cross-sectional data collected from 419 households and applied a multi-stage and simple random sampling design. The data was analyzed using the Best-Worst scaling experimental approach and a multinomial logistic regression model to assess the determinants of gender preferences towards forest conservation and management aspects. The findings of the study revealed gender disparities in forest-related experiences, educational attainment, and financial well-being by indicating that men had more experience with forest resource engagements and higher levels of education, which could influence their preference for conservation and management interventions. The results further revealed that institutional and coordination abilities are crucial for successful forest conservation; thus, community empowerment and personal capabilities were regarded as important among both genders. This study recommends gender-based conservation and management programmes and focusing on community-based driven solutions and regulatory measures such as technical training programmes and empowering local communities with the skills necessary to engage in conservation efforts. Through such initiatives, issues related to gender-specific approaches to conservation initiatives shall form a pivotal role in fostering appropriate sustainable forest conservation and management strategies.*

KEYWORDS: Best-Worst Scaling (BWS), Gazetted Forest Conservation, Gender Preference, Forest Adjacent Farmers.

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INTRODUCTION

Gender differences in preferences for forest conservation and management is fundamental to understanding and shaping effective, inclusive, and sustainable environmental policies. Globally, men and women often prioritize different aspects of conservation due to their distinct social roles, responsibilities, and access to resources (Speaker *et al.*, 2022). Despite growing recognition of gendered perspectives in sustainability of environmental resource utilization, there is a notable gap in the representation of women in decision-making bodies related to forest governance (Bhattarai, 2020; Gabriel *et al.*, 2020). These gendered preferences have a significant impact on the success and acceptance of forest conservation and management programs because conservation strategies should fit the needs and priorities of diverse community members. Empowering women in forest conservation has been demonstrated to result in more equitable resource distribution and improved environmental outcomes, highlighting the need to incorporate both male and female perspectives into forest management policies (Lau, 2020). In order to bridge this gap, the Best-Worst Scaling (BWS) approach was identified to assess the gender difference in preferences of forest conservation and management attributes.

Household-based forest conservation and management attributes are influenced by gender differences in preferences because of varying roles and priorities in environmental aspects. Men and women differ in their preferences for priority areas such as response and adherence to regulatory frameworks, enforcement strategies, conservation strategies, community involvement, empowerment, and participatory governance features (James *et al*., 2021). These distinctions are crucial when developing policies that balance regional socio-economic demands with ecological sustainability. Despite evidence that their participation results in more effective conservation outcomes, women are still underrepresented in areas like forest governance structures, making gender disparities in development issues a persistent challenge (Gouthami, 2023; Heise *et al.*, 2019). Promoting fair and sustainable forest management techniques globally requires addressing these disparities by incorporating both male and female viewpoints into conservation strategies (Padavic *et al.*, 2020).

The BWS or Most Important–Least Important (MIL) approaches offer reliable methods for prioritizing and ranking important conservation factors in order to examine gender differences in preferences for attributes under investigation (Shoji *et al.*, 2021). It is an experimental survey approach that assesses individuals' priorities by identifying what they consider best and worst or the most important or the least important among a range of items (Flynn *et al*., 2007). By using these approaches, respondents can determine which characteristics are the most and least important, which aids in capturing unique preferences among various demographic groups, thereby allowing participants to assess trade-offs between the assessed household characteristics (Soto *et al.*, 2018). This method is especially helpful for comprehending gendered priorities in forest management (Basnett *et al*., 2022). In a similar way, the BWS method classifies conservation attributes according to perceived importance, offering insights into how men and women consider various aspects when making decisions. According to a study by Mameno *et al.* (2024), women are more likely to place an emphasis on social and community-driven conservation strategies, whereas men may prioritize enforcement and organized economic frameworks. In order to ensure that policy recommendations meet the needs of various stakeholders and advance more inclusive and efficient environmental governance, BWS methodology can be applied to empirically evaluate how gender influences

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preferences for forest conservation (Beres *et al.,* 2024). There are several alternate approaches for eliciting preferences and making decisions using Best-Worst Scaling (BWS). Maximum Difference Scaling (MaxDiff), developed by Louviere (1992), is a popular alternative that finds the most and least favored solutions from a set, similar to BWS but without the assumption of hierarchical ranking. Multi-Criteria Decision-Making (MCDM) methods, such as the Analytic Hierarchy Process (AHP) (Saaty & Kearns, 1985) and the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) (Hwang & Yoon, 1981), offer structured frameworks for evaluating multiple attributes at the same time, frequently incorporating pairwise comparisons or distance-based ranking. Furthermore, Discrete Choice Experiments (DCEs) (Louviere et al., 2014) broaden the Random Utility Theory by examining trade-offs at several attribute levels. Hess and Train (2017) investigated hybrid techniques, combining BWS and Latent Class Models to capture diverse preferences. These methods vary in complexity, cognitive load, and applicability, but they all seek to improve preference assessment and decision analysis across multiple domains. The main advantage of using BWS is that it is considered to outperform rating scales and ranks by avoiding biases and making it easier to distinguish extreme items against those in the middle (Gallego et al., 2012).

BWS can be anchored in the Random Utility Theory (RUT), which holds that people make decisions based on how useful they believe various options are, where the random component captures unobserved influences, while a deterministic component represents measurable factors (Beres *et al.*, 2024; Marley, 2024). By simulating stakeholders' decision-making processes, BWS can be used in forest conservation studies to ascertain which conservation attributes they consider the most and least important. A systematic quantification of preferences is made possible by the fact that respondents choose the "best" and "worst" attributes from a given set, reflecting the underlying utility they associate with each factor. Multinomial Logit (MNL) models, which use a probabilistic framework consistent with RUT, can be used in the application of BWS to estimate the likelihood that an attribute will be selected as the most or least important (Habib, 2023; Mogaka *et al.*, 2021; Sharma *et al.,* 2019). The MNL model, a popular discrete choice model, makes the assumption that people choose options according to relative utility, with an exponential choice function representing the likelihood of selecting an attribute. This method has been successfully used in health research, environmental and resource economics among other relevant fields to analyze gendered differences in priorities under study (Robyn *et al.,* 2021). By combining RUT, BWS, and MNL, policymakers can create more focused and inclusive conservation policies that maximize environmental sustainability outcomes while ensuring that interventions meet the needs of various stakeholders (Lundberg, 2018; May *et al.*, 2021).

BWS is typically applied using three distinct case types: Case 1 (Object Case), Case 2 (Profile Case), and Case 3 (Multi-Profile Case), each suited for different research purposes (Cheng *et al.*, 2023; Cheung *et al.*, 2019). In Case 1, participants are asked to select the most and least significant (best and worst) items from a subset of individual objects or items from a larger set. In Case 2, respondents are asked to rank the most and least desirable levels of various attributes that are displayed at predetermined levels in a profile. When understanding how people value varying degrees of a particular attribute in a particular context is the aim, it is helpful. In Case 3, comparisons are made between several complete profiles, each of which has a different set of attribute levels. Because respondents choose their most and least preferred multilevel profiles applied in this study, this case was particularly helpful for assessing comprehensive forest conservation plans by simulating intricate decision-making situations. BWS approach

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was used to identify relative importance of the forest conservation attributes using a multi-profile best-worst scaling survey where the criteria and sub criteria attributes of decision were evaluated relative to all the others. The eleven attributes encompassed three categories: Institutional Capabilities (infrastructural support, program regulation, community empowerment and democratic process), Managerial Capabilities (planning, decision making, coordination and control), and Personal Capabilities (technical, technological and relation abilities).

This paper applied BWS, RUT, and MNL regression models to evaluate household attributes influencing conservation decisions. This approach offers a novel way to examine gender differences in preferences for forest conservation and management initiatives in Elgeyo Marakwet County, Kenya, since BWS method can be used to elicit preference data with higher precision providing for a comprehensive way to identify the best and worst conservation attributes being investigated in this study. In contrast, traditional ranking methods may not allow for a more detailed and preference-sensitive analysis of gendered priorities than traditional rating or ranking methods. While MNL regression allows the estimation of gender-specific determinants shaping conservation choices, RUT is used in the study to model household utility maximization decision-making under uncertainty, explaining differences in preference intensity between men and women. A thorough assessment of the ways in which social, economic, and environmental factors impact gendered conservation priorities is made possible by this methodological framework, which also provides empirical insights into the function of household-level characteristics in forest management. The findings of this study shall aid in the creation of gender-responsive policies that improve sustainability, equity, and community involvement in forest conservation and management initiatives.

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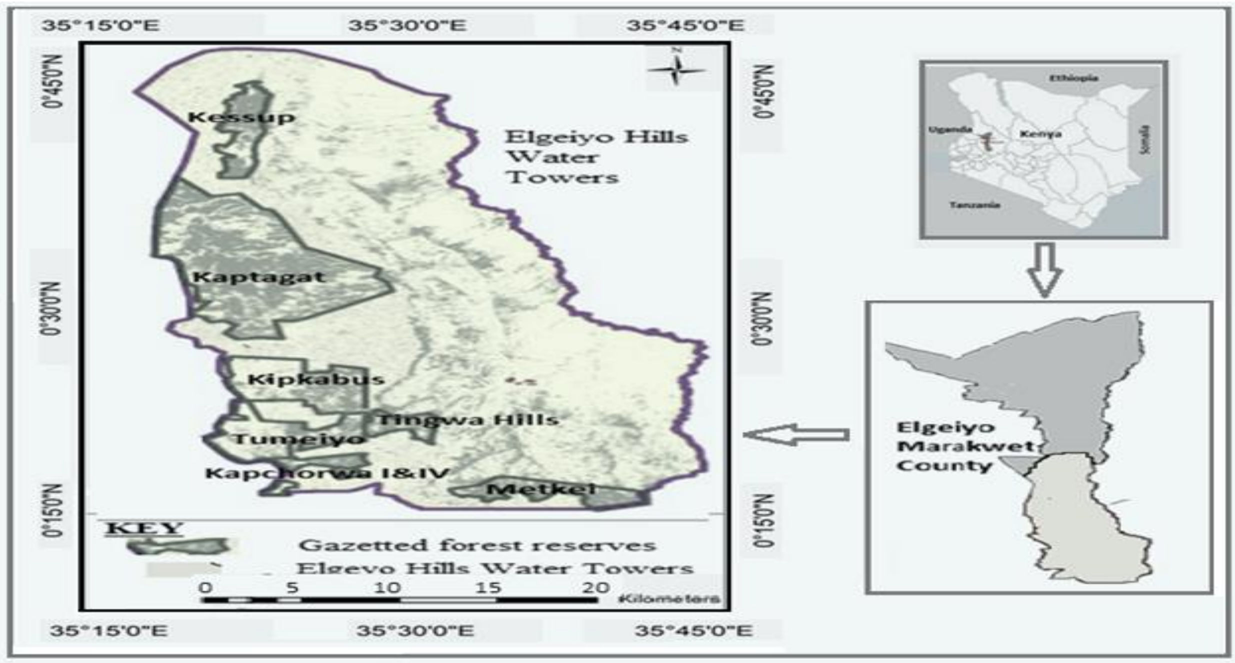
METHODOLOGY

Study Area

The study was carried out in Elgeyo Marakwet County, Kenya, in the Elgeyo Hills Water Towers, which makes up 23.4% (25,354 Ha) of the entire Water Tower area (KWTA, 2020), and forms part of the gazetted forest reserve (Figure 1).

Figure 1: Study Area Map



The county's highlands are home to this vital ecosystem, which smallholder farmers depend on for their livelihoods. With a total area of 3,029.6 km^2, the county is located in the North Rift region of Kenya and accounts for 0.4% of the country's land area. Additionally, it extends from latitude 0° 20′ to 1° 30′ to the North and from longitude 35° 0′ to 35° 45′ to the East. Baringo County forms its eastern boundary, Uasin-Gishu County forms its Southwest boundary, Trans-Nzioa forms its Northwest boundary, and West-Pokot County forms its Northern boundary (RoK, 2015).

Sampling Procedure and Sample Size Determination

The target population for the study comprised smallholder households residing within the adjacent gazetted forest reserves in Keiyo North and Keiyo South Sub-Counties covered under the Elgeyo-Hill water towers. According to the Kenya National Bureau of Statistics (KNBS, 2020) report, the total number of households was estimated at 39,180 households and identified as the target population for the study. The sample size required for the study was determined proportionate to the number of households sampling methodology proposed by Yamane (1967) in Equation 1.

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

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where n = sample size, N = population size, and e = precision level (α = 0.05). Since the proportion of the population is known, N = 39,180 and the value of e = 0.05. The sample size obtained is 396.0377, approximated as 396. The sample size is then estimated at 419 to take care of the non-responsive, presumed to account for 5% of the calculated sample. Thus, the study's cross-sectional data of 419 households in the study area was gathered from community members who reside adjacent to the gazetted forest and live within 5.1 kilometers of the boundaries of seven gazetted forests in the study area, namely, Kaptagat, Kipkabus, Kessup, Kapchorua, Tingwa Hills, Tumeiyo, and Metkei. The enumerators identified to collect data were trained and pilot study was carried out in November 2023. This was meant to ensure the accuracy of the data gathered and it tested the digital tool's technical functionality. Due to the lack of a documented list of the residents of the forest-adjacent community, heads of households were interviewed by adopting a random walks approach, where trained enumerators within the study area chose the starting point for each forest block cluster. The samples were chosen at random from among the households after the patterns and directions from each location were identified, using a semi-structured survey questionnaire and the phone-based Kobo Collect toolbox. Primary data was then gathered following the required validity checks, corrections, and assessments of the data collection tool's functionality and accuracy in December 2023. The ethical approval provided by the Egerton University Institutional Scientific and Ethics Review Committee (EUISERC) under the approval number (EUISERC/APP/314/2024). Also, a research permit from the National Commission for Science, Technology, and Innovation (NACOSTI) was obtained with the license NACOSTI/P/23/30806. Data collected was then cleaned, coded and analyzed using the STAT 17 statistical package.

Analytic Technique

This paper sought to assess gender difference in preference for forest conservation and management among smallholder farmers in Elgeyo Marakwet County. Table 1 presents the demographic characteristics and forest conservation and management variables. The objective of this paper was to assess gender difference and determinants of gender preference and forest conservation and management attitudes. This was assessed in two stages. First, the screening of information will be carried out by comparing the response based on the gender of the household head, concerning the respondents' conservation and management aspects. The second stage is to carry out the difference in gender preference using the best-worst scaling method by integrating gender in the analysis process.

Table 1: Forest Conservation and Management Variables

Variables	Measurement
Socio-economic and institutional factors	
Age	Age of the household (*Years)*
Years lived near forest	Years lived near gazetted forest (*Years)*
Years of schooling	Household head Years of schooling (*Years)*
Household membership	Number of household members *(Number)*
Land size	Household main land size *(Hectares)*
Forest access distance	Distance to the nearest gazetted forest reserve *(Walking minutes)*

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Forest management and conservation responses	
Institution preference	Whether the conservation by the local community is better than exclusive government/state departments alone. *(Rank 1 lowest, 5 highest)*
Program integration	Whether they like forest conservation programs integrated with forest adjacent communities (FAC) *(Rank 1 lowest, 5 highest)*
Strategies effectiveness	Whether the forest conservation strategies are bringing the forest authorities and local communities closer. *(Rank 1 lowest, 5 highest)*
Communal forest management	Whether forest adjacent communities manage the gazetted forest well. *(Rank 1 lowest, 5 highest)*
State forest management	Whether state/government forest departments manage the gazetted forest well. *(Rank 1 lowest, 5 highest)*
Authority response	Whether state/ forest departments are responding well to forest management strategies. *(Rank 1 lowest, 5 highest)*
Management trust	Whether the forest adjacent communities are trusting forest management authorities *(Rank 1 lowest, 5 highest)*
Mutual cooperation	Whether there is mutual cooperation and collaboration between the local communities and forest management authorities. *(Rank 1 lowest, 5 highest)*

Gazetted Forest Conservation Criteria and Sub-criteria

A structured set of criteria and sub-criteria that represent household-level attributes influencing forest management practices were used in this paper to evaluate gazetted forest conservation and management. The assessment sought to identify institutional, managerial and personal capabilities criteria main criteria attributes. Table 2 presents multi-level forest conservation and management main criteria.

Table 2: Multi-level Forest Conservation and Management Main Criteria

Main criteria	Defining forest conservation and management main criteria
Main Criteria 1: Institutional capabilities	Refers to the formal and informal institutions influencing the capabilities of smallholder farmers in addressing forest conservation strategies
Main Criteria 2: Managerial capabilities	Refers to the efficacy of managerial capabilities of forest conservation stakeholders in addressing forest conservation strategies.
Main Criteria 3: Personal capabilities	Refers to the overall smallholder farmer's personal capabilities in addressing forest conservation strategies.

Tables 3 presents a list of eleven multi-level forest conservation and management sub-criteria, namely infrastructural support, program regulation and conservation, community empowerment, and democratic support for institutional attribute; sub criteria attributes

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planning, decision making, coordination and control for managerial attribute; and technical knowledge, technological knowledge and relation abilities for personal capabilities attributes.

Table 3: Multi-level Forest Conservation and Management Sub-criteria

Sub-criteria	Defining forest conservation and management sub-criteria
Infrastructural support	Refers to the infrastructural support such as road and communication networks accessible to smallholder farmers in addressing forest conservation strategies.
Program regulation	Refers to the effectiveness of programs and regulations to smallholder farmers in addressing forest conservation strategies.
Community empowerment	Refers to the adequacy of community empowerment of smallholder farmers in addressing forest conservation strategies.
Democratic support	Refers to the smallholder farmer's ability and empowerment to engage in democratic process while addressing forest conservation strategies.
Planning	Refers to the effectiveness planning skills of forest conservation stakeholders in addressing forest conservation strategies.
Decision making	Refers to the decision making abilities of forest conservation stakeholders in addressing forest conservation strategies.
Coordination	Refers to the level of coordination among forest conservation stakeholders in addressing forest conservation strategies.
Control	Refers to the control aspect of forest conservation stakeholders in addressing forest conservation strategies.
Technical knowledge	Refers to the smallholder farmer's technical knowhow in addressing forest conservation strategies.
Technological knowledge	Refers to the smallholder farmer's awareness and knowledge on technologies needed to address forest conservation strategies.
Relation abilities	Refers the ability of the smallholder farmers to among themselves and other stakeholders in addressing forest conservation strategies and initiatives.

This was assessed against the social, economic and environmental performance alternatives for the gazetted forest conservation strategies. Table 4 presents a list of three forest conservation and management performance alternatives.

Table 4: Forest Conservation and Management Performance Alternatives

Conservation and management alternatives	Defining forest conservation and management alternatives
Social performance	Refers to the influence to the societal social wellbeing of the smallholder farming community.
Economic performance	Refers to an influence to the economic empowerment and standard of living of the smallholder farming community.
Environmental performance	Refers to the influence to the sustainability of the forest resource, and its contribution to climate change and water cycles due to impacts of agricultural activities by smallholder farming communities.

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Analytic Model Specification

The theory of gender variation underlying Best-Worst Scaling (BWS) was based on Random Utility Theory (RUT) (McFadden, 1974) as generalized by Marley and Louviere (2005). RUT presents that choices by individuals are framed in terms of the maximization of their perceived utility. There is some unobservable utility (U) for each alternative consisting of a systematic component (V) and an error term (ε) that is random (Equation 2). By examining the response with attributes selected as "best" or "worst," BWS assists in estimating its utilities.

$$U_{ij} = V_{ij} + \varepsilon_{ij} \tag{2}$$

where U_{il} is the individual i's total utility for attribute V_{ij}, and ε_{ij} the random error term.

In the case of the BWS method, respondents assess a set of features and choose the most (best) and least (worst) preferred solutions based on their perceived relative utility differences. The selection of the best and worst options reflects trade-offs, which provide more preference data than basic ranking approaches (Marley & Louviere, 2005; Weernink *et al*., 2016). For a number of forest conservation and management attributes, the BWS selected the best and worst options. The dual coding was used in the maximum difference estimation with MNL so that best = 1 and best = 0. If a respondent selects the attribute as the most important or best, the best equals 1, and if not, the best equals 0. Alternately, if a respondent views an attribute as worst or least significant, worst equals 1; otherwise, worst equals 0 (Cheung *et al.*, 2019; Soekhai *et al.*, 2023). Integrated as the maximum difference model, the MNL indicated the probability of expressing multiple attributes in terms of the BEST or WORST attribute. The likelihood that a respondent would choose a pair in a particular BWS choice set that maximizes the difference between the worst and best attributes was proportional to the difference between the best and worst items on the importance scale. Next, the maximum difference was presented using the MNL model, which assumes that the utility associated with choosing the best option is equal to the negative of the utility associated with choosing the worst option (Nurlaela, 2018), following the standard logistic model in Equation 3.

$$P(Y_i = j) = \frac{e^{\beta^1 X_{ij}}}{\Sigma_k e^{\beta^1 X_{ik}}} \tag{3}$$

where $P(Y = j)$ the probability of choosing criteria $(i = 1,2,3..,k)$, X_{ij} represents the attribute characteristics, and β is the estimated coefficient vector.

In gender-based forest conservation studies, MNL helps identify whether men and women systematically differ in their attribute rankings. Equation 4 shows distinct utility differences between the best and worst attributes for choice and the explanatory forest conservation and management attribute variables for both males and females

$$P(Y - j) = U_{ij\,MaxDiff} \begin{cases} \beta_{10} + X_{Kij}\beta_{Kij} + \varepsilon_{ij} & \text{, if } i = 1 \text{ “Male”} \\ \beta_{00} + X_{Kij}\beta_{Kij} + \varepsilon_{ij} & \text{, if } i = 0 \text{ “Female”} \end{cases} \tag{4}$$

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where $P(Y-j)=U_{ij\,MaxDiff}$ is the probability of the outcome being in choice category ij that maximize utility for best/worst choice, β_0 is the intercept for category j, β_{Kij} are the coefficients for the predictor variables for category j, X_{Kij} are the predictor attribute variables, and ε_{ij} is the error term.

RESULTS AND DISCUSSIONS

Descriptive Statistics

Descriptive statistics presented in Table 5 provided description of the socioeconomic and environmental characteristics of households studied. A mean difference of -9.09 ($p < 0.001$), men have lived close to the forest for significantly longer than women (M = 36.13, SD = 16.44 vs. M = 27.04, SD = 12.49), suggesting that men have historically engaged with forest resources more. With a statistically significant difference of -1.71 ($p < 0.001$), men reported more years of education (M = 13.12, SD = 3.96) than women (M = 11.41, SD = 4.18). There is no discernible gender difference in other demographic indicators like the size of the household or the number of household members. There are notable variations in a number of measures pertaining to the management and conservation of forests. When it comes to whether local community conservation is superior to exclusive government/state departments alone ($p < 0.05$), whether they like forest conservation programs integrated with Forest Adjacent Communities (FAC) ($p < 0.05$), whether the forest conservation strategies are fostering a closer relationship between local communities and forest authorities ($p < 0.01$), and whether state/government forest departments are effectively managing the gazetted forest ($p < 0.001$), males scored slightly lower than females.

According to these results, women might be marginally more stable financially or have slightly better access to and responsiveness to financial resources. Differences in the distance to the closest forest, however, as well as other conservation and management responses, such as how well the gazetted forest is managed by the communities surrounding it, how well state and forest departments respond to forest management strategies, how much trust the communities have in the forest management authorities, and whether local communities and forest management authorities cooperate and collaborate, were not found to be statistically significant.

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Table 5: Descriptive Statistics for Gender Difference in Preference Variables

Variables	Male (n=233)		Female (n=186)		Combined (n=419)		Diff.
	Mean	SD	Mean	SD	Mean	SD	
Socio-economic and institutional factors							
Age	47.27	11.37	46.53	10.30	46.94	10.91	-0.74
Years lived near forest	36.13	16.44	27.04	12.49	32.10	15.47	-9.09***
Years of schooling	13.12	3.96	11.41	4.18	12.37	4.15	-1.71***
Household membership	5.37	1.89	5.45	2.01	5.41	1.89	0.08
Land size	1.46	0.85	1.38	0.75	1.42	0.81	-0.08
Forest access distance	34.85	57.62	29.61	28.71	32.53	47.06	-5.24
Forest management and conservation responses							
Institution preference	0.87	0.13	0.89	0.14	0.88	0.12	0.02*
Program integration	0.84	0.14	0.87	0.13	0.86	0.14	0.03*
Strategies effectiveness	0.86	0.14	0.85	0.15	0.84	0.14	0.03**
Communal forest management	0.84	0.15	0.85	0.14	0.84	0.15	0.01
State forest management	0.82	0.15	0.87	0.15	0.84	0.15	0.04***
Authority response	0.82	0.16	0.85	0.15	0.83	0.16	0.02
Management trust	0.82	0.15	0.84	0.16	0.83	0.15	0.01
Mutual cooperation	0.82	0.15	0.84	0.15	0.83	0.15	0.02

Note significance levels: *** = p < 0.01, ** = p <0.05, and * = p < 0.10

The findings show gender disparities in economic well-being, forest experience, and education, which could affect conservation participation and resource management. These results are in line with past studies showing that environmental decision-making is influenced by gendered access to opportunities and resources (Agarwal, 2010; Meinzen-Dick *et al.*, 2019b).

Best-Worst Scores Experiment Count Analysis

Based on respondents' preferences, forest conservation attributes were assessed using the Best-Worst Scaling (BWS) case count method. Participants created Best-Worst scores (B-W) by identifying the qualities that were most and least important. The standardized score (B-W/B+W) normalizes the ranking, whereas the aggregate (B+W) score shows the total number of choices for each attribute. Table 6 presents a structured Best-Worst Scores Experiment Count Analysis table that summarizes various forest conservation attributes according to their aggregate values, standardized scores, and best and worst scores. The Best-Worst Scaling (BWS) count results show that Institutional Capabilities (0.466) and Coordination Abilities (0.363) are the most essential traits in forest conservation, with "Best" selected more frequently than "Worst." In contrast, Community Empowerment (-0.503) and Personal Capabilities (-0.500) were seen as less vital, with continuously negative values indicating lesser priority.

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Planning abilities (0.156) and control aspect (0.133) received the highest sub-criteria scores, implying that structured planning and enforcement mechanisms are critical for conservation efforts. In contrast, infrastructural support (-0.131) and decision-making abilities (-0.050) received lower standardized ratings, indicating that they were less frequently valued. These results are consistent with earlier research emphasizing the importance of institutional governance and coordination in environmental management (Marley, 2024; Marley & Pihlens, 2012). These findings therefore indicate that effective conservation programs should prioritize institutional and administrative capacity while addressing gaps in community engagement and personal skill development.

Table 6: Best-Worst Scores Using Count Analysis from Best-Worst Scaling Experiment

Forest conservation attribute criteria	Best scores	Worst scores	Aggregate (B+W)	Best Worse score (B-W)	Std. Score (B-W)/ (B+W)	Sub-criteria Std. Score	Rank
Institutional capabilities	**266**	**97**	**363**	**169**	**0.466**		
Infrastructural support	83	108	191	-25	-0.131	-0.030	7
Program regulation	200	122	322	78	0.242	0.093	2
Community empowerment	36	109	145	-73	-0.503	-0.087	11
Democratic process	100	80	180	20	0.111	0.024	4
Managerial Capabilities	**92**	**139**	**231**	**-47**	**-0.203**		
Planning abilities	9	68	77	-59	-0.766	-0.070	10
decision making abilities	189	209	398	-20	-0.050	-0.024	6
Coordination abilities	212	99	311	113	0.363	0.135	1
Control aspect	9	43	52	-34	-0.654	-0.041	8
Personal capabilities	**61**	**183**	**244**	**-122**	**-0.500**		
Technical knowhow	173	114	287	59	0.206	0.070	3
Technological aspects	104	147	251	-43	-0.171	-0.051	9
Relation abilities	142	158	300	-16	-0.053	-0.019	5

A total of 419 forest adjacent households participated, each of whom chose best and worst attributes from 11 sets of 2 score counts each (838 total choices). The standardized scores in Figure 2 show the relative priority assigned to each sub-criteria attribute. The score was computed as (Best Score Count - Worst Score Count) / (2 × 419). The length of the bars represents the relative influence of each attribute on forest conservation and management. The standardized scale ranges from -1.0 to +1.0, and the 95% confidence intervals indicate the precision of each estimated score. These findings showed that coordination, conservation programs regulation and technical knowhow and society's democratic processes were positively ranked as significant household attributes. Consequently, household relation abilities, decision making attributes, infrastructural support, control aspects, technological issues, planning abilities and community empowerment were negatively ranked as worse sub-criteria attributes. Figure 2 presents the standardized "best-worst" scores and 95% confidence intervals for the eleven hypothetical household sub-criteria attributes that influenced forest conservation and management aspects.

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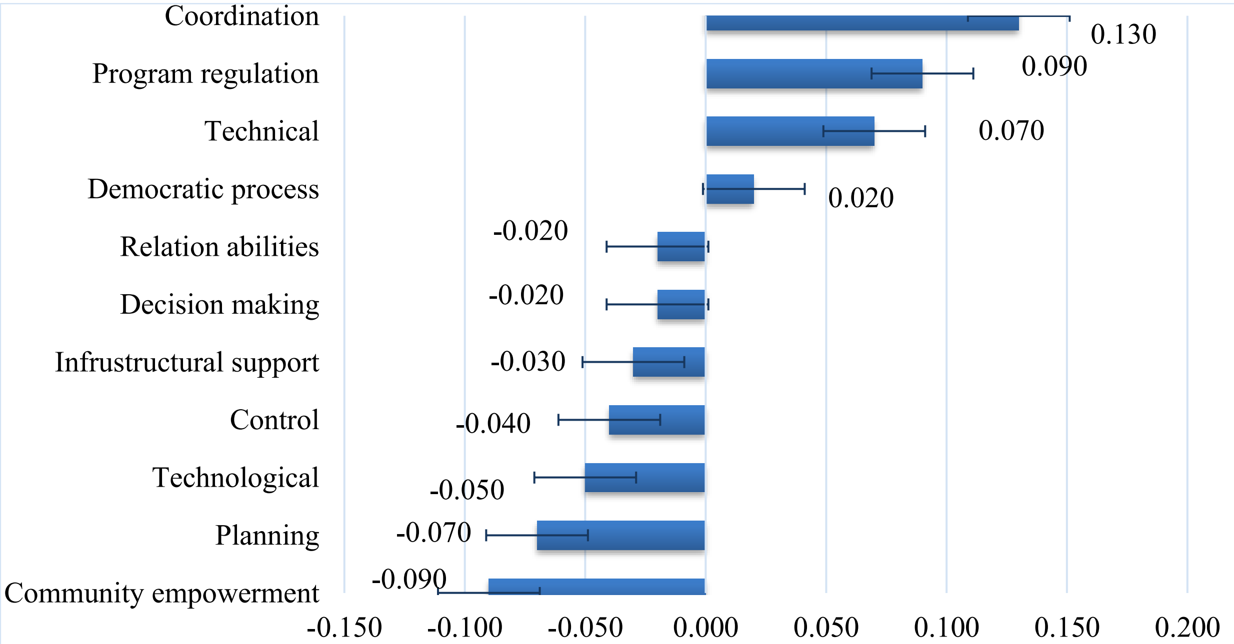
Figure 2: Standardized "Best-Worst" Count Scores Graph



Econometric Model Results

Multinomial regression technique was used to evaluate preferences across social, economic, and environmental alternative dimensions, and investigate the differences between men and women in their assessment of the conservation and management attributes.

Table 6.7: Gender Difference in Preferences under Social Alternative

Forest Conservation and Management Attributes	Male (N=233)	Female (N=186)	Combined (N-419)
	Coeff. (Std. Err.)	*Coeff. (Std. Err.)*	*Coeff. (Std. Err.)*
Institutional capabilities	(base outcome)		
Managerial capabilities			
Infrastructural support	0.5679*** (0.1041)	0.6353 (0.1279)***	0.5717 (0.0727)***
Program regulation	0.3244** (0.1487)	0.0342 (0.1641)	0.1877 (0.1037)**
Community empowerment	-0.0219 (0.1731)	0.1741 (0.1670)	0.0218 (0.1107)
Democratic process	-0.0590 (0.1788)	0.0682 (0.1748)	-0.0472 (0.1174)
Planning	0.2785* (0.1663)	-0.3291 (0.1778)*	0.0488 (0.1119)
Decision making	-0.0908 (0.1660)	-0.0723 (0.1652)	-0.0344 (0.1076)
Coordination	-0.3583** (0.1798)	0.2333 (0.1635)	-0.0182 (0.1134)
Control	0.4282*** (0.1668)	0.0461 (0.1688)	0.2066 (0.1085)**
Technical	0.0577 (0.1505)	0.0290 (0.1592)	0.0325 (0.1024)
Technological	0.0722 (0.1847)	-0.1114 (0.1589)	0.0266 (0.1129)
Relation abilities	0.0873 (0.1679)	-0.2678 (0.1780)	-0.0252 (0.1126)
Constant	-9.4330 (2.2384)	-3.5414 (2.0870)	-7.0640 (1.4705)
Personal relations			
Infrastructural support	0.6332*** (0.1390)	0.5073*** (0.1097)	0.5334*** (0.0784)
Program regulation	0.0699 (0.1744)	0.0382 (0.1692)	0.1060 (0.1186)
Community empowerment	0.2153 (0.2174)	0.2497 (0.1824)	0.1440 (0.1286)

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Democratic process	-0.0093 (0.2073)	0.0938 (0.1873)	-0.0355 (0.1320)
Planning	0.5976*** (0.2139)	-0.4152** (0.1866)	0.0408 (0.1281)
Decision making	-0.1693 (0.1862)	-0.0431 (0.1890)	-0.0518 (0.1234)
Coordination	0.0292 (0.2086)	0.0540 (0.1754)	0.0202 (0.1284)
Control	0.0691 (0.1953)	0.0847 (0.1828)	0.0800 (0.1234)
Technical	-0.1007 (0.1878)	0.2603 (0.1775)	0.1543 (0.1198)
Technological	0.1749 (0.2260)	0.0598 (0.1764)	0.1593 (0.1306)
Relation abilities	0.2898 (0.2085)	0.0139 (0.1988)	0.2310* (0.1331)
- constant	-13.2873 (3.0574)	-6.7068 (2.6065)	-10.0337 (1.8700)
Log likelihood =	-135.5522	-138.3146	-296.9127
LR chi2(22) =	109.71	89.89	161.95
Prob > chi2=	0.0000	0.0000	0.0000
Pseudo R2=	0.2881	0,2452	0.2143

Note: *** p<0.001; **p<0.05; *p<0.1, implies 1 %, 5 % and 10 % level of significance respectively.

The multinomial regression analysis's results for the social alternative that demonstrate how gender affects conservation decision-making are presented in Tables 6.7. The likelihood ratio (LR) chi-square statistics (109.71, 89.89, and 161.95) and their corresponding p-values of 0.0000, that show that the models collectively significantly improve the fit over the null models, demonstrate that the regression output shows that the models are statistically significant. A measure of model fit is given by the log likelihood values (-135.5522, -138.3146, and -296.9127); higher values denote a better fit. With pseudo R-squared values of 0.2881, 0.2452, and 0.2143, the models appear to have a moderate explanatory power for the predictors; they include, explaining between 21% and 29% of the variation in the dependent variable.

There are clear gender differences in preferences for forest conservation attributes, according to the results for social alternatives. The baseline result for comparison is institutional capabilities. Infrastructure support was found to be a significant factor among male respondents at 1% significance level. This suggests a strong preference for investments in facilities, perhaps such as roads, and other infrastructure required for forest conservation and management efforts. Furthermore, there is a positive correlation between male preferences and program regulation at 5% significance level, indicating that men prefer organized regulatory mechanisms in forest conservation and management. Strong support also shown for control measures was significant at 1% significance level, indicating a preference for conservation policy enforcement and monitoring. While coordination skills were negatively correlated and significant at 5% significance level, suggesting less focus on cooperation and interagency efforts, planning skills significant at 10% significance level are valued, suggesting a tendency toward strategic decision-making.

Infrastructure support is still a highly significant factor for female respondents at 1% significance level, reflecting male preferences for conservation infrastructure investments. Although community empowerment ($\beta = 0.1741$) has a positive coefficient, it is not statistically significant, suggesting only a slight preference for local community-engaged policies. In contrast, female preferences are negatively correlated with planning abilities at 10% significance level, indicating that women may be less likely to place a higher priority on long-term strategic planning in forest conservation and management strategies. Despite not being statistically significant, coordination skills ($\beta = 0.2333$) are positively correlated, suggesting

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that women may see some benefit in cooperative conservation efforts in contrast to men who have a negative opinion of coordination.

In the combined sample, program regulation also maintains a positive and significant coefficient at 5% significance level, confirming broad support for regulatory mechanisms; control measures also significant at 5% significance level further emphasize the general preference for strict enforcement of conservation rules. These findings reveal that preferences for conservation vary by gender. While women prefer collaborative and infrastructure-related aspects, men place more importance on regulatory and control aspects. These findings are consistent with earlier research showing gendered approaches to environmental management, where women prioritize community-based solutions and men prioritize efficiency and enforcement (Meinzen-Dick *et al*., 2019a). Consequently, the effectiveness of climate policies was observed to improve by increasing the representation of women in decision-making bodies because they are more concerned about the environment and prioritize equitable resource distribution (Andrew *et al*., 2024; Cook *et al.*, 2019), which improves forest conservation and management outcomes.

The regression results for the economic alternative demonstrate how gender influences decision-making for forest conservation and management are presented in Table 8.

Table 8: Gender Difference in Preferences under Economic Alternative

Forest Conservation and Management Attributes	**Male (N=233)**	**Female (N=186)**	**Combined (N-419)**
	Coeff. (Std. Err.)	***Coeff. (Std. Err.)***	***Coeff. (Std. Err.)***
Institutional capabilities	(base outcome)		
Managerial capabilities			
Infrastructural support	-0.0114 (0.1568)	0.3760** (0.2039)	0.1364 (0.1098)
Program regulation	0.4659*** (0.1023)	0.3986*** (0.1064)	0.3982*** (0.0687)
Community empowerment	0.3739*** (0.1364)	0.2969 (0.1945)	0.2823** (0.1008)
Democratic process	0.0206 (0.1339)	0.1166 (0.1646)	0.1127 (0.0972)
Planning	0.1234 (0.1519)	0.2979 (0.1743)	0.1997* (0.1061)
Decision making	-0.0583 (0.1577)	0.2797* (0.1612)	0.0909 (0.1036)
Coordination	0.0068 (0.1423)	-0.4074** (0.1848)	-0.1441 (0.1046)
Control	0.1290 (0.1446)	-0.5033*** (0.1691)	-0.1795* (0.0990)
Technical	0.2578* (0.1466)	-0.2069 (0.1667)	0.0502 (0.1029)
Technological	-0.0842 (0.1530)	-0.4439** (0.1798)	-0.1926* (0.1079)
Relation abilities	-0.1179 (0.1625)	-0.1163 (0.1677)	-0.1074 (0.1074)
- constant	-8.0590 (2.0201)	-1.5821 (1.9158)	-5.0514 (1.3187)
Personal relations			
Infrastructural support	0.1119 (0.1870)	0.1016 (0.1606)	0.1291 (0.1176)
Program regulation	0.6284*** (0.1479)	0.5126*** (0.1145)	0.5569*** (0.0872)
Community empowerment	0.2517 (0.1589)	0.2564 (0.1883)	0.2405** (0.1101)
Democratic process	-0.1286 (0.1648)	-0.2085 (0.1824)	-0.1556 (0.1152)
Planning	-0.1061 (0.1929)	0.1888 (0.1864)	0.0309 (0.1243)
Decision making	-0.3824* (0.2045)	-0.0936 (0.1696)	-0.2050* (0.1224)
Coordination	0.0454 (0.1817)	-0.0487 (0.1887)	0.0418 (0.1227)
Control	-0.1031 (0.1873)	0.0940 (0.1804)	-0.0151 (0.1168)
Technical	0.3824** (0.1840)	-0.0463 (0.1737)	0.2146* (0.1194)

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Technological	0.6305*** (0.2143)	-0.2518 (0.1818)	0.1572 (0.1254)
Relation abilities	0..2050 (0.2123)	0.0670 (0.1815)	0.0923 (0.1275)
- constant	-11.4298 (2.8290)	-4.3122 (2.1027)	-8.0962 (1.6677)
Log likelihood =	-151.8870	138.7098	-315.1499
LR chi2(22) =	77.04	89.10	125.48
Prob > chi2=	0.0000	0.0000	0.0000
Pseudo R2=	0.2023	0.2431	0.1660

Note: *** p<0.001; **p<0.05; *p<0.1, implies 1 %, 5 % and 10 % level of significance respectively.

The results in Table 8 shed light on gender differences in preferences for forest conservation attributes based on one economic alternative by analyzing the forest conservation and management attributes for both male and female participants, as well as the combined group. The Log likelihood values and Pseudo R2 values demonstrated that the models had strong fit indices. In comparison to the male group (0.2023) and the combined group (0.1660), the female group's Pseudo R2 (0.2431) was the highest, indicating a better model fit. This suggests that a significant amount of the variation in forest conservation outcomes, especially for female participants, could be explained by the economic variables used in the analysis.

The findings reveal that program regulation had a significant positive effect in the male group at 1% significant level, indicating that productive forest conservation practices require well-regulated economic programs. This bolsters the idea that regulated and structured economic systems are essential to attaining desired results. However, there was no discernible effect of infrastructure support, suggesting that the male group's forest conservation efforts may require more than just the availability of tangible resources when an economic alternative is considered. Similarly, decision-making and control showed negative, non-significant coefficients, suggesting that these factors may not strongly influence the economic success of forest management. Community empowerment showed a positive but non-significant effect, suggesting that economic empowerment of communities could potentially play a role, but it is not as central to economic outcomes in forest management.

The female group exhibited a significant positive relationship with infrastructure support at 5% significance level, underscoring the importance of economic infrastructure, including funding and resource allocation, in attaining successful forest conservation outcomes. In contrast, there was little infrastructure support for the male group. Program regulation remained a significant positive predictor at 1% significance level, reinforcing its importance in structuring economic frameworks for forest management. Economic empowerment can be helpful, but its direct impact on forest conservation may not be as strong in the female group as it is in other contexts, as evidenced by the smaller, non-significant effect of community empowerment. When the emphasis is on economic alternatives, coordination and control both show negative significant coefficients at 5% and 1% significance levels respectively, indicating that these factors may negatively influence forest conservation efforts, particularly among females. Program regulation remained a significant predictor for the combined group at 1% significance level, highlighting its significance for both genders in promoting successful economic outcomes for forest conservation. The significant positive impact of community empowerment at 5% significance level indicates that, although to a lesser extent, economic empowerment can support forest conservation and management initiatives. The use of technology in forest

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management, however, had a significant negative impact at 5% significance level, indicating that it may pose financial difficulties or erect obstacles that prevent success.

Several studies have documented the significance of economic factors in the management of forest conservation. As an illustration, Surfo-Adu (2021) emphasized the critical role that regulations and economic frameworks play in advancing sustainable forest management. In line with the current study's findings, theirs showed that organized economic initiatives greatly enhance the outcomes of forest conservation in rural areas. Comparably, studies by Macqueen *et al.* (2020) and Mansourian *et al.* (2022) also noted the significance of government program regulation and infrastructure support in guaranteeing the success of commercial alternatives for forest conservation. The importance of regulatory frameworks and economic empowerment in forest management is supported by these studies. Additionally, the importance of economic resources and technological advancements in forest management points out that these factors can occasionally have a negative economic impact if not properly managed (McEwan *et al.*, 2020; Raihan *et al.*, 2022). This research aligns with the current study's findings regarding technological challenges.

Table 9: Gender Difference in Preferences under Environmental Alternative

Forest Conservation and Management Attributes	Male (N=233)	Female (N=186)	Combined (N-419)
	Coeff. (Std. Err.)	***Coeff. (Std. Err.)***	***Coeff. (Std. Err.)***
Institutional capabilities	(base outcome)		
Managerial capabilities			
Infrastructural support	0.0702 (0.1569)	-0.0414 (0.1588)	0.0189 (0.1044)
Program regulation	-0.0718 (0.1477)	0.0903 (0.1519)	0.0233 (0.1003)
Community empowerment	0.6520*** (0.1239)	0.4559*** (0.0955)	0.5054*** (0.0722
Democratic process	0.3511** (0.1625)	0.0924 (0.1519)	0.1547 (0.1049)
Planning	-0.2252 (0.1509)	-0.0313 (0.1412)	-0.0743 (0.0964)
Decision making	0.0822 (0.1634)	0.1973 (0.1555)	0.1812* (0.1065)
Coordination	-0.1827 (0.1648)	-0.0803 (0.1520)	-0.1209 (0.1060)
Control	-0.0791 (0.1559)	-0.2471 (0.1500)	-0.1661 (0.1014)
Technical	-0.1818 (0.1729)	-0.1595 (0.1491)	-0.1444 (0.1073)
Technological	0.1776 (0.1610)	0.1535 (0.1666)	0.1251 (0.1088)
Relation abilities	0.6429*** (0.1789)	-0.0811 (0.1477)	0.2335** (0.1083)
- constant	-8.6763 (2.0929)	-2.4698 (1.7307)	-5.2864 (1.3216)
Personal relations			
Infrastructural support	0.1569 (0.1993)	-0.1326 (0.1782)	0.0078 (0.1225)
Program regulation	0.3222* (0.1889)	-0.1670 (0.1655)	0.0544 (0.1157)
Community empowerment	0.5835*** (0.1242)	0.5817*** (0.1292)	0.5592*** (0.0845)
Democratic process	0.2701 (0.1960)	0.1507 (0.1730)	0.2017 (0.1209)
Planning	0.0237 (0.1790)	-0.0833 (0.1640)	0.0010 (0.1163)
Decision making	0.0679 (0.1955)	-0.0118 (0.1751)	0.0568 (0.1218)
Coordination	0.1356 (0.1925)	0.0843 (0.1846)	0.1314 (0.1262)
Control	0.1403 (0.1998)	-0.0625 (0.1785)	0.0263 (0.1221)
Technical	-0.3352* (0.2005)	-0.2099 (0.1697)	-0.2604** (0.1259)
Technological	0.0799 (0.1865)	0.2217 (0.1916)	0.1274 (0.1252)
Relation abilities	0.4466** (0.2065)	0.0674 (0.1660)	0.2639** (0.1243)
- constant	-13.3260 2.8454	-3.4461 (2.0559)	-8.4192 (1.6967)

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Log likelihood =	-146.6082	-147.5291	-315.2617
LR chi2(22) =	87.60	71.46	125.62
Prob > chi2=	0.0000	0.0000	0.0000
Pseudo R2=	0.2300	0.1950	0.1657

Note: *** p<0.001; **p<0.05; *p<0.1, implies 1 %, 5 % and 10 % level of significance respectively.

The results for the environmental alternative that reveal gender affects forest conservation management decision-making is presented in Tables 9. The model fit evaluation revealed LR chi-square statistics (87.60, 71.46, and 125.62) with corresponding p-values of 0.0000, which show that all three models are statistically significant in the regression output, showing that the independent variables together help to explain the variation in the dependent variable. Less negative values indicate better model performance and the log likelihood values (-146.6082, -147.5291, and -315.2617) show how well the models fit together overall. The models' pseudo R-squared values (0.2300, 0.1950, and 0.1657) suggest that the included predictors have a modest but significant explanatory power, explaining between roughly 16.6% and 23% of the variation in the outcome variable.

The results of gender differences in preferences under the environmental alternative for forest conservation and management are shown in Table 9, which reveal clear trends between the sexes. Both males and females show strong preferences for community empowerment, making it a highly significant factor for both genders at 1% significance level. Both men and women support programs that increase community participation in forest conservation, though men are more likely to do so. Furthermore, relation skills are highly valued by men at 1% significance level, but not by women indicating significance at 5% significance level. Men may place more value on teamwork and social networking when making decisions about their surroundings, as evidenced by their higher preference for relational skills. On the other hand, men strongly favor democratic processes at 5% significance level, but women do not. This discrepancy implies that men might value participatory governance structures more in forest conservation programs. Males also have a slight positive preference for program regulation being significant at 10% significance level, while females have a negative association though not significant. This discrepancy may indicate that while women may consider regulatory frameworks to be ineffectual or restrictive, men may see them as advantageous. Furthermore, there is a general negative perception of technical aspects of forest conservation among both genders. The male coefficient reaches marginal significance, indicating a reluctance toward technical elements in both males which was found to be significant at 10% significance level and not significant for females. This pattern might indicate that highly technical conservation strategies are less appealing to local communities because they are seen as complicated or inaccessible.

Community empowerment and relation abilities continued to be the most strongly endorsed attributes when taking into account the combined preferences which were all significant at 1% and 5% significance level respectively. On the other hand, when examined across the whole sample, program regulation and democratic processes lose statistical significance. In the combined model, the technical component continues to be a significant negative factor being significant at 5% significance level, supporting the idea that both genders favor empowerment-based and participatory conservation strategies over highly technical interventions.

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These results are consistent with earlier studies, emphasizing gendered viewpoints in environmental decision-making. Research suggests that while men might place more importance on organized governance and regulatory frameworks, women tend to prioritize community-driven strategies and comprehensive sustainability measures (Agarwal, 2010; Meinzen-Dick *et al*., 2019b). Both genders' preference for community empowerment lends credence to the larger body of research supporting participatory conservation policies that incorporate local knowledge and group efforts (Charnley *et al*., 2022). Conservation programs should simplify and contextualize technical interventions to ensure wider community engagement and acceptance, as indicated by the negative perception of technical aspects (Nzau *et al*., 2020). In order to create more inclusive environmental policies, future studies should investigate the underlying causes of these gender disparities.

CONCLUSION AND POLICY IMPLICATION

The findings of this study provide significant insights into the gendered dimensions of forest conservation and management, emphasizing how different attributes are prioritized by male and female respondents. Descriptive statistics revealed notable gender disparities in forest-related experiences, educational attainment, and financial well-being. Specifically, men have more experience with forest resources and higher levels of education, which could influence their perspectives on conservation. Additionally, the Best-Worst Scaling (BWS) count analysis highlighted that institutional capabilities and coordination abilities are seen as crucial for successful forest conservation, while community empowerment and personal capabilities were regarded as less important. These results underscore the need for robust institutional frameworks, while also addressing the importance of community-based approaches. Gender differences in preference were also evident in the multinomial regression analysis across social, economic, and environmental alternatives, with men focusing more on regulatory frameworks, enforcement and structured governance, while women emphasized infrastructure support, community engagement, empowerment and participatory governance, community, and collaborative conservation and management approaches. The findings suggest that effective forest management requires integrating both perspectives to ensure sustainability and inclusivity.

The policy implications of these findings emphasize the need for gender-sensitive conservation programs. The study demonstrates clear gender differences in the prioritization of conservation attributes, with men favoring regulatory and enforcement measures and women emphasizing community involvement. This suggests that conservation programs should be tailored to consider these preferences, encouraging the active participation of women, especially in community-based conservation strategies. Policies should ensure that both male and female perspectives are equally valued in decision-making processes. Furthermore, the study's results underscore the importance of building institutional capacity. Given the high priority placed on institutional capabilities and coordination in forest conservation, policy initiatives should focus on strengthening institutional frameworks, ensuring that both public and private entities involved in forest management are responsive and equipped to manage conservation efforts effectively. Another significant policy implication is the need for infrastructure and economic support. The significant role of infrastructure support, particularly for female respondents, indicates that economic frameworks should integrate infrastructure investments alongside

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regulatory measures. Policies should support the creation of funding mechanisms that provide local communities, especially women, with the resources needed to participate in forest management activities. Additionally, the study highlights the importance of inclusive decision-making processes. As both men and women show strong preferences for community empowerment and participatory governance, policies should prioritize inclusive decision-making and reduce barriers to participation. This could involve enhancing access to education and capacity-building programs, particularly for marginalized groups, to ensure that all community members can engage in forest management.

Finally, the study's findings suggest that policies should simplify technical aspects of conservation. Both genders showed negative reactions toward highly technical interventions, signaling the need to make these approaches more accessible. In order to address this, policies should focus on community-based technical training programs that empower local populations with the skills necessary to engage in conservation efforts without being overwhelmed by complex methodologies. In conclusion, forest conservation policies should aim for a balanced approach that incorporates both regulatory measures and community-driven solutions. Understanding gendered preferences in conservation will be crucial for fostering more effective, inclusive, and sustainable forest management strategies.

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Compliance with Ethical Standards and Ethical Approval

The authors affirm that all procedures performed in studies involving human participants were conducted according to the ethical standards of the institutional and/or national research committee and as stipulated in the ethical code of standard requirements, and that of the National Commission for Science, Technology and Innovation (NACOSTI) clearance permit was obtained with the license number NACOSTI/P/23/30806.

Consent of Participation

Consent was sought pursuant to ethical requirements and regulations provided by the Egerton University Institutional Scientific and Ethics Review Committee (EUISERC) under the approval number EUISERC/APP/314/2024.

Funding Declaration

No funding was received for this study.

Conflict of Interest

The authors declare that they have no competing interests.

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