



GENDERED PERCEPTIONS OF CLIMATE CHANGE AND ENVIRONMENTAL RESPONSIBILITY IN RURAL PAKISTAN

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Abstract

This study investigates gendered perceptions of climate change and environmental responsibility in rural Pakistan. Drawing on survey and focus group data from 1,500 participants across Punjab and Sindh, it explores how men and women perceive environmental risks, engage in adaptation strategies, and participate in community-based environmental initiatives. The study also examines the socio-cultural and educational factors that shape these perceptions and behaviors. Results highlight significant gender differences in awareness, risk perception, and responsibility toward environmental conservation. Women, despite lower formal education levels, demonstrated greater commitment to household-level sustainability practices, whereas men were more likely to participate in community-level initiatives. The findings suggest that climate change adaptation policies must be gender-responsive and culturally attuned to local realities.

Keywords: *Climate Change, Gender Differences, Environmental Responsibility, Rural Pakistan, Adaptation Strategies*

Introduction

Background

Climate change is increasingly recognized as one of the most pressing global challenges of the 21st century, with severe ecological, economic, and social consequences. Its impacts are not uniformly distributed, and vulnerable populations, particularly in developing countries, bear a disproportionate burden. Pakistan, with its diverse topography, agrarian economy, and socio-cultural heterogeneity, is highly susceptible to climate-related risks such as floods, droughts, heatwaves, and shifting agricultural patterns (Ali et al., 2022; Khan & Ahmed, 2021). The Intergovernmental Panel on Climate Change (IPCC, 2023) has highlighted South Asia as a climate hotspot, emphasizing that rural communities in countries like Pakistan are particularly exposed due to dependence on natural resources and limited adaptive capacity.

Environmental responsibility the willingness and ability of individuals and communities to adopt sustainable practices and reduce environmental harm is a key factor in mitigating climate risks. In rural Pakistan, environmental responsibility is shaped not only by ecological knowledge but also by socio-cultural norms, gendered roles, educational levels, and community dynamics (Farooq & Rizvi, 2022). For example, rural women, often responsible for household water management, cooking, and agricultural tasks, may implement daily practices that reduce resource consumption or adapt to environmental variability. Men, on the other hand, frequently make decisions regarding land use, agricultural investments, and participation in community initiatives, influencing collective environmental outcomes (Sattar & Mehmood, 2020).

Rationale of the Study

Despite growing awareness of climate change in Pakistan, research on gendered perceptions and environmental responsibility in rural settings remains limited. Much of the existing literature focuses on urban populations or macro-level climate adaptation strategies, neglecting the gendered nuances of environmental perception and behavior in rural communities (Hussain et al., 2021). Understanding how men and women perceive climate risks, interpret responsibilities, and engage in adaptive practices is

essential for designing effective, culturally appropriate, and gender-responsive interventions. This knowledge can help policymakers, non-governmental organizations, and community leaders target programs that enhance environmental sustainability while empowering marginalized groups, particularly women, who often possess localized knowledge yet face social and structural constraints.

Research Questions

To address these gaps, this study focuses on the following research questions:

1. How do men and women in rural Pakistan perceive the risks and impacts of climate change on their livelihoods and communities?
2. What is the level of environmental responsibility demonstrated by men and women, and how is it manifested in household and community practices?
3. How do socio-cultural, educational, and economic factors influence gendered perceptions of climate change and engagement in environmental sustainability?
4. What are the similarities and differences between male and female perspectives regarding participation in climate adaptation initiatives and local environmental governance?

Significance of the Study

The study holds both theoretical and practical significance. Theoretically, it contributes to the growing body of literature on environmental sociology and gender studies by integrating the concepts of gendered perception, environmental responsibility, and rural community dynamics. It also applies intersectional lenses to explore how multiple social identities gender, education, and socio-economic status—shape perceptions and behaviors regarding climate change.

Practically, the findings can inform the design of rural climate adaptation programs and policies in Pakistan. By identifying gender-specific barriers and facilitators of environmental responsibility, development agencies and policymakers can tailor interventions to enhance participation and efficacy. For instance, women-centered training programs in sustainable agriculture or water management may improve household-level adaptation, while male engagement initiatives can strengthen community-level planning and resource management. The study also emphasizes the importance of inclusive climate communication strategies that recognize the differential access to information and decision-making power between genders.

Conceptual Framework

The conceptual framework of this study draws on gender theory and environmental sociology. Gender theory posits that men and women experience and interpret social phenomena differently due to socially constructed roles, expectations, and access to resources (Connell, 2009). Environmental sociology highlights the interplay between social structures and environmental behaviors, suggesting that individual and collective actions are influenced by cultural norms, knowledge systems, and institutional factors (Dunlap & Brulle, 2015). Integrating these perspectives, the study hypothesizes that gender, socio-economic status, and education collectively shape climate risk perception, environmental responsibility, and engagement in adaptive behaviors.

Structure of the Paper

The paper follows a standard IMRaD structure. Following this introduction, the literature review synthesizes relevant theoretical and empirical studies on gendered perceptions of climate change and environmental responsibility, particularly in rural South Asia. The methodology section details the research design, sampling strategy, data collection instruments, and analytical techniques. The results section presents the quantitative and qualitative findings, with interpretation preceding each table to provide

context. Finally, the discussion interprets the findings in light of existing literature, explores implications for policy and practice, and identifies areas for future research.

Literature Review

= Climate Change and Its Impacts in Rural Pakistan

Climate change is increasingly altering environmental conditions globally, but rural areas in developing countries, such as Pakistan, are particularly vulnerable due to reliance on agriculture, limited infrastructure, and low adaptive capacity (Ali et al., 2022; Khan & Ahmed, 2021). Floods, droughts, and heatwaves disrupt food security, water availability, and livelihoods, disproportionately affecting marginalized groups. According to the Pakistan Meteorological Department (2023), rural communities in Punjab and Sindh are experiencing increasing variability in rainfall patterns, exacerbating agricultural uncertainties.

Research highlights that climate change impacts are not only environmental but also social, affecting health, economic stability, and educational access (Farooq & Rizvi, 2022). Rural populations often lack early warning systems, financial safety nets, or institutional support, which increases their susceptibility to adverse outcomes. These vulnerabilities are further compounded by entrenched social inequalities, including gender-based disparities in decision-making power, access to resources, and mobility.

Gendered Perceptions of Climate Change

Understanding how individuals perceive climate change is critical because perception informs adaptive behavior (Leiserowitz et al., 2021). Gender plays a significant role in shaping these perceptions, as men and women often have different responsibilities, knowledge, and priorities in rural households. Women, for instance, are typically engaged in water collection, fuelwood gathering, and subsistence farming. As a result, they may observe subtle environmental changes before men, giving them unique experiential knowledge of climate variability (Sattar & Mehmood, 2020).

Empirical studies in South Asia demonstrate gendered differences in climate risk perception. Hussain et al. (2021) found that women perceive environmental hazards as more immediate and personal, often linking them directly to household welfare and health outcomes. Men, conversely, focus more on macro-level economic or agricultural implications, such as crop yield or market fluctuations. These differences suggest that gender-sensitive communication is essential for effective climate adaptation policies.

Environmental Responsibility and Behavioral Adaptation

Environmental responsibility refers to the willingness to adopt sustainable practices, reduce environmental harm, and participate in conservation initiatives. In rural contexts, it manifests both at the household and community levels. Women often implement resource-saving strategies, such as reducing water wastage, composting, or adopting energy-efficient cooking practices, due to their role in domestic management (Farooq & Rizvi, 2022; Sattar & Mehmood, 2020). Men are more likely to engage in collective activities, including tree plantation drives, irrigation management, and community-level disaster preparedness initiatives.

Studies in Pakistan and neighboring countries indicate that socio-cultural norms significantly influence environmental responsibility. For instance, mobility restrictions, household duties, and patriarchal decision-making can limit women's participation in public environmental activities, while men may have greater access to institutional and financial resources to participate in community projects (Ali et al., 2022; Khan & Ahmed, 2021). Educational attainment is also critical: higher education levels correlate with greater environmental awareness and proactive engagement among both genders (Farooq & Rizvi, 2022).

Intersection of Gender, Education, and Socioeconomic Status

Intersectionality theory provides a useful lens to analyze how multiple social identities—gender, education, and socioeconomic status—interact to shape environmental perceptions and behaviors (Crenshaw, 1991; Cho et al., 2013). Women in rural Pakistan with limited education and lower economic means face compounded barriers: they may observe environmental changes but lack the literacy or autonomy to act upon their knowledge effectively. Conversely, men with greater financial resources may implement adaptation strategies at the household or community level but may underestimate localized environmental concerns that affect women directly (Sattar & Mehmood, 2020).

Recent research supports this view. Latif and Hussain (2024) reported that rural women, despite lower formal education, often display high levels of commitment to sustainable household practices. However, their voices are frequently excluded from community-level environmental decision-making due to patriarchal norms and institutional biases. These findings underscore the importance of intersectional approaches in both research and policy design.

Community-Based Adaptation and Gender Roles

Community-based adaptation (CBA) emphasizes participatory approaches to climate resilience, integrating local knowledge and collective action (Ensor & Berger, 2009). In rural Pakistan, CBA initiatives have shown that including women in planning and implementation significantly enhances the efficacy of adaptation projects (Hussain et al., 2021). For instance, women-led water management committees can improve irrigation efficiency and household water conservation, while male-led committees often focus on infrastructure development or broader agricultural strategies.

However, cultural constraints often limit women's participation in public decision-making forums. Studies by Farooq and Rizvi (2022) highlight that social norms restricting mobility, requiring male accompaniment, or prioritizing male authority in community councils prevent equitable engagement. Programs that integrate women through culturally sensitive mechanisms such as women-only meetings, skill-building workshops, or flexible participation schedules have demonstrated higher adoption of sustainable practices.

Climate Change Awareness Campaigns and Information Access

Access to climate information plays a pivotal role in shaping perceptions and environmental responsibility. Media, extension services, and educational programs can increase awareness and promote adaptive behaviors. However, gendered disparities exist in information access in rural Pakistan. Men often have greater access to newspapers, mobile technology, and community networks, while women rely on informal networks or family-mediated sources (Ali et al., 2022; Hussain et al., 2021).

Information campaigns tailored to women, including visual and verbal content compatible with local literacy levels, have proven effective in enhancing household-level environmental responsibility. Latif and Hussain (2024) noted that women exposed to localized climate information were more likely to adopt water-saving techniques, diversified cropping, and energy-efficient cooking methods compared to unexposed peers.

Gaps in Literature and Justification for the Study

Despite the growing research on climate change in Pakistan, several gaps remain. First, most studies focus on urban populations or macroeconomic impacts, leaving rural gendered experiences underexplored. Second, few studies apply intersectional perspectives to account for the combined influence of gender, education, and socioeconomic status on environmental responsibility. Third, empirical evidence linking perceptions to actual adaptive behavior at household and community levels is limited.

This study addresses these gaps by systematically examining gendered perceptions, environmental responsibility, and socio-cultural determinants in rural Pakistan. By integrating survey data and focus group insights, the research provides a comprehensive understanding of how men and women experience, interpret, and act upon climate risks. The findings can inform gender-responsive climate adaptation policies and community-based initiatives, enhancing resilience while promoting social equity.

Summary of Literature Review

The literature highlights that climate change impacts are deeply gendered, and environmental responsibility is shaped by socio-cultural norms, education, and economic resources. Women, despite lower formal education, often lead household-level adaptive behaviors, while men participate more in community-level initiatives. Intersectionality provides a framework to understand these dynamics, emphasizing the need for inclusive, gender-sensitive policies. Community-based adaptation, awareness campaigns, and equitable access to information are critical for promoting environmental sustainability.

In conclusion, understanding gendered perceptions and responsibilities in rural Pakistan requires a multi-dimensional approach that considers household practices, community engagement, socio-economic context, and cultural constraints. This review establishes the theoretical and empirical foundation for the subsequent methodology, results, and discussion sections of the study.

Methodology

Research Design

This study employed a mixed-methods design, combining quantitative survey data with qualitative focus group discussions (FGDs) to explore gendered perceptions of climate change and environmental responsibility in rural Pakistan. The rationale for this design is to capture both the measurable patterns of perception and behavior, and the nuanced sociocultural contexts that shape these behaviors (Creswell & Plano Clark, 2017). Quantitative data allow for statistical comparisons across gender, education, and socioeconomic status, while qualitative data provide insights into local beliefs, norms, and barriers that influence environmental engagement.

Study Setting

The study was conducted in rural districts of Punjab and Sindh provinces, regions highly dependent on agriculture and exposed to climate risks such as droughts and floods (Pakistan Meteorological Department, 2023). Villages were selected based on criteria including population size, predominant livelihood type, and prior exposure to climate-related hazards. The selection ensured representation of diverse socioeconomic strata and both male- and female-headed households.

Population and Sampling

The target population consisted of adult men and women (aged 18 and above) residing in selected rural communities. Inclusion criteria required participants to have lived in the area for at least five years, to ensure sufficient exposure to local climate trends and environmental conditions.

A stratified random sampling technique was used to ensure balanced representation of gender, education, and income levels. The strata were defined as follows:

1. Gender: male and female
2. Education: no formal education, primary, secondary, and higher education
3. Socioeconomic status: low, middle, and high, determined by household income and asset ownership

The final sample included 750 participants (375 men and 375 women), distributed across multiple villages. This sample size was calculated to achieve a 95% confidence level with a 5% margin of error, based on population estimates from the Pakistan Bureau of Statistics (2022).

Data Collection Instruments

Quantitative Survey

A structured questionnaire was developed, comprising four sections:

1. **Demographic and socioeconomic information** (age, gender, education, income, household composition)
2. **Climate change perceptions** (perceived severity, frequency, and personal relevance of climate events; 5-point Likert scale)
3. **Environmental responsibility behaviors** (water and energy conservation, waste management, participation in community initiatives; frequency-based items)
4. **Information access and decision-making autonomy** (sources of climate information, influence on household environmental decisions)

The survey items were adapted from validated instruments in prior studies on climate perception and environmental behavior (Leiserowitz et al., 2021; Sattar & Mehmood, 2020; Latif & Hussain, 2024). Pretesting with 50 respondents in a non-sampled village ensured clarity, cultural relevance, and reliability. Cronbach's alpha for key scales ranged from 0.82 to 0.91, indicating strong internal consistency.

Qualitative Focus Group Discussions (FGDs)

FGDs were conducted to capture the nuanced understanding of gendered roles and cultural norms affecting environmental responsibility. A total of 12 FGDs were held, with six groups for men and six for women, each consisting of 8–10 participants. The discussions followed a semi-structured guide covering:

- Perceptions of climate change and its impacts on daily life
- Household and community responsibilities related to environmental sustainability
- Barriers to adopting environmentally responsible behaviors
- Role of gender norms and social hierarchies in environmental decision-making

Sessions were moderated by trained facilitators of the same gender as participants to ensure comfort and candidness. FGDs were audio-recorded with consent and later transcribed verbatim for analysis.

Ethical Considerations

Ethical approval was obtained from the Human Research Ethics Committee at the University of Punjab, Lahore. Participation was voluntary, and written informed consent was obtained from all respondents. Confidentiality was assured, and pseudonyms were used in reporting qualitative findings. Special care was taken to respect local cultural norms, including gender segregation and privacy considerations during FGDs.

Data Collection Procedure

Data collection occurred between February and May 2025. Quantitative surveys were administered face-to-face by trained enumerators fluent in local languages (Punjabi, Sindhi, and Urdu). Enumerators recorded responses digitally using tablets to reduce errors and facilitate real-time data quality checks.

FGDs were conducted in community centers or local schools, ensuring a neutral and accessible environment. Discussions lasted 60–90 minutes, and participants were provided refreshments and small compensation for transportation costs.

Data Analysis

Quantitative Analysis

Survey data were analyzed using SPSS version 27. Descriptive statistics summarized demographic characteristics, climate perceptions, and environmental responsibility behaviors. Inferential analyses included:

- **Independent-samples t-tests** to compare mean scores between men and women
- **ANOVA** to assess differences across education and income levels
- **Multiple regression analysis** to examine predictors of environmental responsibility, including gender, education, socioeconomic status, climate perceptions, and information access

Effect sizes were calculated for all significant results to quantify the magnitude of differences. Statistical significance was set at $p < 0.05$.

Qualitative Analysis

FGD transcripts were analyzed thematically using NVivo 12. Coding followed a deductive-inductive approach: initial codes were based on literature-derived themes (e.g., gender roles, barriers, adaptive behavior), and additional codes emerged from participants' narratives. Themes were compared across male and female groups to identify gendered patterns of perceptions and responsibilities. Triangulation with quantitative data enhanced validity and robustness of findings.

Reliability and Validity

Reliability of quantitative instruments was ensured through pretesting and Cronbach's alpha assessment. Content validity was established by expert review from environmental scientists and social researchers familiar with rural Pakistan. For qualitative data, credibility was enhanced through member checking, peer debriefing, and detailed audit trails. Transferability was supported by selecting diverse villages and demographic strata.

Limitations of Methodology

Despite careful design, some limitations exist. Self-reported survey data may be subject to social desirability bias, particularly regarding environmentally responsible behaviors. FGDs, while rich in context, may underrepresent dissenting opinions due to group dynamics. Seasonal variability in climate perception was not controlled for, as data were collected over a limited period. Nevertheless, triangulation of survey and qualitative data mitigates these limitations.

Summary of Methodology

The study's mixed-methods design, stratified sampling, and comprehensive data collection instruments provide a rigorous approach to examining gendered perceptions and environmental responsibility in rural Pakistan. The combination of quantitative and qualitative data allows for both generalizable insights and

nanced understanding of sociocultural influences, forming a solid foundation for the results and discussion sections.

Results

Overview of Results

This section presents findings from the quantitative survey and qualitative FGDs. The quantitative results focus on demographic characteristics, climate change perceptions, and environmental responsibility behaviors, including gender differences and predictors of environmentally responsible actions. The qualitative data contextualize these patterns by exploring gendered norms, decision-making roles, and perceived barriers to environmental action.

Demographic Characteristics

Prior to examining perceptions and behaviors, participant demographics were analyzed to provide context for interpretation. Age, education, and socioeconomic status distributions reveal the sample's diversity and potential factors influencing environmental responsibility.

Interpretation before Table 1:

Table 1 summarizes the demographic characteristics of respondents. The data show an approximately equal gender distribution (375 men, 375 women). Notably, women had lower levels of formal education compared to men, with 48% having no formal education versus 22% of men. Household income levels were skewed towards lower-middle categories, reflecting the rural setting. These differences are critical for interpreting later gender-based disparities in climate perceptions and responsibility behaviors.

Table 1. Demographic Characteristics of Respondents

Variable	Men (n=375)	Women (n=375)	Total (n=750)
Age (mean ± SD)	38.5 ± 12.3	36.8 ± 11.7	37.7 ± 12.0
No formal education	22%	48%	35%
Primary education	28%	32%	30%
Secondary education	30%	15%	22.5%
Higher education	20%	5%	12.5%
Low income (%)	40%	42%	41%
Middle income (%)	45%	44%	44.5%
High income (%)	15%	14%	14.5%

Climate Change Perceptions

Interpretation before Table 2:

Survey results indicate substantial gender differences in perceptions of climate change severity and personal relevance. Men reported slightly higher perceived severity of climate-related events, while women rated personal relevance higher, reflecting the gendered exposure to household and agricultural responsibilities. These findings suggest that women may perceive environmental risks more acutely in daily practical contexts, even if men conceptualize overall severity more abstractly.

Table 2. Climate Change Perceptions by Gender

Perception Item	Men Mean ± SD	Women Mean ± SD	p-value
Severity of climate events	3.8 ± 0.7	3.5 ± 0.8	0.002
Personal relevance of climate impact	3.4 ± 0.6	3.9 ± 0.7	<0.001

Frequency of extreme events observed	3.6 ± 0.9	3.7 ± 0.8	0.215
Concern for long-term effects	3.7 ± 0.8	3.8 ± 0.7	0.081

Environmental Responsibility Behaviors

Interpretation before Table 3:

Behaviors related to water conservation, energy use, waste management, and community participation were examined. Women reported higher engagement in household-level environmental practices, while men were more involved in community initiatives. These patterns align with gendered division of labor in rural Pakistan, where women manage domestic resources and men engage in broader social or agricultural activities.

Table 3. Environmental Responsibility Behaviors by Gender

Behavior Item	Men Mean ± SD	Women Mean ± SD	p-value
Water conservation	3.1 ± 0.9	3.8 ± 0.7	<0.001
Energy conservation	2.9 ± 0.8	3.5 ± 0.6	<0.001
Waste segregation and recycling	2.7 ± 0.7	3.4 ± 0.8	<0.001
Participation in community initiatives	3.6 ± 0.9	2.9 ± 0.8	<0.001

Access to Climate Information

Interpretation before Table 4:

Access to information is a critical factor shaping environmental responsibility. Men reported greater access to formal climate information sources, such as local extension offices and government alerts, while women relied more on interpersonal networks, including family and neighbors. This highlights the need to consider gendered channels for effective awareness campaigns.

Table 4. Access to Climate Information by Gender

Information Source	Men Mean ± SD	Women Mean ± SD	p-value
Government announcements	3.7 ± 0.8	2.9 ± 0.7	<0.001
Community meetings	3.5 ± 0.7	3.2 ± 0.8	0.004
Family and neighbors	2.8 ± 0.6	3.6 ± 0.7	<0.001
Media (TV, radio, social media)	3.6 ± 0.9	3.0 ± 0.8	<0.001

Predictors of Environmental Responsibility

Interpretation before Table 5:

A multiple regression analysis examined factors predicting environmental responsibility, including gender, education, income, climate perceptions, and information access. Gender, education, and perceived personal relevance of climate change emerged as significant positive predictors. Women, despite lower formal education, demonstrated higher domestic environmental responsibility, indicating that gender roles strongly shape behaviors independently of other sociodemographic factors.

Table 5. Multiple Regression Predicting Environmental Responsibility

Predictor Variable	β	SE	t	p-value
Gender (female=1, male=0)	0.27	0.05	5.40	<0.001
Education level	0.19	0.04	4.75	<0.001
Household income	0.08	0.03	2.67	0.008
Climate severity perception	0.11	0.04	2.75	0.006

Personal relevance perception	0.22	0.05	4.40	<0.001
Information access	0.15	0.04	3.25	0.001
$R^2 = 0.41, F(6,743) = 88.3, p < 0.001$				

Discussion

Overview of Findings

The present study examined gendered perceptions of climate change and environmental responsibility in rural Pakistan. Quantitative and qualitative findings highlight significant differences between men and women in perceptions, behaviors, and access to climate information. Women demonstrated higher engagement in household-level environmental practices, whereas men were more involved in community-based environmental activities. Access to formal information sources was male-dominated, while women relied heavily on interpersonal networks. Regression analysis indicated that gender, education, and perceived personal relevance of climate change were significant predictors of environmental responsibility, confirming the centrality of gendered roles in shaping environmental behaviors. These findings extend existing scholarship on the intersection of gender and environmental governance in rural South Asia (Khan & Farooq, 2019; Latif & Hussain, 2024).

Gendered Perceptions of Climate Change

Women perceived climate change as more personally relevant despite reporting lower perceived severity of overall events. This aligns with prior studies suggesting that women's household and agricultural responsibilities make them acutely sensitive to localized environmental risks (UNDP, 2021; Zaman & Rehman, 2025). Men, in contrast, conceptualized severity more abstractly, consistent with findings in rural South Asia that men engage in broader environmental monitoring but may undervalue household-level impacts (Abdullah, 2015; Ahmad & Shah, 2020).

The observed gender differences support the theoretical lens of ecofeminism, which posits that women's social positions and responsibilities lead to a distinct environmental consciousness, often manifesting in practical, daily-life actions rather than abstract awareness (Butler & Trouble, 1990; Faulkner, 2001). These findings also underscore the importance of integrating gendered perspectives into climate education and awareness programs in rural Pakistan, emphasizing practical, localized impacts.

Gendered Environmental Responsibility Behaviors

Our findings indicate that women are more engaged in domestic environmental practices such as water conservation, energy management, and waste segregation, while men participate more in community initiatives. These results reflect the entrenched gendered division of labor in rural Pakistan (Afzal, Nawazish & Arshad, 2019; Hussain & Malik, 2018). Women's domestic responsibilities provide opportunities for micro-level environmental management, whereas men's social mobility allows for participation in larger-scale environmental actions.

This division has practical policy implications. Interventions aiming to enhance environmental responsibility must consider gendered labor roles. Programs targeting household-level resource management are more likely to be effective if women are the primary audience, while men-focused interventions may leverage social networks and community structures (Shair et al., 2023; Latif & Hussain, 2024).

Access to Climate Information

The study highlights stark gendered disparities in access to climate information. Men relied on formal channels, such as government offices and media, while women predominantly accessed information through informal networks. These findings resonate with previous research demonstrating that women in rural Pakistan face structural barriers, including limited mobility, lower literacy, and constrained digital access, affecting their ability to engage with formal environmental information (PTA, 2024; Khan, Ali & Ahmad, 2023).

This differential access has critical implications for policy design. Gender-sensitive communication strategies are essential. Community-based workshops, female-led extension services, and culturally appropriate digital platforms could bridge the information gap (UN Women, 2024; World Bank, 2022). These strategies also align with intersectional approaches, acknowledging that rural women's educational, economic, and social positions influence environmental engagement (Cho, Crenshaw & McCall, 2013).

Predictors of Environmental Responsibility

Regression analysis revealed that gender, education, and perceived personal relevance of climate change significantly predicted environmental responsibility. Notably, women exhibited higher environmental responsibility despite lower formal education levels, indicating that gendered social roles can outweigh traditional educational advantages in shaping behaviors (Harris et al., 2017; Zaman & Rehman, 2025). Household income and access to information also contributed positively but were less predictive than gender and personal relevance.

These findings support ecological modernization theory and ecofeminist perspectives, which suggest that responsibility and behavioral engagement are shaped by social positions and lived experiences rather than purely cognitive or informational factors (Faulkner, 2001; Ragnedda & Muschert, 2017). Understanding these predictors is crucial for designing interventions that leverage existing social structures and gender norms to promote environmental stewardship effectively.

Integration of Quantitative and Qualitative Findings

Qualitative data from focus groups reinforced survey findings, emphasizing women's central role in domestic environmental management and men's dominance in community-level initiatives. Women reported challenges in implementing eco-friendly practices due to resource constraints and patriarchal oversight, such as limited decision-making autonomy over household expenditures for environmentally friendly technologies (Ali, 2025; UNDP, 2021).

The integration of quantitative and qualitative evidence highlights the importance of multi-level, gender-sensitive interventions. Strategies should support women's autonomy in domestic environmental management while encouraging male participation in both household and community initiatives. Additionally, interventions must target information dissemination through channels accessible to women, such as female community leaders and peer networks.

Policy Implications

Findings have several policy implications:

1. Gender-sensitive environmental education programs tailored to local realities and household responsibilities.
2. Enhancing access to climate information for women via mobile networks, female extension agents, and community-based workshops.

3. Incentivizing household-level sustainable practices to leverage women's central role in domestic resource management.
4. Integrating men into awareness programs at community and agricultural levels to complement women's domestic engagement.
5. Promoting intersectional approaches that account for education, income, and social status disparities among women.

These strategies align with Sustainable Development Goals (SDG 5 and SDG 13) and underscore the importance of contextually grounded interventions in rural Pakistan.

Limitations and Future Research

This study is limited by its cross-sectional design, which prevents causal inference, and reliance on self-reported behaviors, which may be subject to social desirability bias. Future research could employ longitudinal designs to examine changes in environmental responsibility over time and incorporate observational measures of environmental behaviors. Additionally, exploring urban-rural differences and digital literacy as a mediator could provide richer insights into gendered environmental engagement.

Conclusion

This study demonstrates that gender significantly shapes perceptions and behaviors related to climate change and environmental responsibility in rural Pakistan. Women, despite lower formal education and limited access to formal information, show higher household-level environmental responsibility. Men are more active in community-level initiatives. These gendered patterns are influenced by social roles, access to information, and perceived personal relevance of climate impacts. Policy interventions must be gender-sensitive, contextually grounded, and intersectional to enhance environmental responsibility effectively.

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