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Climate Vulnerability and Gendered Coping Strategies: Insights from Disaster-Prone Coastal Odisha

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Abstract: Climate-induced disasters, including floods, cyclones, and droughts, have increased in frequency and severity in coastal Odisha over the past few decades. Recurrent crop failures, livelihood disruptions, and loss of income have heightened economic stress and reduced the resilience of vulnerable communities. These impacts are often gender-differentiated, influencing how men and women respond to and cope with disaster-related challenges. This study examines gender-specific coping strategies in the flood-prone coastal regions of Puri district, Odisha. A mixed-methods approach was adopted to collect primary data from 300 households across 12 villages, along with focus group discussions, key informant interviews and case studies. The findings reveal significant gender differences in coping responses. Men largely adopted economic responses such as temporary migration for employment, livelihood diversification, wage labour in nearby towns and involvement in repair activities. Women, on the other hand, relied more on household and resource management, social support networks, and participation in self-help groups, and borrowing through community networks. Livelihood disruptions and economic insecurity resulted in susceptibility to emotional and psychological stress among men. In contrast, despite several challenges faced by women, they strengthened household resilience and disaster response through caregiving, community engagement, and social networks. Regression analysis further indicated that social capital, education, household income, and access to early warning system, substantially affected gender-differentiated disaster coping strategies. The study emphasizes the significance of social networks and community support systems to develop disaster resilience in coastal communities. The study further highlights the need for integrating gender perspectives into climate adaptation strategies to increase women's participation, improve access to resources, and reinforce resilience in vulnerable coastal communities while providing support to men to cope with mental stress linked to change of occupation and living away from families.

Keywords: climate adaptation, climate change, coping strategies, disaster resilience, gender roles, livelihood adaptation

Introduction

Climate change represents one of the most critical global challenges of the twenty-first century, characterized by rise in temperatures and variability in precipitation [1]. These changes have led to increased frequencies of natural disasters like cyclones, floods, and droughts, predominantly in coastal regions, threatening food and water security, livelihoods, and economic security [2]. These impacts often vary within communities due to existing social inequalities, including poverty, inadequate access to resources, and weak institutional support [3]. Coping

strategies are not a choice but are utmost necessity for the distressed community when such disasters are recurrent and inevitable. often intensify these impacts and limit adaptive capacity. It is thus necessary to understand the diverse coping strategies utilized by the individuals, households, and communities.

Different gender roles and responsibilities contribute to how different individuals experience and respond to disasters. Women face challenges related to access to resources and mobility, and have less involvement in decision-making processes, which increase their vulnerability to disaster risk. Men, in turn, have more involvement in post-disaster economic reconstruction [4].

In the Indian context, the impacts of climate-induced disasters differ depending on regional variations and socio-economic inequalities [5]. Odisha has been one of the highly vulnerable coastal states in India, facing recurrent threats from cyclones, floods, and storm surges [6]. Although, preparedness and management for disasters have significantly improved after the extreme Super Cyclone of 1999, addressing the needs of vulnerable populations continues to be a significant challenge [7].

Disaster response and resource mobilization are facilitated by adaptive governance systems. The accessibility to both adapting and coping strategies as well as disaster relief is frequently determined by the existing participatory and decision-making structures. Gender-equitable coping can be achieved through inclusive gender-responsive policies and governance mechanisms as disparity in access to resources and opportunities is reduced [8].

This study explores gender-specific coping and adaptation strategies by men and women towards climate vulnerability in the coastal districts of Odisha, by understanding the perceptions of men and women towards risk, mobilization of resources, and coping strategies against disasters. Understanding these differences can help policymakers and practitioners to design more inclusive interventions that strengthen resilience and address existing inequalities in vulnerable communities.

The disaster response initiatives, at the community levels in the coastal regions of Odisha have enhanced adaptive capacities and lowered vulnerability to climate variability through community participation and relevant interventions [9]. The coping responses to disasters in the state are often gender-driven, with men primarily concerned with the livelihoods and economically-oriented post-disaster activities and sometimes undertaking significant risks. The caregiving roles and family concerns in the post-disaster phase and after largely remain with the women [10].

Natural ecosystems and green infrastructure also play a significant role in ensuring adaptation to natural hazards such as floods and cyclones [11]. However, accessibility to and utilization of ecosystem management activities are also influenced by gender, affecting equitable access of benefits from resources among different groups. Understanding these gendered patterns of utilization is important to facilitate climate change adaptation in coastal Odisha.

Climate-related disasters also impact on psychosocial aspects of the individuals. Individuals respond differently towards psychological impact based on their gender during the disaster. Women are often at a greater risk in terms of mental health owing to their caregiving responsibilities, lack of access to resources and information and elevated susceptibility to disasters [12]. At the same time, household and community-based support mechanisms have a substantial role to play in preserving psychosocial well-being [13]. While there is growing evidence that suggest that post-disaster men don’t receive the psychosocial interventions, not necessarily because services exclude them, but because gender norms put women and children forward and help-seeking stigma and disaster-response frameworks do not recognize the needs of men [14].

Risk assessment frameworks support informed decision-making in disaster and adaptation planning. Participation in adaptation processes is often influenced by access to information and resources, which may vary across gender groups. Gender-based differences in access can affect the adoption of adaptation strategies and coping responses. These insights can contribute to strengthening community-level disaster preparedness and resilience in coastal regions [15].

Behaviour plays an important role in determining whether responses to natural disasters are adaptive or maladaptive. Men are more likely to adopt income-generating strategies, whereas women often rely on household- and community-based coping measures. These responses are influenced by social norms, risk perceptions, and access to resources. Understanding such gender-based behavioural differences can support more effective adaptation planning [16]. Gender also shapes perceptions of climate-related risks. Women often perceive higher levels of vulnerability but may face constraints related to mobility and economic resources, while men are more likely to adopt external and comparatively riskier adaptation measures [17].

The effectiveness of strategic post-crisis management increases resilience by improving access to resources and strengthening recovery planning. Gender roles affect participation in recovery-related activities and decision-making

processes. Inclusive and context-specific planning contributes to successful adaptation, while an understanding of social systems ensures implementation of more appropriate adaptation measures [18]. The impacts of climate change-induced displacement are experienced differently by both genders. Women often suffer from increased household tasks and mobility limitations, whereas men participate in reconstruction and economic activities. These gendered coping mechanisms affect recovery processes and adaptive capacity [19]. Climate-resilient water resource management can help reduce vulnerability and ensure women's security. Furthermore, access to social networks, infrastructure, and community support systems influence the implementation of adaptive responses, highlighting the gendered nature of adaptation within households and communities [20].

Gender diversity in governance and decision-making processes improves adaptability and resilience to climate-related threats. Inclusive decision-making processes contribute to more equitable adaptation results, while gender-sensitive frameworks support resilience building [21]. An intersectional perspective shows that social, economic, and gender-related factors regulate vulnerability and adaptation practices. Women focus on household- and community-based coping measures, whereas men often tend to adopt externally oriented and risk-based responses [22].

This study examines gender-differentiated coping strategies in Puri district, Odisha, focusing on how gender roles, access to resources, and social networks influence vulnerability and coping responses strategies. It identifies the influence of socio-economic characteristics, including literacy, income, occupation, and family size, on coping strategies, demonstrating the role of these factors in shaping adaptation and resilience outcomes. The findings can support policymakers and practitioners in formulation of more inclusive adaptation policies while promoting greater social and gender equity.

Literature Review

The literature highlights the complex relationship between climate vulnerability and gender-specific coping mechanisms in disaster-prone areas as summarized in Table 1. Governance systems and policy structures play an important role in shaping access to resources and adaptation opportunities. Existing studies indicate that women often experience greater impacts from climate related disasters, including food insecurity, health-related challenges, and livelihood loss. Gender roles influence the coping strategies adopted by both men and women in communities. Culture, short-term adaptation, and institutional response can either support or restrict these responses, suggesting that the need for context-specific and integrated approach to understanding and addressing gendered dimensions of climate vulnerability and adaptation.

Table1: Summary of Related Works

Methodology	Literature Review Insights	Key Contribution	Key Reference
Legal analysis and framework review	Examines climate, biodiversity, and sustainable development legislation in Najaf; highlights gaps in local implementation	Provides insights into governance and policy frameworks that can guide community-level adaptation and gender-inclusive strategies.	[23]
Survey and household interviews	Analyzes gendered risks of food insecurity among rural households in Indonesia	Identifies how women are disproportionately affected by climate-induced food insecurity, informing gender-sensitive adaptation planning.	[24]
Systematic review	Reviews the literature on climate change impacts on women’s health and vulnerability	Highlights gendered health risks under climate stress and emphasizes integrating women’s health into resilience planning.	[25]
Mixed-methods (survey + interviews)	Examines gendered dimensions of climate change impacts and adaptive strategies	Shows that men and women adopt different coping strategies; underscores social norms that affect adaptation in vulnerable communities.	[26]
Quantitative analysis of weather shocks	Studies the gendered impacts of extreme weather events	Demonstrates that women experience greater exposure and vulnerability; informs gender-responsive risk-reduction strategies.	[27]

Case study and surveys	Investigates smallholder farmers' perception and adaptation options in Ethiopia	Highlights gender differences in perception and coping strategies; offers comparative insights for similar coastal regions.	[28]
Intersectional vulnerability assessment	Examines gender-based vulnerability and adaptive capacity in disaster-prone coastal areas	Integrates multiple vulnerability factors, providing a holistic framework for gendered adaptation planning.	[29]
Ethnographic and field study	Explores resilient traditions and livelihood shifts in Assam handloom communities	Shows how traditional practices support adaptive capacities and emphasizes culturally sensitive interventions.	[30]
Longitudinal survey	Analyzes adaptation outcomes in climate-vulnerable coastal Bangladesh	Finds short-term adaptation can exacerbate gender inequities; underlines the need for long-term, gender-aware strategies.	[31]
Mixed-methods (survey + interviews)	Studies female entrepreneurs' vulnerability to climate risk in sub-Saharan Africa	Identifies barriers and enablers for women's private-sector adaptation; informs economic empowerment approaches.	[32]
Survey and participatory assessment	Investigates economic empowerment through climate mitigation initiatives	Shows climate mitigation programs can strengthen women's economic and adaptive capacities.	[33]
Case study and interviews	Examines pastoral coping and adaptation strategies	Highlights women's well-being in adaptation measures; demonstrates gendered differences in pastoral communities coping with climate stress.	[34]

Source: Developed by Authors

Despite the increase in research on climate vulnerability and post-disasters adaptation, studies examining gender differences in coping mechanisms among highly disaster-prone communities, such as those in Odisha, remain limited. While several studies have examined the socio-economic and policy dimensions of climate vulnerability, less attention has been paid to how gender shapes coping responses in disaster-prone coastal communities. In Odisha, where recurrent floods and cyclones affect livelihoods, evidence on the role of household decision-making, social networks, and access to early warning information remains limited.

Conceptual Framework

Fig1 shows the conceptual framework, which connects the elements of climate stressors, gendered vulnerability, coping strategies, and resilience outcomes. Floods, cyclones, droughts, and heat waves are climate stressors that cause disasters for people's lives and communities. Individuals adopt coping strategies to manage stress and reduce its impact. Coping strategies are behavioral, economic, psychological, and social interventions used in response to stressful situations. The effects of these stressors will be moderated by factors such as resource and information access, division of labor, decision-making, and existing norms and social expectations, which can be considered gendered vulnerability factors. These will influence the choice of coping strategy. Furthermore, some factors are necessary for resilience: social capital (networks, self-help groups), institutional interventions (government relief, NGOs), policy measures (gender-sensitized policies), and access to early warning systems. Gendered vulnerability factors will help individuals and communities adapt and strengthen their resilient capacity. Studies show that coping strategies differ not only between genders but also within male and female household heads. As found in research on flood- and drought-affected communities in Bihar, India, although decisions about coping mechanisms such as migration and employment are made by men, some coping mechanisms, such as consumption reduction, are decided after discussion within the family unit. In general, men tend to engage in economic coping strategies involving migration and income diversification, while women rely on social networks, household resource management, and community assistance programs. Ultimately, the relationship between coping mechanisms and resource availability defines household resilience, food and water security, and the resilience of the entire community.

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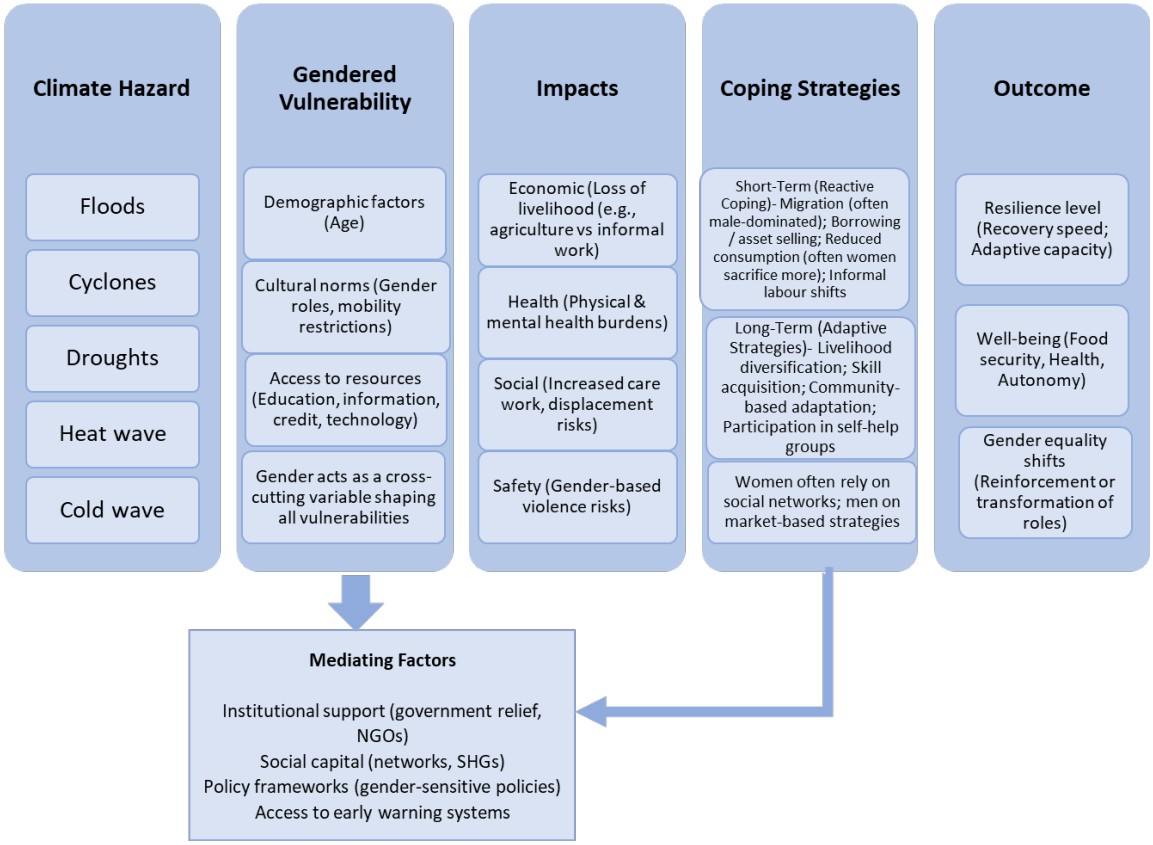


Figure 1: Conceptual Framework: Gendered Coping Strategies in Climate-Induced Disasters

Source: Developed by authors based on literature review

Materials and Methods

Study Area

The study focuses Puri district, lying on the east coast of Odisha, India. The district is vulnerable to frequent occurrence of natural disasters such as cyclones, floods, and droughts as a result of changing climate. Some of the significant disasters over the last thirty years in Puri district include cyclones and severe floods that have had largely affected the lives and livelihood of rural population and infrastructure. As a coastal district, Puri is especially prone to such disasters due to its proximity to the coastline along with dependence on agriculture and fishery.

Research Design

A mixed-methods approach was adopted, integrating both quantitative household surveys with qualitative focus group discussions and key informant interviews. The mixed-methods approach enabled triangulation of findings and facilitated a comprehensive understanding of gendered coping strategies in disaster-prone communities.

Sampling Strategy

This study involved a multi-stage sampling design to identify the areas and participants as described in Table 2 below. The study area was purposively selected based on its vulnerability to climate-induced disasters, climate-sensitive livelihoods, and accessibility to resources. The systematic random sampling technique was used to ensure participation of diverse socio-economic groups. Primary survey was conducted for total of 300 households for the quantitative part of the research.

Sample Size Justification

The size of the sample chosen was 300 households, which comprised diverse socio-economic categories of people living under conditions susceptible to climate change effects in vulnerable coastal regions. The sample households comprised of agricultural laborers, fishing communities, wage earners, and non-farming households. It was thought appropriate for analyzing gender differences in coping mechanisms through quantitative data analysis. Further, additional qualitative information obtained from focus groups, key informant interviews, and case studies was incorporated to authenticate survey results.

Table 2: Sampling Framework and Selection Criteria

Stage	Sampling Unit	Selection Criteria	Sampling Technique
Stage 1	District	Exposure to climate hazards (floods, cyclones); history of frequent disasters; high socioeconomic vulnerability	Purposive sampling
Stage 2	Villages	Exposure to recent climate-induced disasters; dependence on climate-sensitive livelihoods; accessibility for field research	Purposive sampling
Stage 3	Households	Representation of diverse socioeconomic groups (landless households, small farmers, non-farm households)	Systematic random sampling

Source: Authors' field survey data (2024–2025)

Data Collection Methods

Household surveys were conducted using structured questionnaires to collect quantitative information on demographic characteristics, livelihood activities, disaster experiences, coping strategies, and access to resources. Both male and female household members participated to capture gender-specific perspectives. Separate Focus Group Discussions (FGDs) were conducted with men and women to understand community experiences, coping mechanisms, and disaster responses. Key Informant Interviews (KIIs) with government officials, disaster management authorities, NGO representatives, community leaders, and women's SHG members provided insights into institutional support and local responses. Additionally, household case studies were conducted to document detailed experiences and coping strategies adopted during climate-induced disasters. These multiple data sources enabled triangulation and improved the reliability of the findings. In general, data collection was done using quantitative research methods through 300 household surveys and qualitative data through focus group discussions, key informants' interviews, and household case studies. The above sources provided triangulation for findings and gender coping strategies.

Variables and Measurement

Table 3 shows the variables used in the logistic regression and their measurements. The coping strategies were used as dependent variables, coded as a dichotomous outcome (adopted = 1, not adopted = 0). The independent variables used in the model include gender, level of education, average household annual income, land ownership status, membership in any community groups and access to early warning information.

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Table 3: Description and Measurement of Variables Used in the Logistic Regression Analysis

Variable	Type	Measurement
Gender	Independent	Male=0, Female=1
Education	Independent	Years of schooling
Income	Independent	Annual household income
Land ownership	Independent	Yes=1, No=0
Community participation	Independent	Member=1, Non-member=0
Early warning access	Independent	Access=1, No access=0
Coping strategy adoption	Dependent	Adopted=1, Not adopted=0

Source: Authors' field survey data (2024–2025)

Data Analysis

Quantitative data from household survey were analyzed using descriptive statistics, such as frequency distribution and cross-tabulation. The gender-disaggregated analysis was performed to determine the variations in coping strategies adopted by males and females. Binary logistic regression was employed to examine factors influencing the adoption of disaster coping strategies. The dependent variable was coded as 1 for households adopting coping strategies and 0 otherwise. Independent variables included gender, education, income, land ownership, participation in community groups, access to early warning information, and household size. The qualitative data obtained through interviews and focus group discussions were subjected to thematic analysis, wherein the responses were grouped on the basis of themes like gender roles, resource availability, and coping mechanisms.

Bias Mitigation and Data Reliability

To eliminate internal biases, the study used a combined methods research design that utilized both household surveys, FGDs, KIIs, and case studies. In order to ensure gender-sensitive information was captured, separate FGDs were organized for men and women. The respondents represented various socio-economic classes to avoid sampling biases. The validity of the gathered data was confirmed by cross-referencing quantitative data with qualitative insights.

Ethical Considerations

Informed consent was obtained from all participants. Confidentiality and anonymity were maintained throughout the study. Special attention was given to ensuring that women felt comfortable sharing their experiences.

Results and Discussion

Exposure to Climate-Induced Disasters

These findings demonstrate that most of the households in the study area have been affected by various disasters caused by climate change over the last decade (Table 4 and Figure 2).

Table 4: Exposure to Climate-Induced Disasters (Past 10 Years)

Type of Disaster	Households Affected (%)	Average Number of Events Experienced
Floods	72	3.1
Cyclones	64	2.6
Drought	38	1.7
Heatwaves	29	1.4
Crop failure due to climate variability	56	2.3

Source: Authors' field survey data (2024–2025)

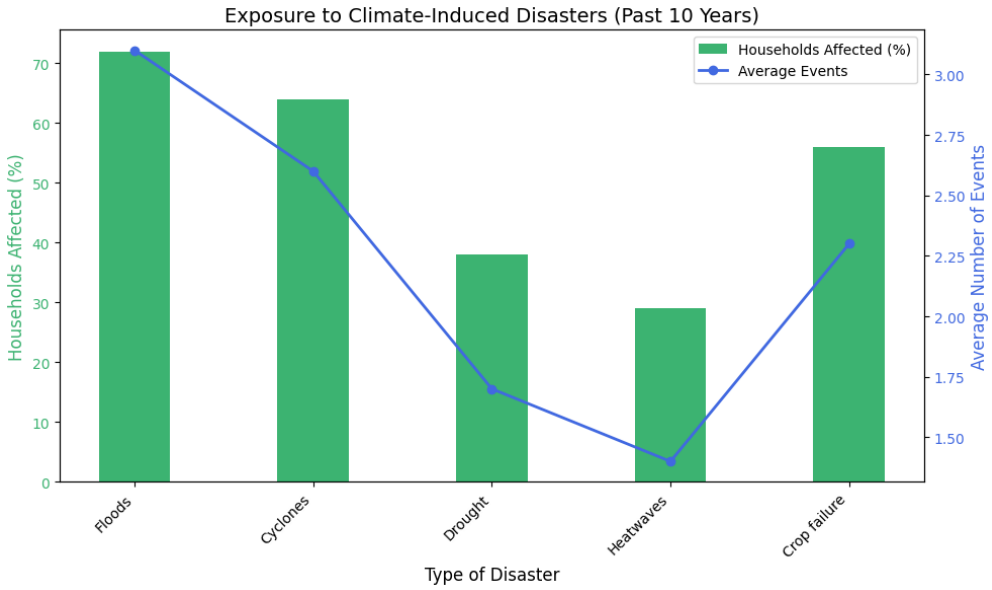


Figure 2. Exposure to Climate-Induced Disasters (Past 10 Years)

Source: Authors' field survey data (2024–2025)

Floods were found to be the primary cause of climate-induced disruptions, affecting the largest share of households (72%). Affected households experienced floods more frequently than other hazards, with an average of 3.1 events over the 10-year period. Cyclones were the second most common hazard, affecting 64% of the households with an average of 2.6 events experienced during the decade. Climate-induced crop failures affected 56% of surveyed households, with an average of 2.3 occurrences over the same period. Droughts (38% of households) and heatwaves (29% of households) also caused significant losses, with an average of 1.7 and 1.4 events respectively during the decade.

Community elders reported that disasters have intensified, occur more frequently, and have become unpredictable in recent years, with notable changes in patterns of rainfall, increasing temperatures, and amplified storm intensity. Temporary closure of markets and workplaces due to disasters cause substantial economic loss for households dependent on daily wage labour.

Socioeconomic Characteristics of Survey Respondents

The socio-economic profile of the participants revealed notable gender-based differences as illustrated in Table 5. Males had a slightly higher mean age (41.2 years) than females (39.5 years) with an overall mean age of 40.3 years. Literacy rates were higher in males (72%) than females (58%). Men showed greater participation in agricultural activities (54%) and owned more lands (68%). They displayed more involvement in small business/ trade (12% vs. 8%) and fishing (7% vs. 4%) compared to women. In contrast, females exhibited substantially higher involvement in community organizations (71% compared to 35% for males) and greater engagement in daily wage labor (32%) than men.

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Table 5: Socioeconomic Characteristics of Survey Respondents

Variable	Male Respondents (n=140)	Female Respondents (n=160)	Total (n=300)
Mean age (years)	41.2	39.5	40.3
Average household size	5.4	5.4	5.4
Literacy rate (%)	72	58	64
Primary occupation – agriculture (%)	54	49	51
Daily wage labour (%)	27	32	30
Small business/trade (%)	12	8	10
Fishing and allied activities (%)	7	4	5
Land ownership (%)	68	22	44
Participation in community groups (%)	35	71	54

Source: Authors' field survey data (2024–2025)

Gendered Coping Strategies

Table 6 and Figure 3 describe the gender-based differences in coping mechanisms in disaster-induced scenarios, reflecting existing gender roles and their varied access to resources at the household and community levels. It was observed that the majority of men adopted external measures to restore household income. These included mobility-based strategies, such as migration for work (48%) and livelihood diversification (42%), wage employment in the nearest town (37%), and repairing housing structures (51%), which often involved high-risk activities The adoption of these coping mechanisms by men may be attributed to their greater involvement in income-generating activities. On the other hand, women relied on household- and community-based strategies, including household resource management (74%), participation in community SHGs (63%), lowering household consumption (58%), and borrowing from relatives or community members (52%). Women were also actively involved in community coordination for relief purposes (36%). Overall, the findings indicate that women primarily adapted to climate-related disasters using household-centered and community-based coping mechanisms, while men were more likely to be involved in economic and infrastructure-based recovery activities.

Table 6: Gender Differences in Coping Strategies During Climate Disasters

Coping Strategy	Men (%)	Women (%)
Temporary migration for employment	48	9
Livelihood diversification	42	21
Wage labour in nearby towns	37	19
Repair of housing/infrastructure	51	14
Household resource management	18	74
Participation in self-help groups	11	63
Borrowing from relatives/community	26	52
Reducing household consumption	22	58
Community relief coordination	17	36

Source: Authors' field survey data (2024–2025)

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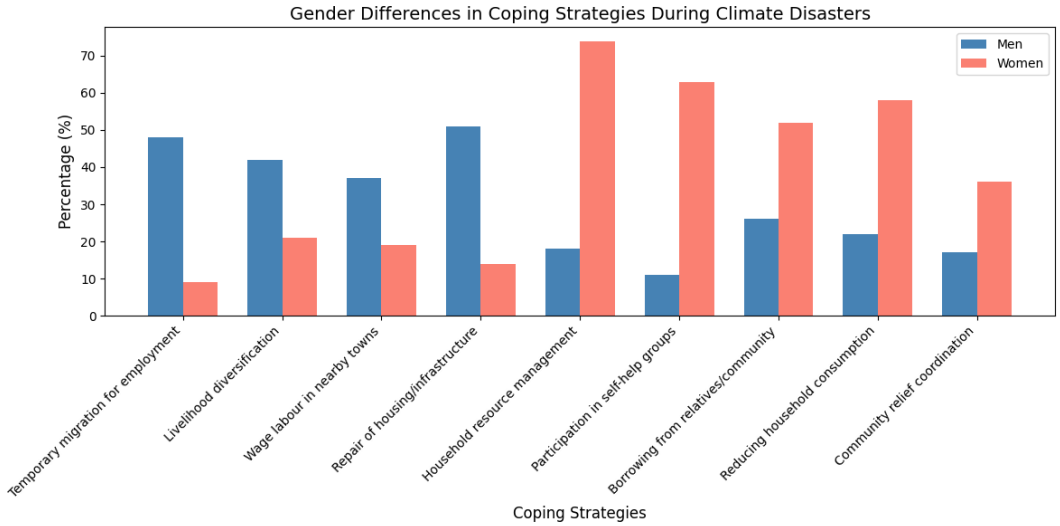


Figure 3: Gender Differences in Coping Strategies During Climate Disasters

Source: Authors' field survey data (2024–2025)

5.4 Determinants of Climate Disaster Coping Strategy Adoption

The results of regression analysis highlight the factors influencing the adoption of climate disaster coping strategies among the respondents (Table 7). Gender (being female) had a significant positive effect on adoption ($\beta = 0.42$, $p = 0.01$). Participation in community groups emerged as the strongest predictor of coping strategy adoption ($\beta = 0.48$, $p < 0.01$). Other important factors included land ownership ($\beta = 0.35$, $p = 0.01$) and access to early warning information ($\beta = 0.31$, $p = 0.02$). Education ($\beta = 0.27$, $p = 0.02$) and household income ($\beta = 0.19$, $p = 0.03$) also positively influenced the likelihood of adopting coping strategies. Household size did not have a statistically significant effect on coping strategy adoption ($\beta = -0.05$, $p = 0.21$).

Table 7: Regression Analysis of Determinants of Coping Strategy Adoption

Independent Variable	Coefficient (β)	Standard Error	Significance (p-value)
Gender (Female = 1)	0.42	0.16	0.01
Education level	0.27	0.11	0.02
Household income	0.19	0.08	0.03
Land ownership	0.35	0.14	0.01
Participation in community groups	0.48	0.15	0.00
Access to early warning information	0.31	0.12	0.02
Household size	-0.05	0.04	0.21

Source: Authors' field survey data (2024–2025)

Note: Dependent Variable: Adoption of Climate Disaster Coping Strategy (1 = Yes, 0 = No); Sample size: 300 households; Pseudo R^2: 0.32; Model significance: $p < 0.01$

Gender-Differentiated Coping Strategies in Climate-Induced Disasters

Table 8 explains the coping mechanisms adopted by men and women in response to climate-change-related natural disasters across various dimensions. Men mostly adopted coping mechanisms that revolved around external engagement and mobility, including migration to nearby urban areas to search of employment and diversification of income sources. They were also engaged in rescue operations, community decision-making, and investments aimed at strengthening livelihoods for future. These strategies further involved taking risks, managing resources, and using social networks to restore livelihoods and rebuild damaged infrastructure.

Table 8: Coping Strategies of Men and Women in Climate-Induced Disasters

Dimension	Coping Strategies of Men	Coping Strategies of Women
Economic coping	Moving to towns in search of jobs; having diversified sources of livelihood, including paid employment, fishing, and construction jobs	Budgeting of household expenses; undertaking small income-generating activities such as keeping livestock, making crafts, processing food, and marketing local produce
Livelihood adaptation	Occupational shifts (such as moving from agriculture to wage labour); adopting new agricultural technology or crops; diversification of livelihoods	Kitchen gardens, seed conservation, crop rotation, and food storage systems; household economic activities such as food processing and tailoring
Risk-taking roles	Involvement in rescue operations, property protection, reconstruction of infrastructure, and repairs of damaged houses	Ensuring safety of children, elders, and family members; household evacuation and distribution of aid supplies
Social coping	Attendance at community meetings, village leaderships, or disaster committee	Dependence on community networks, women's organizations, and self-help groups for emotional and economic assistance
Mobility and migration	Temporary or permanent migration to cities or other regions for employment	Limited mobility due to caregiving responsibilities and social norms; often remain in villages to manage households
Access to information	Greater access to disaster warnings, training programs, and institutional support due to social mobility and access to warning dissemination instruments like mobiles	Information often received through community networks, NGOs, or local women's groups
Psychological coping	Often suppress emotional stress due to social expectations related to masculinity	More likely to seek emotional support from family members, neighbors, and community groups
Household resource management	Decision-making related to major assets such as land, livestock, and financial investments	Management of food, water, fuel, and daily household resources during crisis periods
Community engagement	Participation in village-level planning and infrastructure rebuilding	Organization of relief distribution, shelter management, and community caregiving
Long-term adaptation	Investment in alternative livelihoods, migration strategies, and agricultural technology	Strengthening community resilience through collective action, savings groups, and local knowledge

Source: Authors' field survey data (2024–2025)

In contrast, women primarily focused on managing their households and staying socially active. These included household budgeting, maintaining kitchen gardens, saving seeds, participating in small business endeavors, ensuring family safety, and engaging in the organization of community relief efforts. Overall, the coping strategies adopted by both men and women reflected distinct gender roles, with men tending to engage in economically oriented and mobility-based responses, while women focused on household management, caregiving responsibilities, and community support during and after disasters.

Discussion

The results highlight gender-based differences in vulnerability and coping responses during climate disasters in coastal Odisha. Floods and cyclones are experienced frequently and severely. Agriculture and fisheries were the predominant sources of livelihood, households were more reliant on natural resources and climatic conditions, making them highly susceptible to climate-related risks. Floods often destroy standing crops and damage agricultural land, while cyclones not only affect livelihoods but also damage housing, infrastructure, fishing equipment, and other assets.

Men had higher levels of education and greater contribution in agricultural activities and fishing, along with better access to land ownership and property. During most disaster events, they were expected to be involved in rescue work

and averting distress, which could result in delaying help-seeking and increasing their exposure to risk. A common male-coping strategy was observed to be temporary migration to neighbouring towns for employment for alternative income, especially when agricultural production or fishing were disrupted. They also diversified their livelihoods in alternative activities, seeking aid from agencies, and investing in livestock to fulfill the immediate needs of the family. They also faced responsibilities to ensure economic security of the family, and crisis and failure of income could result into stress and anxiety. This was also reflected through emotional withdrawal, strain in the relationships, lack of engagement in household or community wellbeing, eventually leading to substance abuse and domestic violence [12].

On the other hand, role of women was greater in community-based activities, social networks, and household management. Stronger social networks helped community to coordinate in terms of resource sharing such as food, water, and information to the vulnerable individuals. Child care, house work, cooking activities, and aged-dependent responsibilities were predominantly borne by women, which intensified during and post disaster events, as families struggled to secure food, water, and shelter. Many women reduced their own food consumption to provide food for their children and aged family members. Women's SHGs helped in raising finance, provided opportunities for savings and mutual support during disasters. However, socio-cultural norms in many communities' hinder mobility of women and limit their access to relief services, employment opportunities, and information related to disaster preparedness.

The findings further highlight the vital role of social capital in strengthening resilience. The regression analysis indicates that gender, membership in community-based organizations, land ownership, and access to early warnings systems had significant effects on the coping strategies. Women could aptly adopt such strategies because of their stronger participation within the family and community networks. Women's social networks and the role of SHGs in disaster preparedness were particularly important. These findings align with study by Behera et al. (2021), where social networks play important role in disaster response [35].

Overall, the results underscore that the complementary roles of men and women, if recognized and supported, can strengthen disaster resilience and reduce gender vulnerabilities [17]. Furthermore, resilience should be conceptualized as a gendered and socially rooted process, rather than merely an economic or infrastructural outcome. The findings contribute to the achievement of SDG 5 (Gender Equality), SDG 11 (Sustainable Cities and Communities), and SDG 13 (Climate Action).

Recommendations

In order to build resilience and minimize gender vulnerabilities in disaster-prone coastal Odisha, there is a need to incorporate a stronger gender perspective into climate adaptation policies and disaster management. Gender-focused programs should ensure that women have better access to resources such as microfinance and livelihood opportunities, while also encouraging their involvement in community activities and disaster governance. Preparedness can be enhanced through training and education programs focused on household resource management and psychological readiness to cope with disasters. Development of infrastructure should be gender-responsive, taking into consideration challenges related to restricted mobility and childcare needs. At the same time, livelihood diversification and safer post-disaster recovery options for men should be promoted. Strengthening early warning systems, disaster-resilient infrastructure, and climate education can further improve the adaptive capacity of vulnerable communities.

The findings also highlight the importance of traditional knowledge, social networks, and self-help groups in building resilience. Therefore, locally rooted approaches, along with targeted interventions for marginalized groups, should be integrated into disaster risk reduction strategies. In addition, mental health support and awareness programmes are important for addressing the psychological stress associated with disasters. Policies that encourage women's participation in disaster governance, microfinance initiatives, and income-generating activities can further strengthen community resilience while addressing household needs.

Conclusion

The study examined the socio-economic factors and gender roles in disaster vulnerability and coping among communities in the disaster-prone districts in coastal regions of Odisha. The key strength of the study was the adoption of a mixed-methods approach integrated with gender perspective for data collection and analysis. The findings reveal varying patterns of gender-based coping strategies adopted by male and female members of the communities. Men primarily depended on migration-based (and potentially high-risk) and income-based strategies, including temporary migration for earning alternative livelihood, wage labour in neighbouring towns, livelihood diversification, and the repair of damaged housing and infrastructure. Women relied more on managing their household resources, social networks, SHGs, and community-based resources and support systems. Gender, community participation, land ownership, and access to early warning systems were found to be important predictors of coping strategies adopted as

per binary logistic regression (Pseudo $R^2 = 0.32$). The results indicate complementary roles of men and women in disaster preparedness, relief, and recovery. The study further suggests that integrating gender aspects in climate adaptation and disaster management programs can strengthen community resilience and promote more inclusive and effective adaptation strategies. Reliability of the study conclusion was increased due to the use of several types of data sources such as surveys of households, focus group discussions, key informants' interviews, and case studies of households. The conclusions were verified by comparison of quantitative and qualitative data, which decreased the impact of possible biases that could be introduced during the data collection process. The inclusion of the respondents from various socio-economic backgrounds and discussions of men and women separately allowed receiving different points of view and making an unbiased conclusion about gender-specific coping strategies.

The study is however, limited to few selected disaster-prone villages in coastal Odisha, and may be extended to other coastal villages with different social and environmental contexts. Future research may expand the geographical scope and may include longitudinal approach to understand how the coping strategies have changed with time in different environmental regimes.

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Appendix A: English Translation of Household Questionnaire

Questionnaire Section	**Questionnaire Transcript (English Translation)**
Demographic Information	Information collected on respondent gender, age, educational level, occupation, household size, and annual household income.
Climate Disaster Exposure	Questions asked about whether the household experienced climate-induced disasters during the last 10 years, types of disasters experienced (floods, cyclones, droughts, heatwaves, and crop failures), frequency of occurrence, and losses faced.
Coping Strategies	Questions related to coping responses adopted by households, including temporary migration, livelihood diversification, wage labour, household resource management, consumption reduction, borrowing from social networks, self-help group participation, and post-disaster repair activities.

Resource and Institutional Access	Questions regarding access to early warning information, sources of disaster information, and support received from government agencies, NGOs, and community organizations.
Gender Roles and Decision Making	Questions examining household decision-making, responsibilities of men and women during disaster situations, and participation in community-level disaster response activities.
Open-Ended Responses	Questions exploring major challenges faced during disasters, effective coping mechanisms, and suggestions for improving disaster resilience.