



## **WOMEN'S AGILITY IN COPING WITH CYCLONE AND CYCLONE-INDUCED HAZARDS: A CASE STUDY ON FEMALE-HEADED HOUSEHOLDS IN COASTAL BANGLADESH**

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### **Abstract**

Women's coping capacity and adaptation practices lead to transformed social roles and responsibilities, making them essential for building resilience against cyclones and cyclone-induced hazards. This study aimed to investigate the evolution and agility of women's coping mechanisms, adaptive capacities, and available resources in response to cyclones and cyclone-induced hazards. A mixed-method approach, comprising questionnaire surveys and semi-structured interviews, was adopted to collect data from women in female-headed households in Gabura Union, a coastal area of Bangladesh. The findings reveal these women's impressive and transformative adaptation capacity. Their local knowledge, skills, and resilience have helped their families cope with recurrent and intensified cyclone events. In the absence of husbands, female heads have taken on work outside the home, migrated for jobs, and performed full household responsibilities. They make decisions, maintain connections with communities and organizations, and gain self-empowerment through knowledge of the outside world. Consequently, their adaptive capacity in the face of cyclones and related hazards has increased. The results also indicate that response and adaptation transformations depend on the female heads' socio-economic condition. These findings are valuable for developing a sustainable and inclusive cyclone-resilient plan for women.

**Keywords:** Cyclone Resilience, Female Heads, Women's Role Transformation, Women's Adaptation Practices

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## INTRODUCTION

Bangladesh is no stranger to the devastating impact of tropical cyclones, with severe incidents occurring frequently throughout each year (Ahsan & Warner, 2014; Rahman et al., 2022). According to the World Risk Index (WRI) 2024, Bangladesh ranks 9th, with a score of 27.73, as one of the countries with the highest disaster risk (Bündnis Entwicklung Hilft & IFHV, 2024). Cyclones and their associated hazards have a particularly profound impact on women's health and well-being, significantly increasing their work burden, limiting their opportunities, and weakening their capacities. As such, women in Bangladesh face unique risks and vulnerabilities in the face of cyclones (Ikeda, 1995; March et al., 1999; Warren, 2007; Dankelman, 2008; Lane & McNaught, 2009; Khatun & Islam, 2010; Sultana, 2014; Alston, 2015).

In coastal Bangladesh, socio-cultural and religious norms have traditionally restricted women's roles. However, this began to shift following Cyclones Sidr in 2007 and Aila in 2009, which devastated the region with widespread loss of life, severe damage to property and infrastructure, and extensive livelihood disruptions. The aftermath of these cyclones exacerbated conditions through prolonged waterlogging, increased soil and water salinity, heightened food insecurity, and crises in water supply and employment. Additionally, local ecological and livelihood patterns were altered, disrupting the region's environmental and socio-economic fabric (Mallick & Vogt, 2012, 2014; Mallick et al., 2017; Khalil & Jacobs, 2021; Khalil et al., 2021; Mohibbullah et al., 2021; Ahsan et al., 2024).

As a result, many men migrated in search of work, leaving women to shoulder all household responsibilities (Islam & Walkerden, 2014; Khalil et al., 2021). This shift led to women gaining greater access to resources, involving more actively in decision-making, and participating in income-generating activities, thereby challenging patriarchal practices and attitudes (Milazzo & Walle, 2015; Bradshaw et al., 2017; Khan, 2019). In their husbands' absence, women's enhanced coping capacities and transformative adaptations have been crucial for the survival of female-headed households in cyclone-prone areas (Sultana, 2014; Khalil et al., 2021; Masud-All-Kamla & Nursey-Bray, 2024).

Therefore, this study sought to explore women's coping capacities, available resources, and adaptation strategies in response to recurring cyclones and cyclone-induced hazards in coastal Bangladesh. The evaluation period begins in 2009, when significant changes arose due to saline water intrusion after cyclone Aila (Mallick & Vogt, 2012, 2014; Mallick et al., 2017; Khalil & Jacobs, 2021; Khalil et al., 2021; Mohibbullah et al., 2021; Ahsan et al., 2024). Focusing on how women's knowledge, skills, actions, and practices have evolved over these past 15 years, this research addresses the following questions: How do women cope with cyclone-induced hazards using available resources? What

response and adaptation strategies are adopted by female heads of households? How have their capacities transformed over time with changing social circumstances? What motivates these transformations, and how do they reduce vulnerability to cyclones?

To answer these questions, a comprehensive analysis was conducted through a mixed-method approach, integrating both quantitative and qualitative data from female-headed households in Gabura, one of the most affected areas in the Satkhira District of Bangladesh's southwestern coastal region. Aligning with the Sendai Framework for Disaster Risk Reduction and the Sustainable Development Goals (UNDRR, 2023), this study provides valuable insights for developing sustainable, inclusive, and cyclone-resilient strategies for women. The findings emphasize how women's capacity-building and resilience are central to their survival, highlighting the often-overlooked social transformations that occur in disaster contexts, particularly among female-headed households.

## **LITERATURE REVIEW**

### **Women's Disaster Coping, Adaptation, and Transformative Resilience *Capital to Cope, Respond, and Adapt***

The natural, physical, financial, human, and social dimensions of capital are most commonly associated with response, recovery, and adaptation in disaster contexts (DFID, 1999; Islam & Walkerden, 2022). Social capital, defined as the collective action of social networks among households, neighbors, and community organizations, plays a crucial role in resilience (Adger, 2010; Scheffran et al., 2012). There are three forms of social capital: bonding (i.e., immediate family, relatives), bridging (i.e., neighbors and friends), and linking (government or non-government organizations) (Putnam, 2000; Szreter & Woolcock, 2004). These social capital networks are crucial for enhancing women's adaptive capacity, empowering them, and reducing their vulnerability through robust connections.

### ***Indigenous and Local Knowledge in Coping and Adaptation Practices***

In disaster studies, the terms "indigenous knowledge" and "local knowledge" are often used interchangeably. This knowledge facilitates place-based, contextual, and experiential coping practices, transmitted orally and evolving through social learning across generations (Agrawal, 1995; Ellen et al., 2000; Sillitoe, 2006; Khalil et al., 2016). Such practices utilize the skills, resources, and knowledge systems of local communities to survive, cope, adapt, and adjust to natural hazards (Kates, 1978; UNISDR, 2008). Local knowledge aids in preventing, mitigating, preparing, responding, and recovering from disaster impacts, a concept known as "coping and adaptation strategy." Coping refers to short-term and immediate measures by individuals and communities, while adaptation

involves a long-term progression of livelihoods (Shafie & Rahman, 2009; Said et al., 2024).

Few studies have focused specifically on the indigenous and local knowledge of women in disaster coping and adaptation. Particularly, female heads of households have been underexplored despite their distinct vulnerabilities and experiences pertaining cyclones compared to women with husbands as primary providers (Nasreen, 1995; Islam, 2010; Abedin et al., 2013; Alam & Rahman, 2014, 2019; Khalil et al., 2020; Khalil & Jacobs, 2021; Rahman et al., 2022; Masud-All-Kamal & Nursey-Bray, 2024).

### ***Social Transformation Theory: Changes in Social Roles and Adaptation Transformation from the Perspective of Women Facing Disasters***

Evidence shows that disasters can change socio-economic, political, and gender dynamics within communities (Davis, 2014). Notably, disasters may help reduce women's vulnerability by creating "windows of opportunity" to challenge unequal gender structures and empower women (Horton, 2012; Bradshaw, 2013; Pacholok, 2013). Indeed, women's grassroots movements and resilience following disasters suggest that significant social changes can occur in such times (Enarson & Chakrabarti, 2009; Moreno & Shaw, 2018).

Social transformation theory views women as a group capable of altering their social status (Irwin, 2005; Mulinari & Sandell, 2009; Panday, 2016; Khan, 2019). Social transformation enhances women's ability to connect with others and strengthen their social capital in the form of mutual trust, understanding, respect, and recognition among different parties (Beck, 1992; Backer, 2001; Beck-Gernsheim et al., 2003; Giddens, 1991, 2009; Panday, 2016). At the community level, women's life transformations through their status, roles, knowledge, resource access, and capacity-building can make them significantly more capable (Puigvert, 2003). When their social taboos and economic barriers lessen, women are increasingly able to assume full household responsibilities and utilize their capacities independently to build resilience (Beck & Beck-Gernsheim, 2002; Chitkara, 2001; Irwin, 2005; Panday, 2016; Bradshaw et al., 2017; Moreno & Shaw, 2018; Khan, 2019).

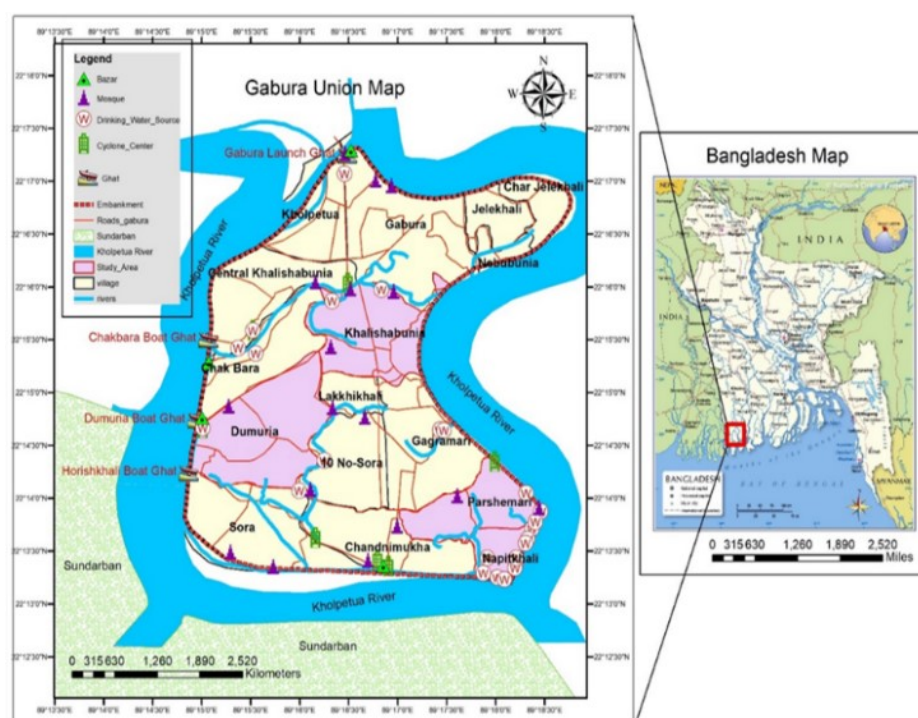
However, there is limited research on the changing patterns or transitions in adaptation strategies practiced by women over time, especially in response to disasters (Berman et al., 2012; Islam et al., 2017; Moreno & Shaw, 2018; Khan, 2019; Yadav et al., 2021; Masud-All-Kamal & Nursey-Bray, 2024).

## **RESEARCH METHODOLOGY**

### **Study Area**

The Gabura Union of Bangladesh's Satkhira District was chosen as the study area (Figure 1). Gabura is the most adversely affected union within the district's

Shyamnagar Upzila. It is located in the southwest coastal region of Bangladesh, adjacent to the Sundarbans. Four villages (Dumuria, Khalishabunia, Parsemari, Napitkhali) in the Gabura Union were specifically selected based on their high vulnerability to and severity of cyclones, economic conditions, and prevalence of female-headed households. Cyclones, cyclone-induced storm surges, salinity, and waterlogging are the most frequent and severe in this region. Consequently, residents in the area suffer from a scarcity of safe drinking water, food, employment, and sanitation (Islam, 2010; Mallick & Vogt, 2012).



**Figure 1: Map of the Study Area**  
 Source: Author's Contribution

### Methodology and Data Collection

A mixed-method approach, consisting of both questionnaire surveys and semi-structured interviews, was adopted for this study. First, household-level questionnaire surveys were conducted, focusing exclusively on female-headed households from the four villages. Based on a comprehensive list of 160 female-headed households provided by union council members, a total of 114 female heads were chosen for the survey using the stratified random sampling technique's proportional allocation method. Additionally, semi-structured

interviews were conducted with 44 female heads selected via purposive sampling. Table 1 provides details of the study sample.

<b>Table 1: Study Sample</b>			
<b>Household Questionnaire Survey</b>			
Villages	Number of female-headed households	Selected households	Selection criteria
Dumuria	62	44	Female heads of female-headed households (whose husbands had died/ are disabled/ had migrated/ had divorced/abandoned them), with personal experience of cyclones.
Khalishabunia	40	29	
Parsemari	30	21	
Napitkhali	28	20	
Total	160	114	
<b>Semi-structured Interview of Female Household Heads</b>			
Villages	Interviewed persons	Selection criteria	
Dumuria	15	Female heads from female-headed households that are extremely vulnerable to cyclones and had successfully adapted against cyclones.	
Khalishabunia	08		
Parsemari	10		
Napitkhali	11		
Total	44		

## RESULTS AND DISCUSSION

### Scenario of Cyclone-induced Hazards

The Gabura Union area has been frequently impacted by cyclones over the past 15 years, leading to significant changes. Long-term saline water inundation and the expansion of shrimp farming have rendered much of the land agriculturally unproductive. Consequently, those who once relied on agriculture and fishing have been forced to abandon their traditional occupations, driving widespread male migration out of the area due to job scarcity (Islam & Walkerden, 2014; Khalil et al., 2021; Mallick & Vogt, 2012). Ultimately, residents continue to struggle to regain their previous quality of life following severe cyclones such as Sidr (2007), Aila (2009), and Amphan (2020).

<b>Table 2: Cyclone &amp; Cyclone-induced Hazards in the Study Area</b>				
Severe cyclones (in last five years)	Cyclone occurrence (in last five years)	Frequency of cyclone (in a year)	Cyclone-induced hazards	Severity (compared to 15 years ago)
Yaas (May 2021), Amphan (May 2020), Bulbul (Nov 2019), Foni (Apr 2019)	5 times	Once a year	Storm surge, salinity, water logging, and erosion	Increased frequency and intensity

Table 2 illustrates the impact of cyclones and cyclone-induced hazards in the study area. Over the past 5 years, respondents reported experiencing

cyclones five times, with an average frequency of once per year. Participants noted that the frequency and intensity of cyclones and associated hazards—such as storm surges, salinity, waterlogging, and erosion—have increased over the past 15 years.

### Socio-demographic Characteristics of Female Household Heads

Table 3 provides socio-demographic information on the sampled female heads in the study area. Approximately half of the respondents are widows (49.1%), while the remainder are divorced, abandoned, or left by their husbands (47.4%). In most cases (66.6%), their husbands had initially migrated temporarily for work due to employment shortages caused by cyclones. Over time, these temporary migrations became permanent as the men remarried in their new locations, leaving their previous families behind, a pattern noted in other studies (Islam & Walkerden, 2014; Khalil et al., 2020). The majority of female heads live on extremely low incomes of 1,500-4,999 BDT per month (76.3%) and rely on multiple income sources for survival (75.4%). They work as laborers in shrimp or crab farms (64%) and catch fish in the river (73.7%), while a considerable number are also employed as household help in affluent families (57.9%). Indeed, women in this area rely on multiple income-generating activities yet face wage discrimination, earning less than men for similar work (Fauzi et al., 2022). For instance, women typically earn 250 BDT per day, while male workers earn 350 BDT per day, as documented in other studies (Enarson, 2000; Saha, 2015). Finally, most of the women are illiterate (78.1%), aged between 36 and 59 years (64.9%), and live alone (34.2%).

**Table 3:** Socio-demographic Characteristics of Female Household Heads

Socio-demographic characteristics	Pct. (%)	Socio-demographic characteristics	Pct. (%)
<b>Main Occupations</b>		<b>Educational status</b>	
Fishing	73.70	No education	78.1
Shrimp/crab farm labor	64	Primary & above	21.9
Household help	57.90		
Cattle/poultry rearing	31.60		
Brickfield labor	14.90		
<b>Monthly Income</b>		<b>Living alone</b>	
Extremely low income (1500-4999 BDT)	76.3	Yes	34.2
Low income (5000 BDT & above)	23.7		
<b>Age</b>		<b>Partner Information</b>	
Young women (20-35)	23.7	Died	49.1
Middle-aged women (36-59)	64.9	Divorced/abandoned/	47.4
Elderly women (60 & above)	11.4	left forever	

Income options		Main Reasons for leaving/ divorce
1 to 3 income options	75.4	Went for work, didn't return/ married there 66.6
4 to 6 income options	24.6	

Note: 1 USD= 121.82 BDT

### Activities Performed by Women in Two Situations: 'Before' and 'After' the Incident of Husband's Death, Permanent Abandonment, or Divorce

In traditional divisions of labor, men are typically responsible for tasks outside the home, while women handle daily household duties. This arrangement is disrupted when husbands die, migrate temporarily or permanently, or abandon their families. In such cases, wives assume the role of household heads, taking full responsibility for their families (Beck-Gernsheim et al., 2003; Bradshaw et al., 2017). Figure 2 illustrates this shift, comparing the responsibilities undertaken by women when their husbands are present versus when they are absent. The terms 'Before' and 'After' represent the periods preceding and following a husband's death, permanent departure, or separation/abandonment, respectively.

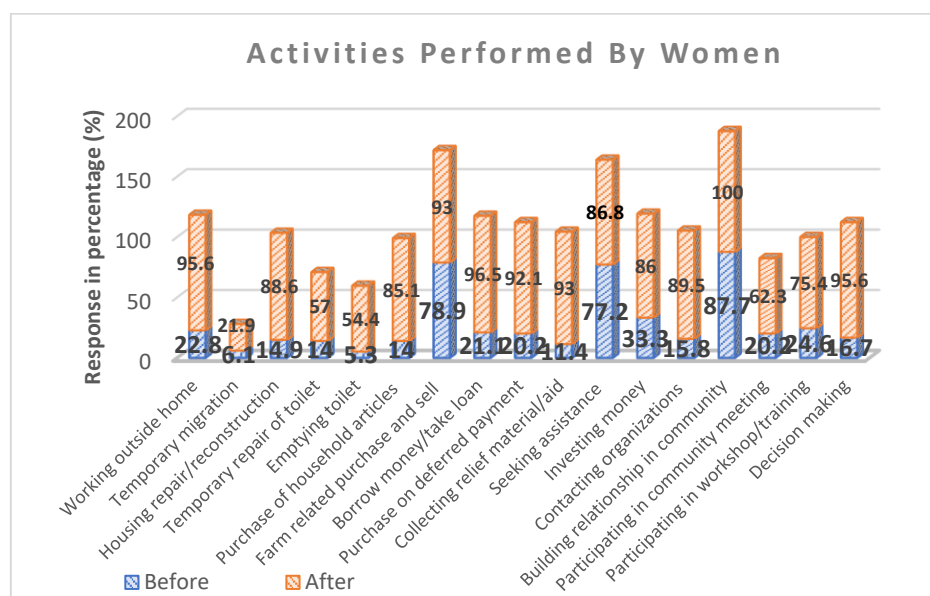


Figure 2: Activities Performed by Women



One abandoned woman related her situation this way:

*“When my husband was with me, I did not do any work outside the house. His income supported family expenditures. Now, I have to work as a daily wage worker outside the house. Even then, work is not available in the area. I have to go without food. So, I work as a maid in a brick kiln for six months of the year. After six months, I used to get fifty thousand BDT. With that money, I pay off the debt and run the family. When my hands are again empty, I have to go back to the brick kiln.”* Another female household head added, *“I have to fulfill all the responsibilities in the household because I don't have a husband. Shopping, repairing the house, tarring the roof tins, cleaning the toilets---I have to do them all. Other than those, I have many other things to do in the household.”*

When a husband is present, women primarily engage in three activities: farm-related purchase and sales (78.9%), relationship-building (87.7%), and community assistance (77.2%). Their involvement is minimal in tasks such as work outside the home, house repairs and maintenance, relief collection, money borrowing, decision-making, and contacting organizations. In contrast, the absence of a husband leads to a notable shift in activity patterns, with drastically increased involvement in work outside the home (95.6%), house repair and maintenance (88.6%), decision-making (95.6%), and aid or relief material collection (93%). In this situation, female heads are required to make all decisions independently. As one respondent explained:

*“Since I don't have a husband, I must make all the family decisions. I have to go outside for work and to bring any help if available. I understand reality now more than before. My awareness about everything has now increased.”*

This finding corroborates those of other studies (Islam & Walkerden, 2014; Islam et al., 2017; Khan, 2019; Khalil et al., 2020; Khalil & Jacobs, 2021; Masud-All-Kamal & Nursey-Bray, 2024; Sultana, 2014).

### **Adaptation Transformation of Female Heads in the Last 15 Years**

Women's adaptation practices have evolved in response to changing cyclone hazards and socio-economic circumstances. A large majority (89.5%) of respondents agreed that there is a notable difference between their current adaptation practices and those they followed 15 years ago. Table 4 lists these differences in detail.

**Table 4:** Adaptation Transformation of Female Household Heads

Difference in adaptation practice	Strongly disagree (1)	Disagree (2)	Neither agree or disagree (3)	Agree (4)	strongly agree (5)
Didn't preserve rainwater	1%	2%	3.9%	34.3%	58.8%
Didn't preserve dry food	-	2.9%	9.8%	49.0%	38.2%
Didn't evacuate to shelter center/safe places	-	2.9%	4.9%	38.2%	53.9%
Didn't collect & preserve cooking fuel	-	1%	4.9%	47.1%	47.1%
Didn't preserve valuables	-	11.8%	10.8%	54.9%	22.5%
Improved awareness and understanding of cyclone response strategies	1 %	1%	5.9%	43.1%	49%

Previously, most respondents lacked awareness of cyclone preparedness and adaptation strategies, as cyclones were less frequent and severe. They relied on their husbands for decisions and actions regarding cyclone preparedness. However, in their husbands' absence, these women have assumed full responsibility for their families, including working outside the home and maintaining community communication, increasing their awareness of current issues and the broader world. This shift is evident in six key adaptation practices: 'preserving rainwater,' 'storing dry food,' 'saving cooking fuel and valuables,' 'evacuating to cyclone shelters or safe places,' and 'improved awareness and understanding of cyclone response strategies.' According to Table 4, most female heads 'agreed' (score 4) or 'strongly agreed' (score 5) that they had not engaged in these adaptation practices in the past. An elderly female head explained:

*“Before Cyclone Aila, I was not aware of the danger of cyclones. We used to have cyclones but never had storm surges like this. The natural pond water was drinkable then. We never needed to hold rainwater and didn't even have a water container. But saltwater intrusion after Aila has destroyed our freshwater sources. Water shortage has become severe. Now, I store water in a water tank during monsoons, which can be used in times of crisis. Moreover, when I get cyclone signals, I store water in bottles and take them to cyclone shelters with me.”*

**Table 5:** Significant Attributes Influencing Adaptation Transformation

Socio-demographic characteristics	Significance (p-value)
Income	.012 a **
Extremely low income (74)	55.50 (mean score)
Low income (24)	38.50 (mean score)
Age	.645 b*
Education	.305 a *
Living alone	.621 a*
Partner information	.925 a*

Note: a. Mann-Whitney test b. Kruskal Wallis Test \* $p > 0.05$  \*\* $p < 0.05$

Mann-Whitney U and Kruskal-Wallis tests (Table 5) were conducted to examine whether changes in adaptation practices among female-headed households over the last 15 years are linked to their socio-demographic characteristics. The average scores for adaptation changes were compared against factors such as income, age, education, partner status, and solo living status. The analysis showed a significant relationship ( $p = .012$ ) between income and changes in adaptation practices. Specifically, the mean adaptation transformation score for extremely low-income households (55.50) was higher than that for low-income households (38.50), suggesting that adaptation transformations are more pronounced among economically disadvantaged groups. In other words, female heads with lower incomes report more significant changes in their cyclone response activities compared to those with higher incomes.

### Preparedness and Adaptation Practice Transformation of Female Heads

Table 6 outlines the transformative adaptation practices, available coping capital, and related challenges of female heads without husbands in response to cyclones.

**Table 6:** Coping Capital and Adaptation Practices of Female Heads

Area	Response & adaptation activities	Coping capital
Income & employment	Work outside home, migrate for work, depend on multiple income options	Local skills, natural resources, bridging capital
Housing & toilet	Repair, protect, and maintain (i.e., tying roof, putting tar, emptying toilet) house & toilet by themselves using locally available materials like polythene, paper, branch/leaf, blanket, cement bag, jute rag, etc.	Local knowledge & skills
	Take assistance for repairing house-toilet as labor, material, money	Bonding, bridging & linking capital
Water	Travel long distances to collect water, travel with neighbors for water collection, borrow water from neighbors/relatives	Human capital & social capital
	Consume less water or use contaminated water	Human capital (negative adaptation)
	Preserve rainwater	Local knowledge & skill, linking capital

Sanitation	Share toilet, use hanging toilet	Local knowledge & bonding & bridging capital
Fuel	Collect fuel by themselves from river using nets, dry and preserve fuel using basket (dry on roof and store on elevated shelf/platform)	Local knowledge, natural resources (forest)
	Cook once in two days to save fuel. Use portable oven, tin container & brick as temporary oven	Local knowledge & skill
Food	Purchase food on deferred payment	Bridging capital
	Consume less, skip meals, only consume watered rice and potato	Human capital (Negative adaptation)
	Preserve dry food, medicine	Local knowledge
	Borrow food, accept food assistance from neighbors & relatives	Bonding and bridging capital
Cattle rearing	Rear cattle in enclosed areas to avoid the impact of salinity	Local knowledge
Vegetation	Try to grow vegetables in the rainy season, use rainwater, apply different techniques like hydroponics, integrated vegetation	
Material/ goods preservation	Preserve goods/materials on raised platform, improvised shelves on walls, or wooden/bamboo false ceiling underneath the roof	Local knowledge & skills
Evacuate to safe places	Cyclone shelters, relatives' houses, embankment/road/boat	Bonding, bridging & linking capital
Cyclone awareness	Awareness regarding cyclone preparedness, response, recovery activities, information regarding cyclone signal, relief & assistance	Bonding, bridging and linking capital
Decision making	Take all vital decisions by themselves including evacuation. This has increased their awareness and capacity to respond.	Bonding & bridging capital
Maintaining Communication	Maintain communication for formal & informal assistance	Bonding, bridging & linking capital

Note: Local knowledge and skill are considered human capital; bonding, bridging and linking capital are considered social capital; and natural resources are considered natural capital.

A significant number of women in the study area are widowed, divorced, or abandoned. In the absence of a husband, these women are compelled to work outside the home, migrate for employment, and independently manage all household responsibilities. They make decisions autonomously and engage actively with their communities and various organizations, which enhances their awareness of broader issues. Consequently, their coping strategies and adaptation practices have evolved to address these challenges, making them more capable, knowledgeable, and effective in responding to cyclones. Moreover, to mitigate employment crises, female heads often rely on multiple income sources, a finding reported by Khan (2019) as well.

Additionally, women have adapted by preserving rainwater, fuel, dry food, and medicine; evacuating to cyclone shelters; and expanding their awareness of cyclone preparedness and response activities (see photographs in the Appendix). Over the past 15 years, these adaptation practices have undergone significant transformation to better address cyclonic adversities. This transformation is more noticeable among economically disadvantaged groups compared to those with more resources. Ultimately, this study's results validate

that the absence of a husband significantly impacts women's ability to adapt, aligning with prior findings (Islam et al., 2017; Khalil, Jacobs, & Kuruppu, 2016; Khan, 2019; Masud-All-Kamal & Nursey-Bray, 2024; Sultana, 2014). Despite the additional vulnerabilities and burdens that female heads face, they effectively leverage their skills, resources, and capabilities to adapt to challenging conditions.

## **CONCLUSION**

The transformative adaptation practices of female heads—characterized by heightened awareness, coping strategies, and adaptation capacity—are essential for their survival in cyclone-prone environments. These women have cultivated self-reliant communities where they earn livelihoods, seek community assistance, and confront environmental challenges using innovative measures and the social, natural, and human resources available to them. However, when male partners migrate for better opportunities, often resulting in bigamy or polygamy, women are left in vulnerable positions, bearing the entire burden of household responsibilities and child-rearing.

To build resilience in the face of these adversities, women have developed effective survival strategies using their invaluable practical knowledge, skills, social networks, and adaptive practices. Yet, these efforts alone are insufficient, as societal, governmental, and non-governmental support remains limited. In fact, most interventions offer only short-term relief, failing to deliver lasting solutions. Strengthening the capacities of female heads is more impactful than providing temporary aid. Specifically, women require sustainable employment opportunities that uphold their dignity. Government and non-governmental organizations active in the region should therefore introduce comprehensive social safety nets, food security initiatives, insurance schemes, and employment opportunities, and skill development programs for women. At the same time, creating local employment opportunities for men could reduce migration and the subsequent abandonment of women. Policies discouraging second marriages and divorce are also vital to protect these vulnerable women.

In summary, this study's findings are crucial for understanding the evolution of women's adaptability over time. These insights can guide efforts to empower women and drive positive change within communities. By examining the social, human, and natural resources available to female heads and the challenges they encounter, researchers, practitioners, and policymakers can design and implement development projects that genuinely improve their lives.

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## ETHICAL STATEMENT

This study adhered to the Universiti Malaya Research Ethics Guidelines and was approved by the Universiti Malaya Research Ethics Committee (UM.TNC2/UMREC\_3017). Informed consent was obtained from all participants, and confidentiality was strictly maintained. The authors declare no competing interests and confirm that the study is original, unpublished, and not under consideration elsewhere.

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