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RECEIVED 07 February 2023

ACCEPTED 02 November 2023

PUBLISHED 07 December 2023

## CITATION

Ahmed KJ, Atiqul Haq SM and Hyder MB (2023), A comparison of migrant and non-migrant households' choices on migration and coping mechanisms in the aftermath of cyclone Aila in Bangladesh. *Front. Environ. Sci.* 11:1160394. doi: 10.3389/fenvs.2023.1160394

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# A comparison of migrant and non-migrant households' choices on migration and coping mechanisms in the aftermath of cyclone Aila in Bangladesh

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This research focuses on understanding the complex impact of Cyclone Aila on migration decisions, particularly regarding the motivations that compel specific vulnerable populations to remain in their current locations despite severe consequences. It conducts a comparative analysis of migration choices, adaptive strategies and capacities of migrant and non-migrant populations in Bangladesh after the 2009 Cyclone Aila, focusing on the severely affected districts of Satkhira and Khulna. To achieve this, a comprehensive survey of 284 households was conducted, including 130 migrant and 154 non-migrant households. The research utilized statistical techniques, such as frequency distribution, chi-squared tests, and multinomial logistic regression, along with qualitative insights gathered through in-depth interviews and analyzed using NVivo software to provide a more comprehensive understanding of the coping capacities of these households. The findings indicate that the severity of the cyclone experience significantly impacted migration choices, with non-migrant households displaying a firm attachment to their original location because of better economic opportunities, emotional bonds, vibrant social networks, and a higher tolerance for adversity. Migrants are attracted to locales, providing better living conditions, safety, and access to healthcare and education. This research also revealed differences in the adaptive strategies adopted by migrants and non-migrants. Migrants have more options for housing, agriculture, livestock management, food security, health and sanitation, and employment. Most migrant households (47.7%) had high adaptive capacities across various domains, such as food security, housing and shelter, crop production, livestock and poultry rearing, health and sanitation, and livelihood prospects. Non-migrant households had much lower percentages of high adaptive capacity, ranging from 5.3 percent to 9.7 percent. These findings suggest that migration can improve adaptive capacity, especially when responding to weather events, such as Cyclone Aila. Therefore, it is important to create targeted support measures that cater to the unique needs of both migrant and non-migrant households to promote resilience and improve wellbeing during the post-crisis period.

## KEYWORDS

extreme weather event, cyclone Aila, migration decisions, migrant and nonmigrant households, coping strategies and capacities, Bangladesh

## 1 Introduction

It has been observed over recent decades that the frequency, intensity, and severity of extreme weather events, particularly floods and storms, have markedly intensified (Seneviratne et al., 2021). This series of events has resulted in significant alterations in population dynamics that affect mortality, migration, and fertility rates (Frey and Singer, 2010; Jiang and Hardee, 2011; Frankenberg et al., 2015; Casey et al., 2019; Vollset et al., 2020; Muttarak, 2021; Haq, 2023). The sixth assessment report of the Intergovernmental Panel on Climate Change (IPCC) has identified extreme weather events as direct drivers (e.g., due to damage to houses by tropical cyclones) and as indirect drivers (resulting from the degradation of climate-sensitive livelihoods) of involuntary migration (Pörtner et al., 2022).

Globally, it is projected that by 2050, approximately 216 million people will have migrated to new areas due to environmental changes such as rising temperatures and sea levels (Schewel et al., 2022). Asia (Southeast and East Asia), followed by Sub-Saharan Africa, experiences the highest annual migration from extreme weather events (Pörtner et al., 2022). Households affected by severe weather events (both migrant and non-migrant households) use numerous strategies to cope with the consequences of disasters. At the same time, it is unclear, as there is insufficient evidence to understand how coping strategies differ between migrant and non-migrant households.

This study examines the consequences of Cyclone Aila in 2009, which inflicted significant damage to the coastal areas of Bangladesh that were already prone to cyclones. Severe weather events have led to the displacement of numerous individuals, resulting in the loss of homes and livelihoods (Department of Disaster Management, 2009; IOM, 2009; United Nations Development Programme, 2010; Mustafa et al., 2023). Resettlement in nearby urban areas or cities was the choice of many, while some opted to relocate within the affected districts (Mehedi et al., 2010; Kartiki, 2011; Mustafa et al., 2023). Existing studies have explored climate change-related stressors and coping strategies employed by local communities in response to climate change and extreme events (Kartiki, 2011; Islam and Hasan, 2016; Islam and Shamsuddoha, 2017; Saha, 2017; M. N. Q. Ahmed and Haq, 2019; Subhani and Ahmad, 2019; Haq, 2022; Islam et al., 2022). Few studies have explicitly focused on the differences in coping mechanisms between families with and without migrants. It is essential to consider migration and non-migration when examining the impact of extreme weather events, as demonstrated by research (Hjälml, 2013). This study fills this information gap by concentrating on Cyclone Aila-hit households that moved to nearby regions and contrasting them with non-migrating households in impacted areas.

The relocation of individuals due to extreme weather events may not necessarily result in improved employment or resilience upon arrival at their new destination. Investigating and comparing the coping mechanisms and capacities of both migrant and non-migrant households in the aftermath of Cyclone Aila can provide valuable insights and inform practical policy recommendations for these vulnerable communities. A more nuanced understanding of the relationship between migration choices and coping mechanisms in the face of catastrophic weather events is essential for devising informed policies.

## 2 Literature review

The term “an extreme weather event” is used in the study to provide a general and inclusive description of the phenomenon being studied. It is a broad category encompassing various severe weather occurrences, such as cyclones, hurricanes, floods, and droughts (Seneviratne et al., 2021). Using this term, the study aims to emphasize the broader relevance and applicability of the research beyond the specific case of Cyclone Aila. This allows the findings and conclusions to inform policy considerations and decision-making processes concerning extreme weather events. However, within the body of the research paper itself, the specific event, Cyclone Aila, is the focus of the study and is examined in depth to understand its impacts on migration decisions and related factors.

Extreme weather events in Bangladesh have had severe consequences, leading to the migration of millions of people and compromising their livelihoods (Davis et al., 2018). Coastal areas, which are most affected due to the high frequency of cyclones and storms, have experienced significant population displacement (IOM, 2009; Davis et al., 2018). For instance, Cyclone Aila struck the coastal areas of Bangladesh in 2009, causing extensive damage and affecting millions of people (Department of Disaster Management, 2009; United Nations Development Programme, 2010). As a result, affected individuals migrated to nearby urban areas such as Satkhira, Paikgacha, Batiagata, Khulna, Dhaka, and Chattogram (Mehedi et al., 2010; Kartiki, 2011).

Studies conducted in Bangladesh have focused on understanding the coping strategies employed by locals in response to extreme weather events (M. N. Q. Ahmed and Haq, 2019). Additionally, research has explored how the vulnerability of individuals to floods, cyclones, and droughts influences their coping strategies (Haq, 2022). Other studies have also explored the socioeconomic challenges confronted by migrants originating from regions impacted by Cyclone Aila (Kartiki, 2011; Islam and Hasan, 2016; Islam and Shamsuddoha, 2017; Saha, 2017; Subhani and Ahmad, 2019). Migration has been identified as a crucial survival strategy to combat the effects of extreme weather events (Paul and Routray, 2011; Mallick and Vogt, 2014; Singh and Basu, 2020), mainly internal migration within the country (Hugo, 2011).

Social and financial capital influences migration decisions in response to extreme weather events and individuals' perceptions and experiences of the event (Kartiki, 2011). Although migration is often seen as a lack of choice, economic models suggest that individual preferences play a role in decision-making (Harris and Todaro, 1970). Family status and social networks also contributed to migration decisions in Thailand and Vietnam (Jampaklay et al., 2007; Winkels, 2008). Furthermore, the socioeconomic conditions in the destination area may not differ significantly from those in the place of origin, leading some households to choose to stay and struggle with limited livelihoods and resources.

Migration due to extreme weather events has shown an upward trend (Gray and Mueller, 2012), and the decision to migrate is influenced by a range of economic, social, geopolitical, and environmental factors (McLeman, 2018; Best et al., 2021; Pörtner et al., 2022). Internal labor migration has been identified as an effective means of absorbing shocks, particularly for households dependent on agriculture (Gröger and Zylberberg, 2016). The New

Economics of Labor Migration (NELM) theory (Stark and Bloom, 1985) emphasizes livelihood development and risk management in migration studies (McDowell and de Haan, 1997; Ellis, 1998). According to NELM theory, migrating and non-migrating households are likely to adopt different coping strategies, with migrating households generally having greater coping capacity.

Migration decisions depend on context-specific factors, such as the loss of property, livestock, and crops due to extreme weather events (Joarder and Miller, 2013), poverty driving seasonal migration (Khandker, 2012; Khandker et al., 2012), and agricultural changes (Azam, 2011). Numerous studies have highlighted the socioeconomic impact of extreme weather events on households (Mallick and Vogt, 2014; Islam and Hasan, 2016; Islam and Shamsuddoha, 2017; Saha, 2017; Carrico and Donato, 2019). Migration, whether internal or international, temporary, or permanent, is considered a viable coping strategy to mitigate the risks of extreme climate events (Warner, 2010; Black et al., 2011; Marino, 2012). Livelihood diversification is often associated with migration as a coping strategy (Carling and Schewel, 2018; Mallick and Schanze, 2020; Biswas and Mallick, 2021), and its success hinges on the availability of livelihood opportunities and decision-making control over settlement (McLeman and Hunter, 2010; Biswas and Mallick, 2021).

Emerging research explores differences in coping strategies between voluntary and involuntary immobility in response to climate-induced risks (Ayebe-Karlsson et al., 2018; Mallick and Schanze, 2020; Wiegel et al., 2021). Efforts have been made to understand migration's push and pull factors and examine the socioeconomic impacts of cyclones in coastal Bangladesh (Moniruzzaman et al., 2018; Subhani and Ahmad, 2019). Some argue that non-migration, or "staying," deserves more attention in academic and policy discussions (Hjälml, 2013).

Coping strategies are defined as strategically selected and consciously evaluated actions individuals and families take to overcome uncertainties, secure necessities, limit expenses, or earn extra income (Snel and Staring, 2001). These strategies can be categorized as ex-ante (precautionary measures taken before a potential shock) or ex-post (actions taken to mitigate the consequences of an adverse event) (Dercon, 2002). Ex-ante strategies include savings, asset accumulation, and insurance, while ex-post strategies involve reducing expenditures, increasing household production, and diversifying income sources (Aguilar and Hurst, 2005). The impact of these strategies can be short- or long-term. Families often resort to short-term coping mechanisms during crises, such as using savings or selling assets, and may adopt longer-term strategies when short-term measures prove insufficient (Cameron, 2001).

The ability of households to manage severe climate events depends on their coping capacity, which involves adapting to disruptions, minimizing damage, capitalizing on opportunities, and recovering from adverse circumstances (Gallopín, 2006). On the other hand, adaptive capacity refers to the ability to make beneficial longer-term changes before and after extreme weather events (Smit and Wandel, 2006). Enhancing awareness of risks and consequences can significantly increase the resilience of settlements, infrastructure, and local economies. This study focuses on ex-post coping strategies rather than ex-ante strategies. It aims to investigate the coping strategies and capacities of migrant and non-migrant

households following their experience of Cyclone Aila in 2009, identifying potential differences between the two groups.

Adger et al. (2020) appropriately emphasized the crucial role of migration as a survival strategy for vulnerable populations endowed with the necessary capacity and resources. They highlight the significance of urban areas as destinations for those seeking refuge from the adverse impacts of climate change. Similarly, Afifi et al. (2016) provide a relevant perspective by stressing that individuals engaged in climate-sensitive professions, particularly farmers, often face the necessity of either temporary or permanent migration for their sustenance. This migration can be considered a proactive adaptation, representing a practical response to changing environmental conditions. However, Jha et al. (2018) present a counterpoint by contending that migration should not be viewed solely because of the failure to adapt. They illustrate the transformative potential of migration, asserting that migrating households can acquire invaluable knowledge, establish vital social networks in host areas, and contribute to the wellbeing of their origin communities by sending remittances. This diverse discourse sheds light on the complexity of migration in the context of climate change and underscores the need for nuanced policy approaches that can harness its full potential.

The existing literature has provided a multifaceted understanding of migration in response to extreme weather events. This study focuses specifically on the case of Cyclone Aila and highlights the broader implications for policy and decision-making concerning a range of such events. However, there is a notable gap in the literature regarding the nuanced exploration of the factors influencing the choice between migration and non-migration, particularly concerning the socioeconomic and social capital variables. This research aims to address this gap by delving deeply into households' coping strategies and capacities in the aftermath of Cyclone Aila, providing insights into why some individuals and families choose to stay despite significant challenges. In doing so, we enhance our understanding of the intricate relationship between migration and adaptation strategies. Additionally, the study focuses predominantly on ex-post coping strategies, shedding light on how households respond to adverse circumstances, complementing the literature, which often emphasizes ex-ante strategies for risk reduction and long-term resilience. Moreover, it acknowledges the importance of considering non-migration as a vital component in discussions of climate change adaptation and its critical role in specific contexts. Thus, this research offers valuable insights into the intricate dynamics of migration choices during and after extreme weather events, providing a foundation for more targeted policy interventions.

## 3 Methodology

### 3.1 Selection of study areas

The cyclonic event named Aila, which made landfall along the coast of Bangladesh on the 25th of May 2009, resulting in profound and catastrophic consequences. Numerous districts in Bangladesh experienced significant setbacks and impairments, leading to severe restrictions on their means of sustenance. Determining the study

areas involves a series of systematic steps: first, identifying suitable districts, then selecting upazilas within these districts, and, ultimately, the designation of unions and villages for analysis.

The 12 districts in Bangladesh that have been severely affected by cyclones are Satkhira, Khulna, Bagerhat, Pirojpur, Barisal, Patuakhali, Bhola, Laksmipur, Noakhali, Feni, Chattogram, and Cox's Bazar (Barua et al., 2016; K. J. Ahmed and Tan, 2021). In our study, we employed a non-random multistage sampling design to select the study areas, similar to the approach used by (B. Ahmed et al., 2019a; K. J. Ahmed et al., 2019b). A non-random multistage sampling design was employed as a systematic approach to select study areas in Bangladesh that experienced the impact of Cyclone Aila. This design involved multiple stages of selection, wherein clusters of affected regions were initially identified based on predetermined criteria, such as their vulnerability and the severity of cyclone impact. By utilizing this design, we could strategically sample and efficiently collect data from large and geographically diverse populations. In our study, we applied a non-random multistage sampling design to identify cyclone-affected study areas in Bangladesh, starting with identifying highly affected districts and selecting specific upazilas, unions, and villages within those districts.

Initially, we identified the two districts, Khulna and Satkhira, that had experienced the highest impact—in terms of deaths, affected households, and the number of people migrated—caused by Cyclone Aila. Out of the 190 deaths recorded in all affected districts of the country, Khulna reported 59 fatalities, and Satkhira reported 57 deaths (Gupta, 2009). Khulna and Satkhira districts had about 104,615 affected households. Koyra and Shyamnagar upazilas in these districts recorded the highest numbers, with 41,043 (39%) and 33,740 (32%) households, respectively. Migration was also observed, with approximately 123,000 people moving away from these two districts following the disaster. Of these migrants, 34 percent (42,000 people) were from Koyra, and 29 percent (36,000 people) were from Shyamnagar (Mehedi et al., 2010; Subhani and Ahmad, 2019).

Next, we identify the four most affected administrative subdivisions (upazilas) within Khulna and Satkhira. These upazilas, namely, Dacope and Koyra in Khulna and Assasuni and Shyamnagar in Satkhira witnessed extensive damage from Cyclone Aila. Approximately 76 percent of the households in these upazilas were either entirely or partially damaged (United Nations Development Program, 2010). Based on our earlier findings that Koyra and Shyamnagar upazilas exhibited a higher number of affected households and experienced significant migration, our research was explicitly concentrated on investigating the upazilas of Koyra and Shyamnagar in the Khulna and Satkhira districts, respectively.

In the third stage, we conducted expert interviews to identify specific unions (administrative units below the upazila level) and villages for our study. Key informant interviews were conducted with the Upazila Nirbahi Officers<sup>1</sup> of each upazila to gather information about the affected unions and villages. We also

sought to identify locations that had not experienced a severe impact from Cyclone Aila and areas where households had migrated during the survey period. Residents were also consulted to determine the unions and villages where households relocated following the cyclone. Based on recommendations from the two Upazila Nirbahi Officers, we selected Gabura village in the Gabura union of Shyamnagar and Borobari village in the Uttar Bedkashi union of Koyra as the affected villages in their respective sub-districts (Figure 1). Furthermore, we were advised to visit additional villages to locate migrant households in the two upazilas. These villages included Srifolkati in the Ishwaripur union, Jelekhalai in the Munshiganj union (both in Shyamnagar Upazila), Gobra village in the Koyra Sadar union, and Chondipur village in the Amadi union (both in Koyra Upazila).

### 3.2 Sampling and data collection strategies

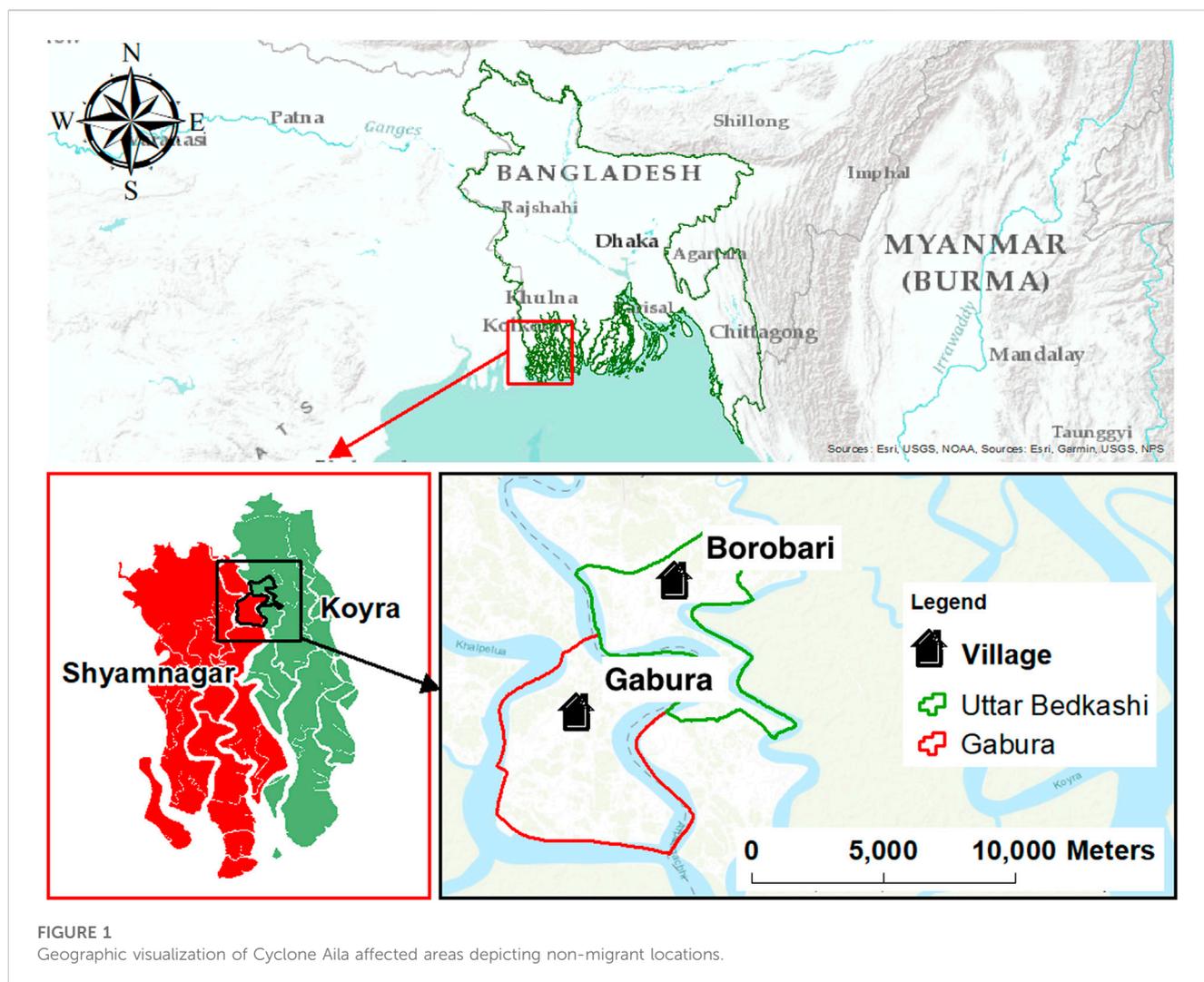
This study utilized convenience and snowball sampling techniques to gather information from migrant and non-migrant households. Convenience sampling, a form of non-probability selection, was employed to select respondents based on specific practice criteria such as their availability during the survey, accessibility, geographic proximity, and willingness to participate (Elfil and Negida, 2017). Snowball sampling was utilized to identify migrant households, as they were not concentrated in a particular place (Elfil and Negida, 2017).

These sampling strategies were chosen for two primary reasons. Firstly, the exact population size of migrant households was unknown, and not all individuals residing in the villages were migrants. Secondly, migrant households were dispersed across different areas within the villages, making it difficult to obtain an accurate sample size. Furthermore, due to the absence of some household heads or other members during interviews, strict adherence to a standardized sampling technique was not feasible.

This study focuses on migrant households affected by Cyclone Aila who could not return to their places of origin and ended up migrating with family members to neighboring areas (e.g., rural to rural). The term “migrant household” refers to the household as a unit and includes all members who left their place of origin after Cyclone Aila, had not yet returned, and had moved semi-permanently or permanently as of the interview date. On the other hand, “non-migrating households” refers to those households that did not leave their places of origin and remained in the affected areas until the survey date.

The non-migrant households included in this study were selected from two specific villages in the study area: Gabura and Borobari. Returnees from these villages were excluded from this study. If the head was unavailable, interviews were conducted with the household heads or other members. In cases where the household head was absent, we sought information from the most knowledgeable or next oldest person. Occasionally, additional informed members assisted the household heads in accurately responding to the questions. During our field visits, households that were identified as having migrated to neighboring countries, such as India, were not included in the survey if there was no resident or neighboring individual available to provide the necessary information about those households. This exclusion was required to ensure that the study focused on households

<sup>1</sup> Chief executives of an upazila. The Upazila Nirbahi Officer is the Chairperson of the Upazila Disaster Management Committee, who coordinates the disaster management activities at the upazila level.



where residents or nearby individuals could obtain reliable and complete data. Additionally, households in which no suitable respondents were available to provide information were excluded. For instance, some households were predominantly male members who worked outside the village and returned home late in the night. These households were revisited until an available household head could be interviewed. Ultimately, 284 households were included in this study, consisting of 130 migrant households and 154 non-migrant households (Table 1). The justification for choosing this sample size is the need to obtain sufficient households from the migrant and non-migrant groups to ensure statistical reliability and meaningful analysis. Including a substantial number of households in each category allowed for a more comprehensive examination of the research objectives and facilitated the identification of significant patterns or differences between the two groups. This sample size was selected to provide a reasonable representation of both migrant and non-migrant households, considering the available resources, logistical constraints, and the objective of the study.

The investigation used a semi-structured questionnaire based on previous studies by Moniruzzaman et al. (2018) and Rabbani et al. (2022) to inquire about household migration patterns and coping

strategies. Before participation, individuals provided written consent after being introduced to the research objectives and significance. They were assured that their information would remain anonymous, even if published online, and that interviews would be recorded for data analysis. The written consent form explicitly stated that the collected data would be solely used for this study and would not be used in any further research or shared online in its raw form. Notably, all interviewees willingly participated and agreed to be recorded.

### 3.3 Data analysis

The data analysis involved utilizing frequency distribution, chi-squared test, and translation of local dialects. Frequency distribution was employed to present the socio-demographic characteristics of the participants as well as the factors influencing their decision to migrate. The chi-squared test was utilized to determine the differences in coping strategies between the two groups: those who migrated and those who did not.

A multinomial logistic regression model was employed to analyze the coping capacities of households following Cyclone Aila or migration. This statistical approach is well-suited for data

TABLE 1 Number of households surveyed from the study villages.

District	Upazila	Unions	Villages	Total households	Total population	Total households surveyed*	Type of responders*
Satkhira	Shyamnagar	Ishwaripur	Srifolkati	1,250	5,506	26	Migrant
		Munshiganj	Jelekhal	516	2,346	28	Migrant
		Gabura	Gabura	1,460	6,966	104	Non-migrant
Khulna	Koyra	Koyra Sadar	Gobra	606	2,799	41	Migrant
		Amadi	Chondipur	113	439	35	Migrant
		Uttar Bedkashi	Borobari	541	2,231	50	Non-migrant

Data source: Bangladesh Bureau of Statistics. (2014), Bangladesh Bureau of Statistics. (2015); \* This study serves as the source.

with a dependent variable with multiple subcategories (Liang et al., 2020). Our study measured low, moderate, and high coping capacities in various domains, including food security, housing and shelter, crop production, livestock and poultry production, health and sanitation, and livelihoods.

The questionnaire administered to households contained a specific question to assess coping capacities: "Considering your household's conditions after Cyclone Aila or migration as a unit [for migrant households], how do you rate your household's coping capacities in terms of food security, housing and shelter, crop production, livestock and poultry production, health and sanitation, and livelihoods?" The response options included low, moderate, and high coping capacities.

In the multinomial logistic regression model, households with low coping capacity were designated as the reference group. We included the migration status of the household (migrant or non-migrant) as an explanatory variable to examine the differential survival capacity between the two groups. Additionally, several other factors were considered, including household head education, household income, household size, and primary income sources.

The goodness of fit for the regression model was assessed using the Chi-square test, Cox and Snell R<sup>2</sup>, and Nagelkerke R<sup>2</sup>. The Chi-square test evaluates the model's overall fit, while the Cox and Snell R<sup>2</sup> and Nagelkerke R<sup>2</sup> provide information about the proportion of variance explained by the model. Odds ratios were calculated to compare the relative probabilities of different coping capacity levels, enabling a comprehensive understanding of the associations between the explanatory variables and coping capacities.

By employing multinomial logistic regression, we aim to gain insights into households' coping strategies and capacities following Cyclone Aila or migration and examine the influence of various factors on coping capacities in different domains. This statistical approach allows for a robust analysis of the relationships between the explanatory variables and coping capacities, enhancing the comprehensiveness of our research findings.

The qualitative data collected from field notes and audio recordings underwent a transcription process to create protocols and transcripts. This transcription was performed using NVivo, a software for managing qualitative data. A professional translator with experience in transcribing social research interviews was employed. The audio recordings were transcribed without including any comments on the participants' behavior, such as

anxiety or depression. However, all relevant verbal content, including dialects and filler words, was recorded. The researcher carefully reviewed the translations to familiarize themselves with the data, following the approach outlined by Riessman (1993). Relevant information was then coded and extracted using NVivo. Both protocols and transcripts were coded, and from each transcript, one or more content summaries were created to ensure content consistency within a sentence or paragraph. The coding process is an integral part of qualitative analysis, as it aids in organizing data into meaningful groups or patterns (Tuckett, 2005). Interview excerpts were utilized to provide supplementary quantitative data whenever possible.

## 4 Results

### 4.1 Socio-demographic characteristics and household profiles: A comparison between non-migrants and migrants

Table 2 presents a comprehensive analysis of the socio-demographic characteristics of the respondents and households, distinguishing between non-migrant and migrant individuals. The gender distribution indicates a predominance of males in both groups, with non-migrant males accounting for 71 percent of the respondents while migrant males comprised 62 percent. This gender disparity in migration patterns is common in many societies and may reflect underlying social, economic, and cultural factors.

Examining the education level of household heads, it is evident that a significant educational gap exists in non-migrant and migrant households. Among non-migrant households, more than half (55.8%) had heads with no formal schooling, highlighting the urgent need for educational interventions. In comparison, the percentage of heads with no schooling was slightly lower among migrant households (47.7%), suggesting a relatively higher educational attainment among migrant populations. A higher percentage (12.3%) of migrant household heads with higher secondary education or above indicates the potential role of migration as a mechanism for upward social mobility and access to better educational opportunities.

Income disparities between non-migrant and migrant households are strikingly evident. A significant proportion (57.1%) of non-migrant households reported a monthly income

**TABLE 2** Socio-demographic characteristics of non-migrant and migrant and their households.

Socio-demographics	%	
	Non-migrant N = 154	Migrant N = 130
<b>Gender</b>		
Male	71	62
Female	29	38
<b>Education of household head</b>		
No schooling	55.8	47.7
Primary	30	33.8
Secondary	9.7	6.2
Higher Secondary and above	4.5	12.3
<b>Income of household (monthly BDT)</b>		
<6,000	57.1	9.2
6,001–9999	28.6	60
>10,000	14.3	30.8
<b>Mean</b>	<b>5,142 BDT</b>	<b>8,730 BDT</b>
<b>Household size</b>		
1–4	26	51.5
5–6	33.1	23.8
7+	40.9	24.6
<b>Mean</b>	<b>5.82 people</b>	<b>4.09 people</b>
<b>Primary income sources</b>		
Farming	7	6
Fishing	21	22
Agri- and nonagricultural day labor	61	47
Small entrepreneurship	6	11
Government and non-government services	5	14

<sup>a</sup>USD, 108 BDT, and 1 EURO, 118 BDT, as date of 8 July 2023. Source: Household Survey, 2017–2018.

Bold values represents the mean values of variables that are represented by distinct text labels in the column headings marked with “%”.

below 6000 BDT, indicating a prevalence of low-income conditions. In contrast, only 9.2 percent of migrant households fell within this income range, reflecting the potential economic benefits associated with migration. Migrant households had a substantial majority (60%) falling within the income range of 6,001–9999 BDT and a notable proportion (30.8%) with an income exceeding 10,000 BDT. The higher mean income of migrant households (8,730 BDT) compared to non-migrant households (5,142 BDT) underscores the potential role of migration as a pathway to improved economic opportunities and income generation.

The distribution of household sizes differs between non-migrant and migrant populations, with non-migrant households displaying a higher percentage (40.9%) of larger households with 7 or more

members. In contrast, a higher proportion (51.5%) of migrant households comprised smaller households with 1–4 members. These variations in household size may reflect differences in family structure, migration patterns, and socio-economic factors.

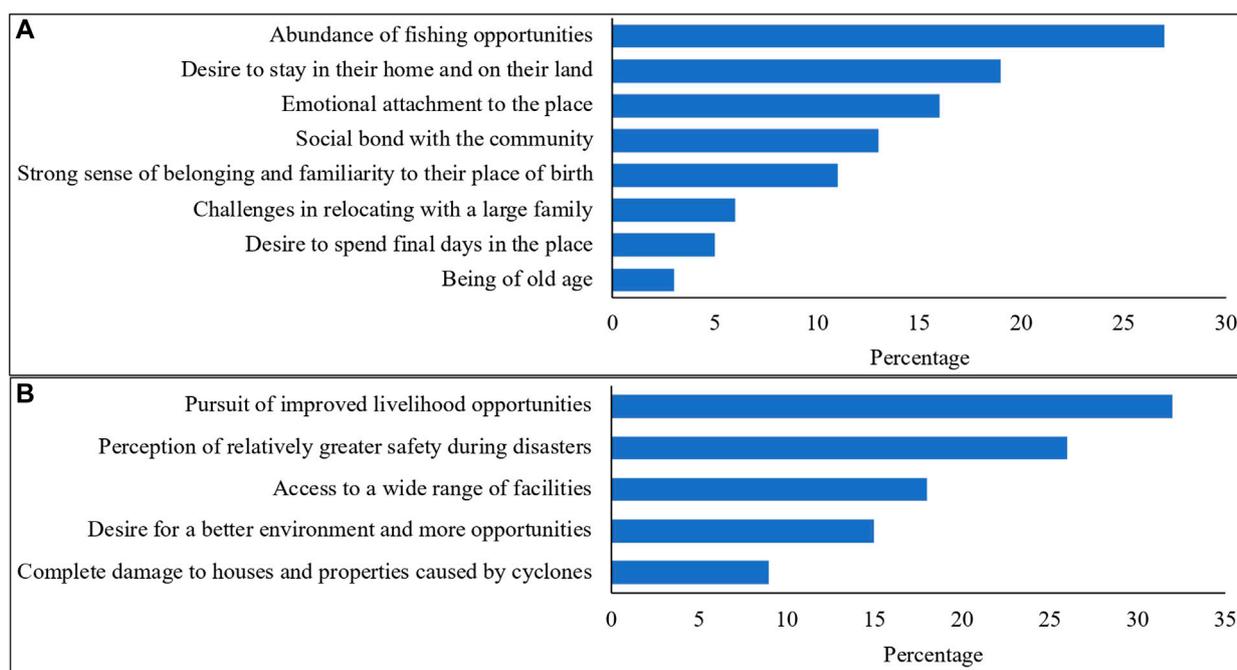
Regarding primary income sources, farming and fishing played relatively minor roles for both non-migrants and migrants, suggesting a declining trend in traditional agricultural activities. Instead, agricultural and nonagricultural day labor emerged as the primary income source for most non-migrant (61%) and migrant (47%) households. This highlights the prevalence of informal labor and the study population’s dependence on daily wage work. The higher prevalence of small entrepreneurship among migrant households (11%) compared to non-migrant households (6%) may signify the entrepreneurial spirit and business opportunities migrants often encounter in destination areas. Additionally, the higher proportion of migrants engaged in government and non-government services (14%) suggests the availability of employment opportunities for migrant populations in the service sector.

## 4.2 Unraveling decision-making: quantitative analysis of motivations behind non-migration and migration

The decision of non-migrants to remain in cyclone-affected villages, despite the impact of cyclones, can be attributed to various factors (Figure 2A). Firstly, 3 percent of non-migrants being of old age indicates that some individuals may prefer to stay in familiar surroundings as they grow older, finding comfort and stability in their existing environment rather than uprooting their lives. Moreover, 5 percent of non-migrants desire to spend their final days there, reflecting the importance of finding peace and closure in a familiar setting as they approach the end of their lives. Challenges in relocating with a large family influence 6 percent of non-migrants to stay. This suggests that the practical difficulties associated with uprooting an entire household, such as finding suitable housing, schools, and employment opportunities for everyone, can discourage them from pursuing migration.

The strong sense of belonging and familiarity with their place of birth is cited by 11 percent of non-migrants. This factor underscores their deep-rooted connections with their communities, including cultural, historical, and familial ties. The attachment to their birthplace, shaped by their upbringing and shared experiences, plays a significant role in their decision to stay despite the cyclone’s impact. Social bonds with the community contribute to the decision of 13 percent of non-migrants to remain. Close-knit relationships, friendships, and a sense of belonging within the community foster a support system that may provide security and emotional wellbeing, reinforcing the decision to stay even in challenging circumstances. Emotional attachment to the place influences 16 percent of non-migrants. This emotional connection may stem from personal memories, sentimental values, or a deep-rooted bond with the environment. This motivates them to endure the difficulties caused by cyclones and rebuild their lives, which they consider home.

Desire to stay in their home and on their land emerges as a crucial factor, with 19 percent of non-migrants expressing this preference. Ownership of property and preserving their established way of life become essential considerations. Economic



**FIGURE 2**  
Influential factors for the decision to stay (A) or relocate (B) among non-migrant and migrant households. Source: Household Survey, 2017–2018.

factors, family heritage, and personal preferences contribute to their decision to stay despite the risks posed by cyclones. Finally, the abundance of fishing opportunities influences 27 percent of non-migrants. This factor suggests that the availability of fishing resources plays a substantial role in their decision to stay, likely due to the importance of fishing for their livelihoods or as a recreational activity.

Figure 2B provides a breakdown of push and pull factors for migrants, indicating the percentage distribution for each factor. These factors represent why households choose to migrate from their previous location, which was affected by Cyclone Aila in 2009. One notable push factor, accounting for 9 percent of the respondents, is the complete damage to houses and properties caused by cyclones. This suggests that individuals affected by natural disasters such as cyclones are compelled to seek new homes and environments due to the destruction they have experienced. This factor highlights the significant impact of climate-related events on migration decisions.

The desire for a better environment and more opportunities emerges as a significant pull factor, constituting 15 percent of the responses. This indicates that individuals seek improved living conditions and more excellent personal and professional growth prospects. It reflects the human tendency to pursue better circumstances and suggests that migrants are driven by the belief that they can achieve a higher quality of life elsewhere. Access to a wide range of facilities is identified as a pull factor for migration, representing 18 percent of the respondents. This suggests that individuals are drawn to locations that offer diverse amenities and services, including healthcare, education, infrastructure, and recreational facilities. The availability of such resources can significantly impact an individual's decision to

migrate as they seek an enhanced standard of living and convenience.

The perception of relatively greater safety during disasters is an intriguing pull factor, accounting for 26 percent of the responses. This finding suggests that individuals believe certain areas or regions are more resilient or better equipped to handle natural disasters, making them feel safer during times of crisis. It highlights the importance of disaster preparedness and resilience in shaping migration patterns and decisions. Finally, the pursuit of improved livelihood opportunities emerges as the most significant pull factor, constituting 32 percent of the respondents. This factor underscores the economic motivations behind migration, as individuals seek better job prospects, higher incomes, and increased financial stability. It indicates that searching for economic advancement is central to driving migration flows.

#### 4.3 Unveiling the motivations for non-migrant households to remain in cyclone-affected areas: qualitative insights

The villages under study are encompassed by vast tidal mangrove forests, including the river and the *Sundarbans*, which serve as indispensable resources, transportation routes, and safeguards against flooding for the inhabitants. Consequently, the residents heavily relied on these areas for fishing, which constituted their primary source of livelihood before the devastating impact of Cyclone Aila and continues to be so for most of them. The subsequent excerpt provided by a 44-year-old male residing in cyclone-affected Borobari offers valuable insights into their perspective:

Fishing has been an occupation passed down through generations, deeply embedded in our way of life, sustenance, and

prospects for the future. Being near the river and Sundarbans has bestowed abundant opportunities upon fishermen like me. Despite witnessing many of my neighbors depart from our cherished village to engage in rickshaw pulling, van driving, and other activities, my decision to remain and pursue fishing offers a superior life for me. (Male, 44 years, Borobari, non-migrant).

Descriptive statistics reveal that 16 percent of non-migrants cited a solid emotional attachment to the area as a critical reason for staying. The following excerpt by a 49-year-old male residing in cyclone-affected Gabura sheds light on why non-migrant households refrained from migrating elsewhere:

This place is my home, the very land of my birth, where I strive and labor to survive. The mere thought of leaving the village fills me with profound sadness. Despite significant damage to my assets during Cyclone Aila, I could not abandon the town. I have been here, will remain here, and ultimately, will be laid to rest here. (Male, 49 years, Gabura, non-migrant)

A majority of non-migrants placed great emphasis on their birthplace as a critical factor. Even in the face of compulsion, such as the forced displacement experienced by many, 11 percent of non-migrants attributed their decision to stay to their attachment to their birthplace. The following quote from a 40-year-old male who has resided in Borobari village for 4 decades encapsulates this sentiment:

Individuals possess an inherent, enduring love and attachment to their birthplace, irrespective of its nature or location. I was born and raised in this village; unless compelled, individuals seldom depart from their homes. I, too, choose to remain here, even though I recognize that life in a less disaster-prone area or city may offer better prospects. (Male, 40 years, Borobari, non-migrant)

The devastation caused by Cyclone Aila resulted in the destruction of homes, land, livestock, and other properties of the surveyed villages, leaving many people displaced and landless. However, some individuals managed to reconstruct their homes and reclaim their land. The third primary reason cited by non-migrant participants for staying was their reluctance to abandon their homes and land, as quoted by 19 percent of them. A 36-year-old male residing in Borobari, who possesses land and restores his partially damaged house after Cyclone Aila, provides the following perspective:

The village of Borobari, located within Uttar Bedkashi Union, is acutely vulnerable to cyclones, tidal floods, saline water intrusion, and various other hazards. The recurrence of these disasters is alarmingly common in this area. Considering that we possess land, a home, and familial ties in this village, one might wonder: where else could we possibly go? Leaving our homes and land behind would be considered dishonorable, and I firmly hold this belief. (Male, 36 years, Borobari, non-migrant)

Social connections within the community are another crucial factor influencing villagers' decision to remain in their current location. The non-migrants who have spent many years in the village and endured numerous climate-related events together have formed a strong sense of community and social bonds. For those who consider migration, leaving the village and relocating elsewhere often leads to feelings of regret. An insightful response from a 39-year-old male residing in Gabura encapsulates this prevailing sentiment:

When one profoundly loves someone, they cannot bear to part ways until death separates them. Similarly, my profound affection for this community, its people, and the land prevents me from even considering leaving them behind. Although I attempted to depart with my family, my

beloved neighbors vehemently opposed my departure. We are a unified community, working tirelessly to build a shared existence fueled by the hope of a better future. (Male, 39 years, Gabura, non-migrant)

To some extent, respondents expressed the challenges associated with relocating a large family, particularly during and after Cyclone Aila. The following statement from a 52-year-old female residing in Gabura echoes the sentiments expressed by 6 percent of non-migrant households.

I tirelessly labor here with my large family. Words cannot adequately convey a sizable household's vulnerability and associated impacts during a disaster. However, migrating as a household unit of ten members is an arduous task. (Female, 52 years, Gabura, non-migrant).

A small percentage of non-migrants (5%) highlighted their desire to be buried in their affected village as a reason for choosing to stay. It is a common aspiration among villagers to find their final resting place in their native village. An emotional response from a 53-year-old female in Gabura exemplifies this sentiment.

I have witnessed numerous disasters, such as the flood in 1988, Cyclone Sidr in 2007, and Aila in 2009. Despite losing all my belongings and possessions, I have managed to survive. I work diligently to maintain a peaceful existence, but tranquility remains elusive here; instead, cyclones arrive. I have lived in this village, and all my memories and stories are deeply rooted here. I wish to depart from this world in my beloved village, not elsewhere. (Female, 53 years, Gabura, non-migrant).

Elderly non-migrant heads of households reported that their physical limitations and the lengthy resettlement process deterred them from considering a move. The excerpt from a 65-year-old male in Borobari village sheds light on their perspective:

I have resided here since birth until [date of the survey]. My life's journey has been intimately connected to this place. Given my current health conditions and vulnerabilities, attempting to start a new life in a different location is impractical. I lack the physical strength required for such a transition. (Male, 65 years, Borobari, non-migrant).

The above qualitative findings provide critical insights that support and complement the quantitative analysis. The residents of the studied villages heavily rely on the surrounding tidal mangrove forests for fishing, which has been deeply ingrained in their way of life and serves as their primary source of livelihood. Despite the devastating impact of Cyclone Aila, many non-migrants chose to stay in their birthplaces due to strong emotional attachments, a sense of belonging, and an enduring love for their community and land. The community's social connections and shared experiences also play a significant role in their decision to remain, as migrating would mean leaving behind their support networks and risking a loss of identity. Additionally, the reluctance to abandon their homes and land, even in the face of recurring disasters, reflects a belief in the honor and value of staying rooted in their native villages. The findings highlight the complex interplay between social, cultural, and environmental factors that shape the decision-making process of individuals in vulnerable communities.

#### 4.4 Insights from migrants: Unraveling push and pull factors of migration in the aftermath of cyclone Aila through qualitative analysis

The research findings highlight that the migration patterns observed were primarily driven by the households' stresses

induced by Cyclone Aila. Migrant participants emphasized that while they could cope with losing their homes and possessions, the inability to secure employment hindered their progress. Before Cyclone Aila, the interviewed individuals relied on fishing and agriculture for their livelihoods. However, the cyclone severely disrupted these means of sustenance, significantly limiting their opportunities. Consequently, people chose to migrate in search of better income opportunities as an immediate response to the strain on their livelihoods. The following excerpt from a 41-year-old male resident of Jeleshali village summarizes the sentiments of the majority of respondents (32%):

In my native village, Uttar Bedkashi Union, there were limited livelihood opportunities other than fishing. Survival was challenging. After the devastation caused by Cyclone Aila in 2009, I stayed there for a month. However, I eventually decided to relocate with my family. We settled in a village where I discovered multiple income-generating prospects, such as working on a shrimp farm, engaging in earthworks, operating rickshaws and vans, farming, collecting honey from the Sundarbans, and driving, among others. (Male, 41 years, Jeleshali, migrant).

When asked about the main factors influencing their decision to migrate, other migrants emphasized the safety of their destination villages in Shyamnagar Sadar, Satkhira, Koyra Sadar, and Khulna (26%). Quotations from a 44-year-old female resident of Srifolkati provide further insights from migrant interviews:

My native village, Gabura, was severely affected by Cyclone Aila in 2009, along with Cyclone Sidr in 2007, regular tidal floods, and saline water intrusion. However, where we currently reside presents a lower risk of cyclones. Comparatively, it is safer than Gabura. (Female, 44 years, Srifolkati, migrant).

A 38-year-old male from Chondipur village added:

This Chondipur village of Amadi Union is relatively safer regarding frequent extreme cyclones and floods. Since migrating after Cyclone Aila in 2009, I have been living here. While finding areas within the sub-district that are entirely free from disasters is challenging, Chondipur offers a safer and more favorable environment, which compelled me to leave my land and home in my native village, Uttar Bedkashi. (Male, 38 years, Chondipur, migrant).

Cyclone Aila had far-reaching consequences on household wellbeing, including food security, shelter and housing, water, sanitation, health facilities, access to medical services, and livelihoods. The destruction of these systems and facilities left the affected households more vulnerable. Individuals sought places where these amenities were readily available to escape these circumstances. Within the study, 18 percent of migrants cited this as a motivating factor for their migration. Excerpts from a 32-year-old female resident of Srifolkati village provide an overview:

After Cyclone Aila struck my village, food, shelter, health, sanitation, and livelihood facilities were insufficient. The affected village continues to suffer from the aftermath of Cyclone Aila. Repairing the roads, buildings, schools, clinics, and other community infrastructure is necessary. I am now in Srifolkati, which is close to Shyamnagar Sadar and offers a range of facilities. (Female, 32 years, Srifolkati, migrant).

Another quotation from a 46-year-old male resident of Jeleshali village highlights:

Access to numerous doctors and health facilities provided by NGOs and the union parishad. The environment is better, with no fear of the dangerous river and no issues with undrinkable water. We are close to relatives, and there are no disaster risks. Additionally, the income opportunities are improved. These necessary facilities for our livelihoods were not available in the regions affected by Cyclone Aila. (Male, 46 years, Jeleshali, migrant).

The study reveals that 15 percent of migrants moved to the studied village due to its better environment and opportunities. A 35-year-old female resident of Chondipur village stated:

The environment in Chondipur, Amadi Union, differs significantly from where I lived before migrating. The living conditions are superior here, allowing for peaceful sleep and a sense of safety. We can move freely without risk, and the river is distant. (Female, 35 years, Chondipur, migrant).

It is crucial to recognize that Cyclone Aila might not affect all households equally, leading to partial or complete damage. During Cyclone Aila, 76 percent of households in the hardest-hit Upazilas of Khulna (Dacope and Koyra) and Satkhira (Assasuni and Shyamnagar) districts experienced partial or complete damage (United Nations Development Program, 2010). In our survey, some households reported complete destruction of their homes and properties, leaving them nothing to rely on. There were no assets to live on. A 53-year-old male migrant from Gobra village in Koyra Sadar expressed a sentiment shared by 9 percent of those interviewed, stating that they migrated because they had lost everything:

The devastation caused by Cyclone Aila in 2009 was unimaginable! It wiped out everything, including my home and the land where I had lived since birth. I had no properties left to sustain myself. Although I could rebuild my house there, there is always uncertainty regarding the occurrence of another massive cyclone. (Male, 53 years, Gobra, migrant).

In summary, the study findings indicate that Cyclone Aila significantly impacted the livelihoods and well-being of the affected households. The inability to secure work, the loss of essential amenities, and the increased vulnerability of the population were key factors driving migration. Safety concerns, better income opportunities, availability of facilities, and a favorable living environment were important pull factors for migrants. The varying degrees of damage caused by the cyclone underscored the differential impact on households, with some experiencing complete loss. These critical insights shed light on the complex dynamics and motivations behind migration in the aftermath of natural disasters.

#### 4.5 Building resilience following cyclone Aila: Quantitative and qualitative insights into coping strategies of migrant and non-migrant households

Table 3 presents the coping strategies practiced by both migrant and non-migrant households in percentages (and corresponding counts) for each strategy. The table highlights the differences in coping behaviors between the two groups.

Non-migrant households show a higher percentage of seeking support from social networks, such as government and NGOs,

TABLE 3 Coping strategies practiced by non-migrant and migrant households.

Coping strategies	Non-migrant % (N)		Migrant % (N)	
	Yes	No	Yes	No
<i>Seeking support from social networks</i>				
Seeking support from Government and NGOs <sup>a</sup>	44 (67)	56 (87)	30 (39)	70 (91)
Seeking support from pre-migrant neighbors <sup>b</sup>	—	—	21 (27)	79 (103)
Seeking support from new neighbors <sup>b</sup>	—	—	35 (45)	65 (85)
Seeking support from migrated neighbors <sup>c</sup>	53 (82)	47 (72)	—	—
Rely on the emotional support of friends/households <sup>a</sup>	81 (124)	19 (30)	23 (30)	77 (100)
<i>Changes in food consumption</i>				
Rely on less expensive foods	14 (22)	86 (132)	15 (20)	85 (110)
Borrow food from neighbors <sup>a</sup>	57 (88)	43 (66)	15 (20)	85 (110)
Purchase food on credit <sup>a</sup>	44 (67)	56 (87)	15 (20)	85 (110)
Reducing the quantity of food per meal served <sup>a</sup>	82 (127)	18 (27)	20 (27)	80 (103)
Reducing the number of meals per day <sup>a</sup>	57 (87)	43 (67)	19 (25)	81 (105)
Eating rice with salt and/or chilies <sup>a</sup>	55 (85)	45 (69)	19 (25)	81 (105)
Collecting wild vegetables (e.g., spinach) <sup>a</sup>	46 (71)	54 (83)	20 (26)	80 (104)
Reducing the quality of food <sup>a</sup>	50 (77)	50 (77)	29 (38)	71 (92)
Cut on expenditure <sup>a</sup>	49 (76)	51 (78)	23 (30)	77 (100)
<i>Rely on savings and loan</i>				
Utilizing savings <sup>a</sup>	20 (31)	80 (123)	65 (85)	35 (45)
Taking money loan with interest to buy food <sup>a</sup>	60 (92)	40 (62)	38 (49)	62 (81)
<i>Livelihood options</i>				
Engaging younger children in livelihood activities	29 (44)	71 (110)	38 (49)	62 (81)
Seeking alternative sources of income <sup>a</sup>	29 (44)	71 (110)	73 (95)	27 (35)
<i>Selling assets and livestock</i>				
Selling assets <sup>a</sup>	9 (14)	91 (140)	38 (49)	62 (81)
Selling livestock	39 (60)	61 (94)	38 (49)	62 (81)

<sup>a</sup>Significant at 5%.

<sup>b</sup>Applicable to only migrant households.

<sup>c</sup>Applicable to only non-migrant households. Source: Household Survey, 2017–2018.

compared to migrant households. On the other hand, many migrant households rely on support from new neighbors, indicating the importance of building new social networks in their recent locations. It is interesting to note that seeking support from pre-migrant neighbors applies only to migrant households, suggesting the continued reliance on their former communities.

A higher percentage of non-migrant households rely on the emotional support of friends and households, whereas this coping strategy seems less prevalent among migrant households. This finding may indicate that migration might weaken emotional support systems for the households that move.

Both migrant and non-migrant households employ coping strategies related to food intake. For instance, reducing the quantity of food per meal and the number of meals per day are

standard practices among non-migrant households. Additionally, a higher percentage of non-migrant households seem to adapt to the situation by eating rice with salt and/or chilies and collecting wild vegetables, possibly due to their familiarity with the local resources.

Migrant households show a higher percentage of utilizing savings, which could be attributed to the financial preparation and planning required for migration. On the other hand, a significant percentage of non-migrant households take loans with interest to buy food, indicating a potential financial strain among this group.

Interestingly, both migrant and non-migrant households are engaging in livelihood activities, with a relatively higher percentage of migrant households involving younger children in such activities. This suggests the importance of child labor for income generation in

migrant households' new locations. Moreover, seeking alternative sources of income is more prevalent among migrant households, possibly due to the need to adapt to the new economic environment.

Both migrant and non-migrant households resort to selling assets and livestock. However, selling assets is more common among migrant households, which could indicate a more desperate measure this group takes to cope with challenges.

While the table provides a valuable summary of coping strategies, augmenting these quantitative findings with a detailed qualitative analysis or interviews conducted with households would be beneficial. By doing so, we can gain a deeper understanding of the underlying motivations behind these coping strategies and obtain a more holistic view of the households' experiences. The subsequent section presents and discusses the findings derived from qualitative interviews.

#### 4.5.1 Seeking support from social networks

As depicted in [Table 3](#), it is evident that both households, categorized as migrants and non-migrants, utilized a range of strategies to address the adverse effects caused by Cyclone Aila. These strategies included seeking financial or emotional assistance from friends, relatives, and government and non-governmental organizations. One male household head from the severely affected Gabura village, who had lost his assets and belongings due to the cyclone, relied on emotional support from his social networks as a coping mechanism. This individual, who is illiterate and earns a monthly income of BDT 6,000 (USD 55/EUR 51) as a day laborer, expressed the importance of this support in helping him recover from the crisis and its associated effects. Like 81 percent of the non-migrants surveyed, he explained:

In times of trouble, such as the loss of assets caused by the cyclone and the resulting poverty, my friends and relatives offer me emotional support when they cannot provide financial assistance. This support is crucial in facilitating my recovery from the crisis and its consequences. (Male, 46 years, Gabura, non-migrant).

Non-migrant households, aware of the cyclone risk, perceived themselves as living with the constant threat of cyclones. Among them, 44 percent reported relying on assistance from government and nongovernmental organizations ([Table 3](#)). A male household head from the cyclone affected Borobari village, earning a monthly income of BDT 6,500 per month (USD 60/Euro 55) as a day laborer, acknowledged the common practice of seeking support from government and non-government organizations among coastal inhabitants. Like many other non-migrants, he also sought help from his migrant neighbors, believing they were in a better position. He stated:

Coastal inhabitants depend primarily on support in the form of food or monetary aid from local and international non-governmental organizations, as well as government social safety nets. Occasionally, I also seek assistance from households that have left the village and now live in more favorable conditions where they can work and earn money. (Male, 41 years, Borobari, non-migrant)

A portion of migrant household heads (21%) mentioned receiving support from their neighbors before migration ([Table 3](#)). They also sought help from their new neighbors (35%) ([Table 3](#)). A female participant, the head of her household, with a primary school education and working as a day laborer, earned BDT 4,500 (USD 42/EUR 38) monthly to support her seven-member household. She emphasized using the significance of support from both her former and current neighbors as a coping strategy:

I left my village, which was severely affected by Cyclone Aila. However, my neighbors from that village supported me financially when I could not meet my family's basic needs, especially food. Sometimes, I also seek assistance from my new neighbors. (Female, 37 years, Srifolkati, migrant).

#### 4.5.2 Utilizing savings and borrowing money

To cope with the financial crises resulting from Cyclone Aila, approximately 65 percent of migrant households reported utilizing their savings, while over 60 percent of non-migrant households stated that they had received loans ([Table 3](#)). This suggests that migrant households exhibited greater financial resilience compared to non-migrant households. A female head of a non-migrant household, who has limited literacy and earns BDT 4,000 (USD 37/EUR 34) as a day laborer, relied on financial assistance from government and non-government organizations. However, she emphasized resorting to taking loans from local individuals when other viable options were scarce:

I received some relief from the government and non-government organizations, but the support was insufficient. I employed several strategies to cope with adverse situations. I spent a small amount on essentials and sold crops, specifically rice. Additionally, when the financial burden became overwhelming, I resorted to acquiring loans from local moneylenders, albeit at high-interest rates, to cover my family's expenses. (Female, 30 years, Gabura, non-migrant).

Likewise, another female head of a non-migrant household, who has limited education but possesses basic writing skills, mentioned receiving a loan from a financial non-governmental organization to repair her partially damaged house. She engages in fishing in the local part of the Sundarbans and earns approximately BDT 3,500 (USD 32/EUR 30) monthly to sustain her household, including eight dependents.

To overcome the vulnerability and poverty resulting from the cyclone, I borrowed money from non-governmental organizations. Cyclone Aila caused partial damage to my house, prompting me to take a loan to purchase materials for housing repairs. (Female, 39 years, Borobari, non-migrant).

These accounts highlight the critical financial circumstances faced by non-migrant households in the aftermath of Cyclone Aila. While accessing support from government and non-governmental organizations provided some relief, it was often insufficient to meet their needs. As a result, borrowing loans, especially from local moneylenders, became a necessary yet burdensome strategy to address immediate financial challenges.

These narratives underscore the importance of enhancing financial support mechanisms and developing sustainable solutions to assist vulnerable non-migrant households in rebuilding their lives post-disaster. Mitigating high-interest loans and ensuring adequate support from reliable sources can help alleviate the financial burdens faced by these households and foster their long-term recovery and resilience.

#### 4.5.3 Changes in food consumption

The analysis of qualitative interviews provides valuable insights into the significant challenge of food insecurity experienced by impoverished non-migrant households. Limited financial resources pose multiple barriers to accessing sufficient and nutritious food, resulting in compromised dietary intake. To cope with this situation, families often employ coping strategies such as borrowing food from neighbors, purchasing food on credit, reducing both the quantity

and quality of consumed food, cutting food-related expenses, limiting the number of daily meals, consuming rice with salt and chilies, and engaging in foraging for wild vegetables. The constraints imposed by financial limitations necessitate these adaptive measures and serve to ensure basic sustenance in the face of food scarcity. A female participant, aged 50, residing in Gabura, shared her experience regarding food insecurity and the measures she undertakes to address it:

Our reliance on small homegrown plants, such as spinach, is crucial in providing our family with edible vegetables amidst the high costs of regular food in the local market, beyond our means as a poor household. Unfortunately, this means that there are instances when we must endure inadequate food intake, compromising our overall health. The perpetual challenge lies in striking a delicate balance between managing our limited resources and maximizing the yields from our cultivated plants. However, despite our diligent efforts, there are moments when the daunting struggle to secure enough food becomes overwhelming. Witnessing the nutritional wellbeing of our family suffer due to financial constraints is disheartening. Nevertheless, we remain resilient and steadfast, tirelessly exploring every avenue to sustain ourselves within this challenging environment. (Female, 50 years, Gabura, non-migrant).

#### 4.5.4 Livelihood options

Seeking an alternative source of income is a widely used coping strategy for migrant households after experiencing Cyclone Aila, as indicated by 73 percent of respondents (Table 3). In comparison, non-migrant households seem to rely less on such alternatives. One migrant household head, who relocated after Cyclone Aila, expressed satisfaction with his current situation, earning BDT 12,000 (USD 111/EUR 102) per month through employment with a non-governmental organization. He emphasized the availability of diverse job opportunities in his new location:

I have found better income prospects here. Previously, in my Cyclone Aila-affected village of Borobari, all coastal residents were limited to working as day laborers or fishers. However, after moving away from Borobari and closer to Shyamnagar Sadar, an administrative center, I now can access various employment options, including day labor, self-employment as a small-scale entrepreneur, service-related administrative jobs, and fishing. (Male, 42 years, Gobra, migrant).

Migrant households also mentioned another avenue for income generation: engaging in earthwork during the dry season between November and April, with many female migrants participating in such activities.

Interestingly, the involvement of children in income-generating activities after Cyclone Aila varied between migrant and non-migrant households. Approximately 29 percent of non-migrant households engaged their children in livelihood activities, while the figure rose to 38 percent among migrant households (Table 3). The migrants' ability to diversify their income sources and involve more family members in paid labor contributed to overall household income growth. One household head who migrated with his family mentioned that their total income was BDT 14,000 (USD 130/EUR 118), earned by himself and his younger son. He explained the potential benefits of having more children:

Households with more children can take advantage of available job opportunities. When there is a demand for labor, children can work and contribute additional income to the family. During the winter, work opportunities such as day labor in shrimp farming and

road and infrastructure construction tend to increase. (Male, 46 years, Chondipur, migrant).

#### 4.5.5 Selling assets and livestock

Selling assets and livestock can be a practical strategy to cope with sudden and unforeseen financial crises. However, non-migrant households did not employ this strategy frequently (only 9% reported using it), likely due to the loss of assets and valuable possessions during Cyclone Aila. In contrast, a greater percentage of migrant households mentioned resorting to selling assets and livestock, with 38 percent reporting having used each strategy (Table 3). A resilient female migrant from Jelekhali, highlighting the resourcefulness and adaptability required to navigate the challenges faced by her family.

If circumstances allow, I engage in rice preservation after the harvest. In times of inclement weather, I sell a portion of our rice stock to acquire other essential commodities. At times, the need arises to part with our hens, ducks, goats, and similar assets to address the pressing needs of my household. Our ability to pursue this course of action is contingent upon possessing sellable assets that can contribute to meeting our daily requirements. Conversely, some households lack such assets or possessions, considerably challenging survival during crises. Cyclone Aila inflicted significant losses upon numerous households, leading to the depletion of valuable assets and possessions. (Female, 40 years, Jelekhali, migrant).

### 4.6 Investigating household wellbeing in the aftermath of cyclone Aila: The implications of migration

Table 4 reveals notable disparities in perceived coping capacity between migrant and non-migrant households across various areas of wellbeing. Interestingly, a significant majority of migrants show a 'high' coping capacity in food security (47.7%), housing and shelter (44.6%), crop production (44.6%), livestock and poultry rearing (43.8%), health and sanitation (44.6%), and means of livelihood (44.6%). In contrast, non-migrant households exhibit substantially lower percentages of 'high' coping capacities in all these domains, ranging from 5.3 percent to 9.7 percent. This suggests that migrants seem to possess higher confidence in dealing with these challenges than non-migrants. A plausible explanation for these disparities could be the influence of Cyclone Aila, which might have impacted the regions where non-migrants reside, making it more difficult for them to develop and maintain coping strategies. On the other hand, migrants who migrated after the cyclone may have sought better opportunities or resources, leading to their higher perceived coping capacities. Understanding these differences can aid in tailoring targeted support and recovery measures to address the specific needs of both migrant and non-migrant households, ensuring more equitable and resilient communities in the face of future challenges.

The multinomial logistic regression analysis (Table 5) provides valuable insights into the perceived coping capacity across different areas of household wellbeing and the factors that contribute to it.

Regarding the variable education of households, households with a higher secondary education level or above have significantly higher odds of perceiving moderate or high coping capacity in various areas. Specifically, households with higher

TABLE 4 Perceived coping capacity across areas of household wellbeing.

Area of household wellbeing	Migrant (%)			Non-migrant (%)		
	Low	Moderate	High	Low	Moderate	High
Food security	20	32.3	47.7	17.6	31.3	5.3
Housing and shelter	20.8	34.6	44.6	37	53.2	9.7
Crop production	20.8	34.6	44.6	59.7	30.5	9.7
Livestock and poultry rearing	20.8	35.4	43.8	50	40.3	9.7
Health and sanitation	20.8	34.6	44.6	53.9	36.4	9.7
Means of livelihood	20.8	34.6	44.6	53.2	37	9.7

education are 2.82 times more likely to have high coping capacity in crop production. This suggests that higher levels of education may equip individuals with knowledge and skills to effectively cope with challenges related to crop production in their households.

Turning to the income of households, households with an income between 6,001 and 9,999 exhibit lower odds of perceiving moderate or high coping capacity in several areas of household wellbeing. In other words, the findings suggest that households with lower incomes, specifically below 6,000, are more likely to perceive 'moderate' or 'high' coping capacity in various areas of household wellbeing. This implies that lower-income households may have developed effective strategies and resilience mechanisms to overcome challenges and maintain their wellbeing. However, the relationship between income and coping capacity is complex, as higher-income households do not consistently exhibit higher coping capacity. Further research and analysis are needed to understand the nuanced dynamics between income levels and coping ability in different areas of household wellbeing.

Moving on to the variable household size, households with larger sizes, specifically with 7 or more members, have significantly higher odds of perceiving moderate or high coping capacity in some regions of household wellbeing. This suggests that larger households may benefit from collective resources and support systems within the family, enabling them to cope better with food security and housing challenges.

Examining the variable primary income sources, we find that households primarily involved in farming and fishing (the reference category) are more likely to have 'moderate' or 'high' coping capacity across various areas of household wellbeing. On the other hand, the negative signs of the coefficients for categories such as agricultural and non-agricultural day labor, small entrepreneurship, and government or non-government services indicate a decreased likelihood of perceiving 'moderate' coping capacity compared to households dependent on farming and fishing. This implies that households relying on agriculture and fisheries may have developed a greater level of resilience and coping strategies specifically tailored to the challenges faced in their regions, such as reliance on agricultural resources, local knowledge, and community support systems. It is important to note that these findings reflect the specific context of the study area and should be interpreted within that context. The results suggest that the primary income sources play a significant role in shaping the perceived coping capacity of households. Further research is needed to explore the underlying mechanisms and dynamics contributing to the varying coping capacity levels across different income sources.

Lastly, the variable household migration status reveals intriguing results. Migrant households have significantly higher odds of perceiving moderate or high coping capacity compared to non-migrant households. Migrant households have 9.72 times higher odds of perceiving high coping capacity in food security, 10.1 times higher odds in housing and shelter, 17.4 times higher odds in crop production, and 18.2 times higher odds in livestock and poultry rearing, 19.2 times higher odds in health and sanitation, and 18.7 times higher odds in means of livelihood. These findings suggest that migration, possibly driven by factors such as seeking better opportunities or escaping adverse conditions, can enhance households' perceived coping capacity across multiple domains of wellbeing.

The findings shed light on the complex interplay between various household variables and perceived coping capacity. Higher levels of education are associated with enhanced coping capacity in crop production, highlighting the role of knowledge and skills. While lower-income households demonstrate effective coping strategies in certain areas, income alone does not determine coping capacity. Larger household sizes benefit from collective resources and support systems. Farming and fishing income sources exhibit higher coping capacity, indicating specialized knowledge and community support. Migrant households demonstrate significantly higher coping capacity across multiple domains, suggesting the potential benefits of migration. These findings emphasize the need for targeted interventions, recognizing the importance of education, income sources, household size, and migration status in enhancing household coping capacity and wellbeing.

## 5 Discussion

The findings of this study provide important insights on the coping mechanisms and capacities of migrant and non-migrant families in Bangladesh impacted by Cyclone Aila. The findings show how these two groups dealt with the effects of the catastrophic weather event differently. Due to their capacity to adapt and find new sources of income, migrant households had a greater level of resilience. They did this by utilizing savings, integrating their kids into their livelihood, selling cattle and other assets, and modifying the quality of their meals. On the other hand, non-migrant households depended on tactics like eating less expensive food, borrowing from neighbors, purchasing food on credit, cutting back on the number of meals, eating rice with salt and chili, and utilizing

TABLE 5 Multinomial logistic regression results of perceptions of coping capacity across areas of household wellbeing.

Variables	Coefficients (odds ratio)											
	Food security		Housing and shelter		Crop production		Livestock and poultry rearing		Health and sanitation		Means of livelihood	
	Moderate	High	Moderate	High	Moderate	High	Moderate	High	Moderate	High	Moderate	High
<i>Education of HH (ref = no schooling)</i>												
Primary	.25 (1.2)	.38 (1.4)	.21 (1.2)	.27 (1.3)	.75 (2.1)*	.56 (1.7)	.74 (2.1)*	.51 (1.6)	.79 (2.2)*	.61 (1.8)	.45 (1.5)	.41 (1.5)
Secondary	-.19 (.82)	.73 (2.0)	-.10 (.9)	.42 (1.5)	.32 (1.3)	.64 (1.9)	.30 (1.3)	.65 (1.9)	.67 (1.9)	.88 (2.4)	.49 (1.6)	.80 (2.2)
Higher secondary and above	-.26 (.76)	.85 (2.3)	-.37 (.69)	.66 (1.9)	.32 (1.3)	1.0 (2.8)	.03 (1.0)	.86 (2.3)	.22 (1.2)	.99 (2.6)	.04 (1.0)	.89 (2.4)
<i>Income of household (ref=&lt;6,000)</i>												
6,001–9,999	-.93 (.39)*	-.36 (.69)	-.61 (.54)	-.42 (.65)	-1.05 (.35)*	-.57 (.56)	-1.7 (.17)**	-1.1 (.34)*	-1.52 (.21)**	-.87 (.41)	-1.44 (.23)**	-.82 (.43)
>10,000	-.10 (.89)	-.23 (.78)	.08 (1.0)	.22 (1.2)	-.73 (.48)	-.17 (.84)	-1.4 (.22)**	-.65 (.52)	-.90 (.40)	-.29 (.74)	-.97 (.37)*	-.33 (.71)
<i>Household size (ref = 1–4)</i>												
5–6	.47 (1.6)	.31 (1.3)	.36 (1.4)	.42 (1.5)	.17 (1.1)	.29 (1.3)	.09 (1.0)	.15 (1.1)	.35 (1.4)	.41 (1.5)	.13 (1.1)	.29 (1.3)
7+	.32 (1.3)	.21 (1.2)	.32 (1.3)	.41 (1.5)	.08 (1.0)	.26 (1.3)	.36 (1.4)	.40 (1.5)	.23 (1.2)	.35 (1.4)	.59 (1.8)	.56 (1.7)
<i>Primary income sources (ref = farming and fishing)</i>												
Agri- and nonagricultural day labor	-.61 (.53)	-.69 (.5)	-.66 (.51)	-.64 (.52)	-.69 (.5)*	-.57 (.56)	-.38 (.67)	-.32 (.72)	-1.11 (.32)**	-.84 (.42)*	-.86 (.42)*	-.69 (.49)
Small entrepreneurship, govt. and non-govt. services	-.09 (.90)	-.84 (.43)	-.23 (.79)	-.87 (.41)	-.01 (.99)	-.71 (.49)	.11 (1.1)	.58 (.55)	-.88 (.41)	-1.27 (.28)*	-.48 (.61)	-1.0 (.35)
<i>Household migration status (ref = non-migrant)</i>												
Migrant	.17 (1.1)	2.2 (9.7)**	.36 (1.4)	2.3 (10.1)**	1.6 (4.9)**	2.8 (17.4)**	1.6 (4.8)**	2.9 (18.2)**	1.65 (5.2)**	2.95 (19.2)**	1.63 (5.1)**	2.93 (18.7)**
Chi-square statistics	78.2**		62.6**		83.6**		81.9**		89.18**		84.80**	
R <sup>2</sup> : Cox and Snell (%)	24.1		19.8		25.5		25.1		26.9		25.8	
R <sup>2</sup> : Nagelkerke (%)	27.3		22.4		28.9		28.3		30.4		29.1	

Note: 'Low' as reference category; \*\* $p < .01$ , \* $p < .05$ ; Bold indicates the relatively higher odds ratio.

Source: Household Survey, 2017–2018.

wild veggies. These findings are consistent with other research that has demonstrated how Cyclone Aila affects coping mechanisms and migration decisions (Roy et al., 2009; Kartiki, 2011; Mallick and Vogt, 2014; Mallick et al., 2023).

This research reveals a significant determinant of post-cyclonic migration to be the stress related to livelihoods. Beyond the immediate loss of shelter and property, individuals affected by Cyclone Aila were primarily driven to relocate due to the challenges in maintaining their means of sustenance. The incursion of saltwater, rendering homes and property repair insufficient for sustaining livelihoods, compelled many families to seek alternative employment opportunities and safety in relatively secure areas within the sub-districts. This finding resonates with the research conducted by Mustafa et al. (2023), which identifies destroyed homes, employment shortages, inadequate life-sustaining facilities, unlivable conditions, and food scarcity as crucial factors driving post-cyclonic migrations.

Comparing the two findings, there is a noteworthy convergence regarding the importance of livelihood-related stress as a driving force behind post-disaster migration. Both studies highlight the critical role that the ability to secure employment and ensure one's livelihood plays in migration decisions. This commonality emphasizes that migration choices are often intricately linked to preserving economic stability and basic survival needs in the aftermath of catastrophic events. Such insights underscore the complex interplay of individual options, social networks, and family circumstances in shaping migration decisions, as acknowledged in previous research by Carrico and Donato (2019), Harris and Todaro (1970), Jampaklay et al. (2007), and Winkels (2008).

This research findings highlight the crucial importance of financial resilience in distinguishing between migrant and non-migrant households. Migrant households tend to display better economic stability, consistent with Saha's (2017) study that showed improved economic conditions for migrant households affected by events like Cyclone Aila. This correlation underscores the adaptability and recovery potential of migrant households, who are often more adept at quickly identifying and pursuing alternative sources of income in the aftermath of climate-related disasters. However, it is essential to acknowledge that various contextual factors, such as the extent of losses and damages, access to aid, and housing options, significantly influence the coping mechanisms and capacities of migrant households (Penning-Rowsell et al., 2012).

This research provides a more detailed examination of the financial aspect of resilience in the context of climate-related challenges, which is complementary to the perspectives presented by Adger et al. (2020) and Afifi et al. (2016) on the role of migration as a survival strategy and adaptation mechanism for vulnerable populations. Jha et al. (2018) also emphasize that migration can be a positive change catalyst, and our findings contribute to this discourse by highlighting the specific facet of financial resilience. This highlights the importance of financial stability as a critical dimension of overall adaptability and survival for households affected by climate-induced disruptions. These insights suggest that targeted policies can be designed to leverage the potential of migration as a resilience-building strategy while addressing the needs of vulnerable communities.

Our findings indicate that post-cyclonic migrations tend to be concentrated near the affected areas of origin. This observation broadly aligns with the perspectives of Call et al. (2017) and Martin et al. (2013), who have similarly reported that migrations triggered by rapid-onset, extreme environmental events often encompass relatively short travel distances. Non-migrant households were highly committed to their areas of origin, which was motivated by social-emotional relationships, education, employment, and home. The possibility of continuing their prior employment and the difficulties of relocating with prominent families and senior people encouraged their decision to stay. This study demonstrates the complex interplay between place attachment, economic opportunities, social and environmental considerations, and the decision to migrate or remain in the place of origin, which is consistent with recent research (Biswas and Mallick, 2021; Best et al., 2022; Rabbani et al., 2022; Mallick et al., 2023).

While relocation is frequently regarded as an unfavorable coping technique, it is an essential alternative for households impacted by weather disasters (Paul and Routray, 2011; Mallick and Vogt, 2014; Islam and Hasan, 2016; Kamal et al., 2018; Priovashini and Mallick, 2022). Based on the findings in Table 5, it is possible to conclude that migration, motivated by factors such as seeking better opportunities or avoiding unfavorable conditions, can potentially improve households' perceived coping capabilities and adaptive capacity across multiple facets of wellbeing. These aspects include food security, housing and shelter, agricultural cultivation, livestock and poultry management, health and sanitation, and employment possibilities. As a result, migration can boost household resilience in the face of catastrophic weather events (Kartiki, 2011; Penning-Rowsell et al., 2012). However, other characteristics that may enhance coping methods and capacities among migrant households, such as the level of loss and damage, savings, access to aid, and housing possibilities, should be included in future studies.

## 6 Conclusion

The study concludes by highlighting the potential of migration to enhance adaptability and resilience in the face of climate-related challenges. It reveals the positive impact of migration on resource accessibility, household welfare, and income diversity, underscoring its innovative aspects. These outcomes emphasize the significance of migration in empowering individuals to invest in risk-reduction strategies and effectively cope with changing environmental conditions.

The research has two implications. Firstly, it highlights the need for migration policies that address the diverse needs of vulnerable populations and provide equitable access to the benefits of migration. Secondly, the study emphasizes the importance of climate change mitigation efforts to reduce the need for migration as an adaptive response. Investments in disaster risk reduction, climate adaptation, and sustainable development can create resilient communities where people can thrive in their current environments. Therefore, migration should be viewed as a complementary strategy supporting equitable and sustainable outcomes.

An intriguing avenue for future research lies in investigating the intricate dynamics of migration in various regions affected by climate change and exploring how policies, local contexts, and social factors interact. Furthermore, researching innovative

strategies and policy frameworks that can maximize the resilience-enhancing potential of migration will be a valuable pursuit. In summary, this study demonstrates that migration can be a powerful tool for fostering resilient communities. Still, it must be integrated into climate change policy while considering its limitations, and continuous efforts should be made to discover new ways to harness its full potential.

## 7 Policy implications, limitations, and recommendations for future research

These findings have significant policy implications for tackling the issues related to climate-induced migration. First and foremost, there is a need for focused initiatives to better the socioeconomic circumstances and sources of income in coastal regions, mainly for non-migrant households. The vulnerability of non-migrant households can be decreased through improving access to education, income-generating opportunities, and social support networks, giving them viable alternatives to migration.

Second, efforts should be undertaken to increase the resilience and adaptive ability of migrants and non-migrants in the face of the effects of climate change. This may be accomplished by investing in infrastructure development, taking precautions against disasters, and encouraging sustainable living habits. Additionally, social protection programs should be developed to accommodate the unique needs of both migrants and non-migrants, considering their various vulnerabilities and coping mechanisms.

Promoting cooperation between government entities, non-governmental groups, and local communities is critical to creating comprehensive and inclusive migration policies. These laws should protect immigrants' human rights, assist their assimilation into their new communities, and consider their rights and welfare. The necessity for forced migration should be diminished by working to establish chances for sustainable development in the places of origin.

The study has certain limitations that should be taken into consideration. First, it limited the analysis of coping mechanisms and capacities to families impacted by Cyclone Aila in 2009, limiting its emphasis. As a result, it is possible that the conclusions cannot be applied to other extreme weather situations or broader settings. Second, the study had a limited sample size and insufficiently thorough data from many migrant homes. This deficiency makes it difficult to reach detailed findings. The ability to establish a strong relationship between climate change, coping mechanisms, and migration status is also questioned by research that uses a small sample size, concentrates on a single extreme event, and ignores differences in coping mechanisms and capacities before and after the event. Therefore, care must be used when extrapolating the findings to the larger implications for migratory patterns and climate change.

Future studies are required to examine the long-term effects of migration caused by climate change on both migrants and non-migrants. Longitudinal research can shed important light on the social dynamics, wellbeing outcomes, and adaptation mechanisms related to migration. The complex causes and effects of climate change migration may also be better understood via comparison studies across various settings and geographies, which can then help

guide evidence-based policymaking and planning at local, national, and international levels.

## Data availability statement

The datasets presented in this article are not readily available because Participants of the research were ensured through written consent that the obtained information would be used for only this research, and their raw information neither will be used for further research nor will be deposited online. Requests to access the datasets should be directed to ka906@georgetown.edu; k.m.jafor1991sust@gmail.com.

## Ethics statement

Ethical review and approval was not required for the study of human participants in accordance with the local legislation and institutional requirements. Written informed consent from the patients/participants.

## Author contributions

KA: Conceptualization, Conducted fieldwork, Writing—original draft preparation, Methodology, Software, Visualization. SA: Writing—draft revision, Methodology, Editing, Validation. MH: Conducted fieldwork, Writing—Reviewing, Methodology. All authors contributed to the article and approved the submitted version.

## Funding

The author(s) declare that no financial support was received for the research, authorship, and/or publication of this article.

## Acknowledgments

We would like to express our heartiest thanks to the respondents who provided valuable information and helped us during fieldwork.

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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