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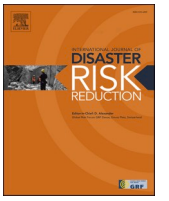

Rethinking migration in a changing climate: Multifaceted and interconnected drivers and adaptive strategies in Bangladesh

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ABSTRACT

Climatic hazards could shape migration in regions vulnerable to climate change such as the Southwestern coast of Bangladesh. While the nexus of environmental change and human mobility has been researched, how contexts shape migration drivers and patterns remain unclear. This article addresses this gap by examining migration dynamics in the Khulna City Corporation and Koyra Upazila, to discern the influence of urban and rural vulnerabilities. We surveyed 300 households and conducted four focus group discussions and six key informant interviews to unpack the interplay of environmental, economic, and social drivers of migration. The findings indicate that in Koyra migration is predominantly driven by hazards such as cyclones and salinity intrusion, which severely disrupt rural livelihoods. In Khulna, migration is in turn shaped by economic opportunities and better living conditions. In both locations, economic vulnerability amplifies the impact of climatic hazards particularly among low-income groups. While survival-driven migration persists in Koyra, migration in Khulna is increasingly a result of strategic decisions and planned adaptation aimed at long term socio-economic resilience, for example by investing in skills development. The results highlight how immediate environmental pressures intersect with aspirations for economic stability and make migration a complex phenomenon. These insights can guide policy measures to enhance community resilience, reduce vulnerabilities, and address the multidimensional migration challenges across diverse settings.

1. Introduction

Migration induced by climatic hazards has become a global concern, particularly in vulnerable coastal zones where recurrent environmental shocks disrupt livelihoods and living conditions. With its extensive low-lying areas, coastline, and high population density, Bangladesh is one of the most exposed countries to this crisis [1,2]. Tropical cyclones, tidal surges, floods, riverbank erosion, and salinity intrusion have intensified socio-economic vulnerabilities, resulting in increasing human displacement and migration [3,4]. In contexts like these, migration is often portrayed as a survival mechanism [5,6], but it is also shaped by socio-economic conditions such as economic stresses and opportunities, social networks and institutional support or lack thereof [7–10]. For example, migration is not only influenced by prolonged drought in Somalia, but also by weak governance, political fragility, and limited income opportunities [10]. Similarly, in the Central American Dry Corridor, migration results from a combination of climate impacts, violence,

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limited institutional support, and livelihood challenges [9]. A meta-analysis by Hoffmann et al. [11] highlights that the impact of environmental stresses and shocks on migration varies significantly by region, national income-level, dependence on agriculture, and governance capacity. Recent syntheses on the climate-induced migration in the Global South indicate that migration is a complex interplay of environmental, socio-economic, political, and institutional factors, and often becomes a last resort adaptive response, particularly in regions with limited adaptive capacity [7]. However, a nuanced understanding of these complexities is vital for crafting interventions that increase resilience and adaptive capacity among affected communities [8].

Existing literature has examined the link between climatic hazards and migration, emphasising the influence of push and pull factors on movement patterns. Theoretical frameworks, such as Lee's [12] push-pull model and Black et al.'s [13] five-driver approach, have improved the understanding of migration drivers and decisions to migrate. While these frameworks acknowledge the complex drivers of migration, they have been tested only to a limited extent in empirical studies, particularly in contexts where climate hazards and economic hardship intersect in unique ways. Though all of Black et al.'s drivers were considered in our research, economic drivers emerged as the most prominent ones. Therefore, we placed particular emphasis on economic drivers in the discussion, not as a pre-determined focus, but as a reflection of the empirical findings. Hence, these frameworks may oversimplify the interplay of climatic hazards and economic vulnerabilities and overlook context-specific factors that shape migration decisions [8,14–18]. This limitation is also evident in widely referenced international protocols, such as the Intergovernmental Panel on Climate Change's Sixth Assessment Report [19], which largely focuses on the environmental dimensions of climate-induced migration, offering limited analysis on how these factors intersect with other stressors and local vulnerability contexts [19]. While economic factors are acknowledged as key drivers of migration [20,21], the role of financial precarity such as debt burden remains underexplored [e.g. 22,23]. Much of the earlier research has focused on how regional rather than local factors shape migration decisions. We seek to address these gaps by examining the interplay of climatic hazards, economic stresses, and migration decisions in Khulna City Corporation and nearby Koyra Upazila in the southwestern coastal Bangladesh.

We used a mixed-method approach combining quantitative household surveys and qualitative Focus Group Discussions (FGDs) and Key Informant Interviews (KIIs) to generate rich fieldwork data for examining demographic patterns, primary migration drivers, and perceptions of climatic hazards. Methodological triangulation, combining statistical and qualitative methods improves the capacity to capture the interplay of diverse factors and complexities of migration decisions in climate-vulnerable regions [24].

The findings indicate that decisions to migrate are shaped by a complex intersection of environmental hazards, economic constraints, and socio-economic backgrounds. In our research, we use the term "drivers of migration" as outlined by Black et al. while aligning them with Lee's push-pull framework – where push factors compel migration from the place of origin and pull factors attracts migrants to the destination. In Koyra, climatic hazards play a critical role as push factors in decisions to migrate, especially for lower income households with limited adaptive capacity. In Khulna city, diverse economic opportunities and institutional support are pull factors of migration. We also found that financial precarity in the form of debt accumulation is an important driver of migration in both sites. Moreover, decisions to migrate are increasingly shaped by proactive adaptation strategies: households often send younger members of household to urban areas to leverage opportunities, develop skills, and engage in economic diversification. For them, migration is a long-term resilience-building effort rather than a short-term coping strategy. The findings offer a more nuanced understanding of decisions to migrate by highlighting how economic stresses interact with environmental hazards to influence migration. Rather than being a direct and singular consequence of environmental hazards, decisions to migrate emerge from the intersection of financial insecurity, livelihood disruptions, and limited adaptive capacities. This underscores the need to consider wider socio-economic structures and institutional support systems that influence migration trajectories and outcomes.

The remainder of the manuscript is structured as follows. Section 2 reviews earlier literature on migration, highlighting theoretical backgrounds, related themes, and empirical gaps. Section 3 explains the methodology, introducing the study sites, data collection procedures and analytical approaches. Section 4 presents the findings and Section 5 discusses their broader implications for migration and adaptation debates. Finally, section 6 concludes.

2. Literature review

Research on the relationship between climate change and migration dates back to the 1980s but the debate regarding their interconnections continues [25,26]. Decisions to migrate are complex and shaped by multiple factors, with environmental hazards being just one of them. While many studies have highlighted the role of environmental change in migration, variations in its drivers across different national and regional contexts remain underexplored. In what follows, we explore the complex relationship between environmental hazards and human mobility through the lenses of existing theoretical frameworks such as the push-pull theory and Black et al.'s five-driver model. We seek to portray the role of environmental hazards in shaping migration, the impact of economic factors on migration, and the evolving nature of migration as an adaptation strategy.

2.1. Theoretical background

Researchers have introduced a range of theoretical lenses to explain the complex nature of migration. For example, the New Economics of Labour Migration (NELM) portrays migration as a household strategy to manage risk and economic uncertainty [27,28]. The livelihood framework views migration as a part of adaptive livelihood strategy to use five core capitals-human, social, natural, physical, and financial capital [29]. Network theory and cumulative causation explain how social connections shape the persistence and continuation of migration flow over time [29,30]. The aspirations-capabilities framework highlights how migration decisions are influenced by the intersect between individuals' aspirations to improve their lives and their capabilities to act on those aspirations

[31]. Despite these varied theoretical perspectives, migration has traditionally been explained using the push-pull theory [12, see also [32]]. It explains migration as a response to negative "push" factors such as poverty, low wages, limited opportunities and adverse weather, and positive "pull" factors, such as better wages, access to social services, familial ties, and cultural affinities [29]. Push factors compel households to leave their place of origin and pull factors at the destination attract them [29]. However, push-pull theory has been critiqued for being simplistic and for its limited ability to capture the complex interplay of migration drivers [33,34].

Black et al. [13] introduced the five-driver framework which seeks to explain migration dynamics through economic, political, demographic, social, and environmental lenses. Unlike broad categories of drivers in the push-pull theory, Black et al.'s framework highlights the interconnectedness of drivers and their variation in different contexts. The strength of this framework is that it can set migration to the context of broader socio-economic structures and provide a comprehensive understanding of migration as both a cause and consequence of systemic vulnerabilities [27].

Notwithstanding these strengths, the five-driver framework has been critiqued for simplifying the complex interactions among drivers. A systematic review focusing on migration in Africa, for example, criticised the existing frameworks for failing to fully capture the complex interdependencies between migration drivers, arguing that a more integrated approach is needed to account for these nuanced connections [35]. It also often portrays households as passive actors responding to external pressures rather than as active decision-makers navigating complex trade-offs [36]. Acknowledging migrant agency — how households respond to challenges, adapt, and craft strategic migration decisions— would strengthen the analytical ability and help provide a more nuanced and comprehensive understanding of migration decisions.

By adopting these conceptual refinements, we can disentangle political dynamics from other drivers when analysing specific contexts. While regions like Sahel often experience a combination of political, environmental and economic pressures as drivers of migration, in other contexts where political interference plays a more limited role, migration decisions are primarily influenced by economic and environmental stress. By examining context-specific evidence, we seek to address gaps in the literature regarding understanding the nuanced roles economic and environmental factors play in shaping migration decisions.

2.2. Climatic hazards and migration

Climatic hazards shape migration decisions. Sudden-onset disasters such as cyclones, floods, tidal surges, storms, and wildfires can prompt immediate relocation [11,37], while slow-onset stresses such as sea level rise, droughts, salinity intrusion, and desertification can trigger more permanent migration [38,39]. For example, in Bangladesh, repeated flooding drives short-term displacement in coastal areas, [40], while environmental hazards such as erosion and inundation affect households' aspirations to migrate before actual displacement occurs [41]. Berlemann & Tran [42] using household panel data in Vietnam, find that tropical storms significantly increase temporary migration as a strategy for income risk diversification. Cattaneo et al. [43] use cross-country data to find that slow-onset hazards influence long-term international migration dynamics.

Many studies have used a linear framework proposing a direct link between environmental hazards and migration [44,45]. However, others argue that migration decisions arise from a complex combination of environmental, economic and social factors [46–48]. For example, Barrios et al. [49] found that precipitation shortages often lead to internal migration in Sub-Saharan Africa. In contrast, in Southeast Asia many rural households return to their place of origin after a sudden onset hazard such as a flood or an earthquake [50]. In Australia, slow onset events such as heat waves, sea level rise and environmental degradation are associated with longer term or permanent relocation [51]. Some studies, however, find limited evidence that environmental factors drive migration [52,53] even in areas experiencing rapid environmental change [54]. Meta-analyses support this empirical evidence. Reviews by Beine & Jeusette [55]; Daoust & Selby [8] Hoffmann et al. [11]; Kaczan & Orgill-Meyer [56] report mixed and context-specific results. They highlight that no consistent relationship prevails between environmental hazards and migration – instead, outcomes often depend on socio-economic and political mediators. A recent meta-regression by Zhou & Chi [57] suggests that, across global studies, climate stressors are generally weak predictors of out-, in-, or net-migration, with only a modest tendency toward increased outmigration.

This variation in results highlights the need for a context-sensitive analytical approach. If migration decisions are influenced by a diverse interplay of localised socio-economic, environmental, and political factors, a one-size-fits-all framework would risk oversimplification of these dynamics. Recent research, therefore, calls for a more transcalar approach, highlighting the need to understand how global climate dynamics interact with local vulnerabilities to shape migration decision [58].

2.3. Economic vulnerabilities and migration decisions

Economic pressures often mediate the relationship between climate stresses and migration. Limited livelihood opportunities, wage differentials, and constrained access to resources can drive households to migrate from rural, agriculture-dependent areas [21,59]. Environmental hazards seldom act as an isolated triggers; instead, they often intersect with economic factors, making migration a complex phenomenon [52,60–62]. Therefore, both relocation and the inability to relocate must be understood within broader socio-economic structures [63–65].

In this context, economic drivers of migration are shaped by livelihood alternatives and job opportunities. When environmental hazards disrupt agricultural livelihoods and increase poverty, migration becomes a means for household to adapt to economic challenges [66–68]. However, decisions to migrate are not only influenced by available income sources, skills training, and access to social safety nets [45,69,70] but also on relative economic comparisons, for example, cost of living at destinations [71,72].

Case studies from Central America, Sub-Saharan Africa, Russia, and even more climate vulnerable regions like Ghana, India, and coastal Bangladesh highlight that the interaction of economic pressures and environmental hazards exacerbates migration dynamics

[20,73–76]. While economic factors importantly shape migration decisions, they are interwoven with social considerations such as aspirations for better living standards and social mobility [77]. Furthermore, the choice of migration destination is also influenced by ability to sustain traditional livelihoods, rather than just economic considerations [78].

However, beyond household-level economic factors, institutional mechanisms also shape mobility patterns. For example, Boas et al. [64] described how "climate mobility regimes" – power and policy configurations that regulate climate-related movement—operate through donor agendas, postcolonial legacies, national policy, and development discourse. In Ghana, climate migration is often managed by institutional actors through in-situ livelihood approaches – such as rural irrigation projects and employment schemes—designed to prevent rural-urban mobility, despite evidence that mobility serves as a rational adaptation strategy [79]. In contrast, in Bangladesh, Paprocki [80] highlights how anticipatory climate adaptation, supported by the World Bank, promoted shrimp aquaculture over paddy farming, effectively displacing local farmers and creating migration under the pretext of adaptation. Other examples point more subtle mechanisms. In Senegal, coastal fishers rely on cross-border circular migration as an ecological adaptation to adjust to declining fish stocks. But restrictive regulations and limited fishing licences in Mauritania have made this mobility risky and often criminalised [81]. In Tuvalu, mobility is not suppressed but strategically redirected. Institutional actors support local movement projects—like moving within the island or reclaiming land—to administer residence and control over migration decision, thereby resisting external narratives about displacement [82].

Together, these examples highlight the complex interplay of factors that shape migration decisions in response to environmental and economic changes. Yet, the specific roles of financial precarity and institutional support in decisions to migrate has been largely omitted in the earlier literature.

2.4. Migration as an adaptation

Climate migration is often considered a form of forced displacement and a hardship due to environmental hazards, but there is growing evidence that it can also be a beneficial adaptation strategy [75,83–88]. Migration can serve as a long-term strategy for socio-economic transformation by enabling households to access better income sources, opportunities, and resilience [21,33,45]. But its outcomes are influenced by overarching structural dynamics, including labour markets, policies and social networks [33].

Migration can be approached from two directions. First, migration may occur as a direct response to environmental hazards: impacted households explore new sources of income or livelihoods from elsewhere to cope with environmental challenges [89]. Cyclones, coastal erosion, salinity, and flooding often compel rural households to relocate in search of new income sources for their families [90]. However, de Haas argues that migration is not just a response to crises, but a self-sustaining process shaped by established networks, economic linkages and historic migration trends. Second, mobility can be selective, for example one or more household members may move to an urban area or another region to access economic opportunities and send remittances home [89]. Resulting financial flows can play a significant role in increasing household resilience by enabling investment in education, infrastructure development and livelihood diversification, and thereby enhance resilience and adaptive capacity of communities of origin [20,27,89].

However, recent research cautions against promoting migration as inherently adaptive. Szaboova et al. [91] underscore that migration may entail significant trade-offs across well-being, equity, and sustainability, with adaptation outcomes that are highly uneven and dependent on broader institutional and economic structures [91]. Sakdapolrak et al. [92] further challenge the adaptation framing by highlighting the roles of immobility, disconnectedness and simultaneous exposure. Their research on translocal livelihood systems reveals that households are often vulnerable not only in their place of origin but also at destinations – undermining simplistic assumptions about the protective benefits of mobility [92]. At the policy level, Schriever [93] critiques how institutions like International Organisation for Migration (IOM) have positioned migration as a technocratic solution to climate risk. This narrative, Schriever argues, can depoliticize climate-induced migration by diverting focus from historical responsibility, weak governance, and structural inequality, – instead placing the burden of adaptation on individuals [93].

Although migration can be an adaptive strategy, it may not be a viable option for everyone [20,63,94,95]. Resource constrains may prevent poorer people from relocating, leaving them "trapped" in hazard prone areas [96–100]. In addition, kinship, social networks, cultural affinity and psychological attachment to the birthplace can also prevent migration, even when risk levels are high [97,101–104].

Ultimately, the degree to which migration enhances long term resilience depends on factors such as socio-economic conditions, governance structures and access to and availability of adaptive resources [105]. A deeper understanding of their role in migration dynamics is important for designing policies that protect vulnerable communities and promote migration as an adaptation strategy rather than a crisis driven reaction.

The literature highlights the multifaceted relationship between climatic hazards, economic stresses, social factors and migration decisions. Push-pull theory [12] and Black et al.'s [13]five drivers model provide a foundational understanding of migration dynamics, but gaps remain in understanding the contextual variations and evolving migration strategies in climate-vulnerable regions. The roles of financial precarity and institutional support in migration decisions remain largely unexplored. Migration is also increasingly shifting from reactive household displacement to strategic and planned mobility, yet established migration models have little to say about this. In what follows we seek to start addressing these gaps.

3. Methodology

Our research focuses on Khulna, one of the most vulnerable coastal districts in southwestern Bangladesh. Khulna City Corporation

and Koyra Upazila (sub-district) were our research sites in the district. The district has been repeatedly struck by tropical cyclones ranging from category 1 to 5 in intensity [106,107]. The district is a critical migration hotspot due to its exposure to climatic hazards [108].

We chose Khulna City Corporation and Koyra Upazila as study sites (see Fig. 1) because they represent two key dimensions of climate-migration nexus. Khulna city is a receiving area, an urban centre experiencing climate-induced in-migration, while Koyra is an out-migration area due to climate stressors. Koyra Upazila is a rural area extremely susceptible to tropical cyclones, flash-flooding and salinity intrusion. Its proximity to the Bay of Bengal makes it more vulnerable to climatic hazards and substantial livelihood impacts. Category 1 Cyclone Aila battered the coastal region in 2009 and Koyra was one of the worst-affected areas [109]. This cyclone was experienced just 18 months after the Category 4 Super Cyclone Sidr in 2007. The intensity of Aila was relatively low in terms of loss of life and property but its impact has been severe and enduring [2]. It breached coastal embankments and caused massive immediate flooding in the villages, while also leaving them exposed to waterlogging, salinity intrusion and storm surges over longer period of time [110]. Many parts of Koyra remained underwater for two years after Aila which reduced agricultural land productivity, increased tree mortality and contaminated drinking water sources due to salinity intrusion; and lead to scarcity of food, water and livelihood opportunities [2]. Significant forced migration ensued: around two million people were displaced by Aila in all [111] and many of them were from Koyra [112].

Koyra has experienced many cyclones after Aila, but Category 5 Super Cyclone Amphan deserves a mention because of its

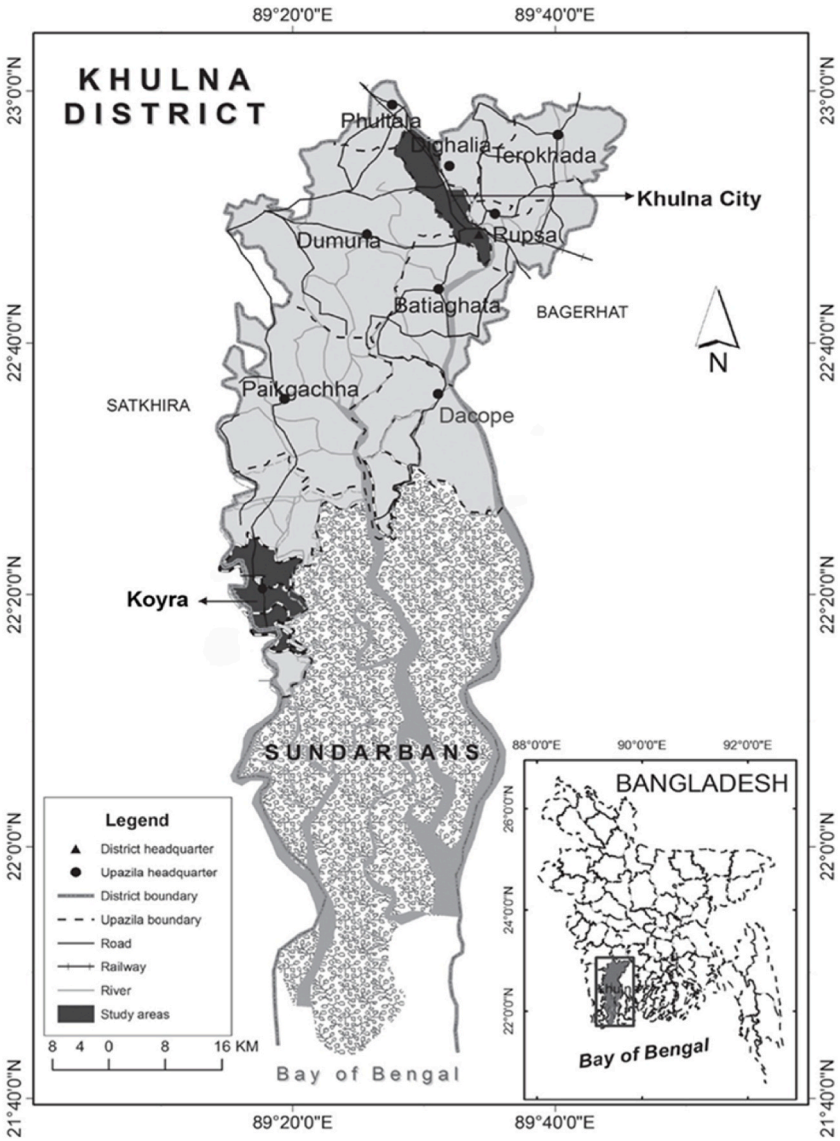

Fig. 1. Study area: Koyra Upazila and Khulna City Corporation.
[Source:(Saha, 2017)]

devastating impacts. It struck in May 2020, just six months after the Category 2 Cyclone Bulbul which battered the area in November 2019. Amphan caused high tides that breached coastal embankments and caused widespread flooding that submerged agricultural land, damaged dwellings and infrastructure, and polluted water sources [113]. Thousands were forced to relocate immediately, and prolonged waterlogging caused salinity intrusion which made agricultural land unproductive. This further stressed the livelihoods of farming and fishing-dependent coastal households [114]. The frequent cyclones compounded challenges, disrupted livelihoods, and forced many residents to leave their homes in search of stability.

Khulna City Corporation has not been immune to climatic hazards. It frequently experiences flooding driven by unpredictable and extensive rainfall, stagnation of storm water, inadequate drainage system and overflowing river water [115]. Salinity intrusion into freshwater systems due to sea level rise, river erosion and reduced river flow adversely affects drinking water sources and farming in peri-urban areas [116]. Although the city may not experience the severity of tropical cyclones quite like Koyra, storm surges, wind and flooding impact on urban life and infrastructure.

Khulna city is the third largest city of Bangladesh, a major regional centre and the default destination for migration from the nearby disaster-affected zones [106,111]. Its relative accessibility and opportunities for livelihoods make it a primary destination for migrants seeking stability and an opportunity to rebuild their lives. Table 1 below provides a concise overview of the key characteristics of both study sites.

3.1. Materials and methods

We adopted a mixed methods approach combining quantitative and qualitative data collection and analysis. Many studies examining the interplay of climatic hazards and migration have also used a mixed methods strategy to discern quantitative patterns alongside a more nuanced understanding provided by the qualitative data [e.g. 2,97,111]. As highlighted by Azorín and Cameron [118], mixed methods offer a more holistic understanding of intricate events, providing insights that neither quantitative nor qualitative methods would achieve on their own.

Fieldwork took place in two phases. The first phase was conducted in February 2024 to conduct a household survey using a semi-structured questionnaire. A total of 300 participants were surveyed: 150 from the Khulna City Corporation and 150 from the Koyra Upazila. In each location, 75 migrants and 75 locals were recruited for the research. We used a combination of purposive and referral (snowball) sampling to ensure a relevant and diverse sample. This strategy is commonly used in studies involving hard-to-reach or mobile populations such as migrants [119,120] The recruitment process was supported by "gatekeepers" such as local government officials, NGO representatives, journalists, and community leaders, who helped identify relevant participants, particularly the in-migrants. It was somewhat challenging to identify migrants for the research, as official data does not always record their number, and they can also change their location frequently before settling in for longer term [121]. We purposively sampled participants based on their availability and willingness to participate. We then used referral sampling to extend the pool of participants from the initial ones until we reached the target of 150 participants in each category across the two sites.

The survey instrument was based on Black et al.'s [13] framework of five migration drivers. The questionnaire solicited information on demography (i.e. age, gender, household size, asset ownership, income level, and education), the most significant climatic hazards in the study area, personal experience of climate-related events, and perceptions of their influence on migration decisions. Migration experiences such as patterns, driving factors, climate-related catalysts, and pull factors influencing decisions were also probed and any additional insights on migration and climatic hazards were solicited.

The household survey was conducted face-to-face by the lead author with households in Khulna City Corporation and Koyra Upazila. The gatekeepers and local contacts familiar with the communities assisted by introducing participants. All household surveys were conducted in native language Bangla to ensure better understanding and comfort for participants to engage fully. The survey was administered door-to-door in residential areas and in local gathering points such as markets. As the lead author administered each survey directly and guided participants through the process, all questions were complete, and no missing data were recorded.

The qualitative data were collected in August 2024. Initial findings from the survey were used to refine the Focus Group Discussions (FGDs) protocol and Key Informant Interviews (KIIs). Four FGDs were conducted—two in Khulna City Corporation and two in Koyra

Table 1
Key characteristics of the Koyra Upazila and Khulna City Corporation.

Characteristics	Khulna City Corporation	Koyra Upazila
Population size	719,557 [117]	220,102 [117]
Geographical area	47.12 square km	1775.41 square km, where 263.12 square km is only plain land, and 951.66 square km is forest area (Sundarbans-world's largest mangrove forest).
Population density	15,762/square km	172.0/square km
Demographic profile	High literacy rate (~88.07 %)	Lower literacy rate (~50.40 %)
Key economic activities	Industries, shipbuilding, seafood processing, small business, retail trade, and diverse service sectors, and various economic opportunities.	Mainly farming, fishing, forestry, and labour selling.
Infrastructure and services	Well-developed healthcare facilities, educational institutions, and transportation networks.	Limited infrastructures with inadequate healthcare facilities, educational institutions, and poor transportation system.

Upazila involving both local residents and migrants. Each FGD included 6–8 people of mixed gender. Six KIIs were also conducted with local government representatives, NGO workers, community leaders, and journalists. Participants for the FGDs and KIIs were purposively selected for relevance to the study objectives, with the assistance of gatekeepers. Personal observations and informal conversations supplemented the above data collection methods, offering further context and enriching the insights gathered.

This research received ethical approval from the University of Leeds ethics committee (Ethics application reference 0852). The information sheet and participant consent forms were translated into Bangla, and we obtained both verbal and written consent from the participants. To ethically handle sensitive issues, neither the key informant interviews nor the focus group protocols elicited sensitive personal information, such as individuals' financial precarity or indebtedness. Participants were informed about the objectives of the study and their right to withdraw at any time without any consequences, and their participation was voluntary. We took special care for the privacy and all data were anonymised and stored securely. No names or personal identifiers were recorded during data collection. All recordings were transcribed with careful attention to confidentially, and transcripts were reviewed to ensure that any potentially identifying contextual details were removed. All data were securely stored on an encrypted, password-protected server maintained by the host institutions. Data access is restricted to the primary researcher and supervisory team. In accordance with institutional data management plan and ethical policy, data will be retained for two years following completion of the research and then securely deleted.

This study does not aim for statistical representativeness. Instead, it focuses analytical depth and contextual relevance, selecting participants based on their lived experiences with migration and settlement in both urban and rural settings. This qualitative orientation emphasises data richness and variation in perspectives, consistent with methodological guidance for exploratory social research in real-world contexts [120]. While the findings cannot be generalised to the entire populations of Khulna City Corporation or Koyra Upazila, they offer grounded insights into migration related challenges and coping strategies shaped by location, vulnerability, and adaptation. These insights are valuable for informing both academic debates and policy discussions on climate-linked mobility and social transformation.

3.2. Data analysis

The survey data were analysed using SPSS. Descriptive statistics summarized demographic information, migration patterns and participants' views on climatic hazards. Crosstabulation was used to explore the relationships between demographic variables (education, income) and drivers of migration, revealing variation across different groups. pattern and participants' view on climate hazards. Inferential analysis – chi-square test of independence – was used to explore the relationships between demographic variables (like education, income) and drivers of migration. Chi-square tests assume independent observations, categorical variables, and expected cell frequencies are at least 5 [122]. These assumptions were checked and met in our analysis. Chi-square test provides a test statistic and a p-value but does not estimate population parameters, therefore, confidence intervals are not typically reported for the chi-square statistic. Accordingly, we report chi-square values and p-values for each test in line with standard reporting practices. Given the limited number of theoretically driven comparisons, formal corrections for multiple testing (e.g. Bonferroni) were not applied. Nonetheless, results are interpreted conservatively, acknowledging the increased risk of Type I error associated with multiple comparisons. Rank analysis examined the relative importance of pull factors such as employment opportunities, better living standard and access to education and health care in influencing migration decision. Participants were asked to rank each factor on a 1 to 5 scale (1 = most important, 5 = least important). Frequencies and percentages were calculated for each rank assigned to each factor. This non-parametric approach allowed for descriptive comparison across sites without assuming equal intervals between ranks, consistent with best practice for ordinal data [123].

The qualitative material was first analysed to identify any themes that where not present in quantitative data. Then the qualitative material was scrutinized in light of the quantitative results to discern where the qualitative material exemplified and provided nuance and granularity to quantitative results. This ensured that qualitative insights did not simply replicate statistical trends but rather added depth and context to them. NVivo was used to analyse the qualitative data. The FGDs and KIIs were conducted in the native language of Bangla, transcribed verbatim, and selected quotes were translated into English. We used thematic analysis and mixed coding approach. The deductive codes were based on predefined themes like push and pull factors of migration, adaptation strategies and influence of climatic hazard on migration. As the analysis evolved, we identified new themes and added inductive codes such as 'debt crisis as a migration driver', 'institutional support', and 'decision-based strategic migration'. This integrated coding approach allowed us to get a comprehensive overview of migration dynamics, while remaining focused on the research objectives.

3.3. Positionality

The fieldwork and primary analysis were conducted by the lead author, a Bangladeshi researcher based at a UK university. We received support from local gatekeepers to ensure cultural and contextual sensitivity. Our background in academic migration research informs our analytical lens. To minimise potential bias, we prioritised participants' lived experiences, ensuring their voice remain central. This study includes various stakeholders like locals, migrants, NGO representatives, Local government representatives to provide balanced perspectives. Ethical considerations guided our methodology, ensuring voluntary participation, anonymity, and respectful representation of diverse perspectives.

4. Results

4.1. Socio-economic profile of the sampled population

Men dominate among the participants. In Koyra, they made 66.7 % of locals and migrants and in Khulna City 58.7 % of the locals and 57.3 % of migrants. Most participants were 25–44 years of age. In Khulna City, one-third of locals and migrants had completed high school. Educational attainment was notably lower in Koyra where 40 % of locals and 52 % of migrants had less than high school education. In Khulna, locals were engaged in private services (21.3 %) and small businesses (18.7 %) but migrants also operated small businesses (22.7 %) and were engaged in day labour (14.7 %). In Koyra, farming was the primary occupation for a third of the locals while migrants engaged in day labour (18.7 %), auto-driving (18.7 %), and farming (16 %). The majority of participants in Khulna earned between 10,000 and 24,000 BDT per month while in Koyra 45.3 % of locals and 61.3 % of migrants earned less than 10,000 BDT monthly.

4.2. Multifaceted push factors driving migration

Our findings indicate that the drivers of migration are multifaceted: economic and environmental factors are primary drivers in our study areas. However, these drivers vary depending on the context and socio-economic background of the people who migrate, and nuanced perceptions provide deeper insight into its complexity.

Almost all migrants considered economic factors the most important push factor for decisions to migrate (98 %, Table 2). Economic opportunities were the primary reason of migration for all income groups (Fig. 2). In Khulna, most migrants who identified economic factors were in the 10,000–24,999 BDT income group, whereas in Koyra, most migrants have incomes below 10,000 BDT (Fig. 2). This highlights how economic vulnerability drives migration of the lower income households, especially in Koyra.

Disruption of livelihoods is a critical factor for migration in both areas. A chi-square test of independence showed a significant association between income level and livelihood impacts, X^2 (2, $N = 150$) = 38.65, $p < .001$. In Koyra, 95 % participants from the lowest income group (<10,000 BDT) and 90 % participants from the 10,000–24,999 BDT income group highlighted livelihood impacts as an important driver of migration (Fig. 3). In Khulna, 90 % and 80 % of the same household income groups considered livelihood impacts an important driver of migration (Fig. 3). These results highlight the central role of economic stresses and opportunities in migration decisions, especially among the lower income households.

Limited livelihood opportunities in Koyra further exacerbates this issue. Households heavily reliant on environmentally sensitive activities such as farming and fishing struggle during economic downturns. The absence of diverse income opportunities forces many families to migrate to urban centres like Khulna City in search for economic opportunities. As one local government representative from Koyra explained,

> "In our Koyra, all men and women want to work, but unfortunately, we don't have enough options. We are highly dependent on nature; that's why our livelihood options are limited. We don't have work throughout the year. We remain unemployed half of the year. There are no industries or mills here. So, we have to move to urban places …"

Our qualitative material brought up another often underrecognized driver of migration: the debt cycle. In both areas, households reported financial troubles linked to microfinance and informal loans. In Koyra, recurring failure of climate sensitive crops due to frequent environmental shocks made households struggle. To manage, households borrowed money from the NGOs (microfinance) or from local informal moneylenders (Mohajon), friends or relatives. When they are unable to repay the loans, many decide to leave, "escaping" the financial pressure and societal impacts of defaulting. Also, in Khulna low-income households faced financial burdens due to rising living costs and emergencies such as illness and hospital bills. These families also depend on loans from formal and informal borrowing systems and when they are unable to pay, they often relocate. One KII participant described a personal experience:

> "One of my friends borrowed money from me six months ago. I've known him for more than ten years. Though they were migrants in our area, but we had a very close connection. However, he was supposed to pay back the money within three months, but they failed. One day, I came to know that they escaped the area without any notice. As they were migrants, and I do not know their original place, so I cannot chase them. This type of incident is becoming frequent."

Table:2
Migration push factors in Khulna City Corporation and Koyra Upazila.

Factors of Migration	Examples	Yes (frequency)	Yes (Percent)
Economic	Job availability, income potential	**147**	**98.0**
Social	Family reunification, access to better education, healthcare	17	11.3
Political	Governance issue, conflicts, political instability	0	0
Environmental	Climate change impacts, natural disasters	**129**	**86.0**

Notes.
N = 150 (migrant sub-sample).
Statistical summary: Descriptive statistics presented.
Source: Primary household survey, 2024.

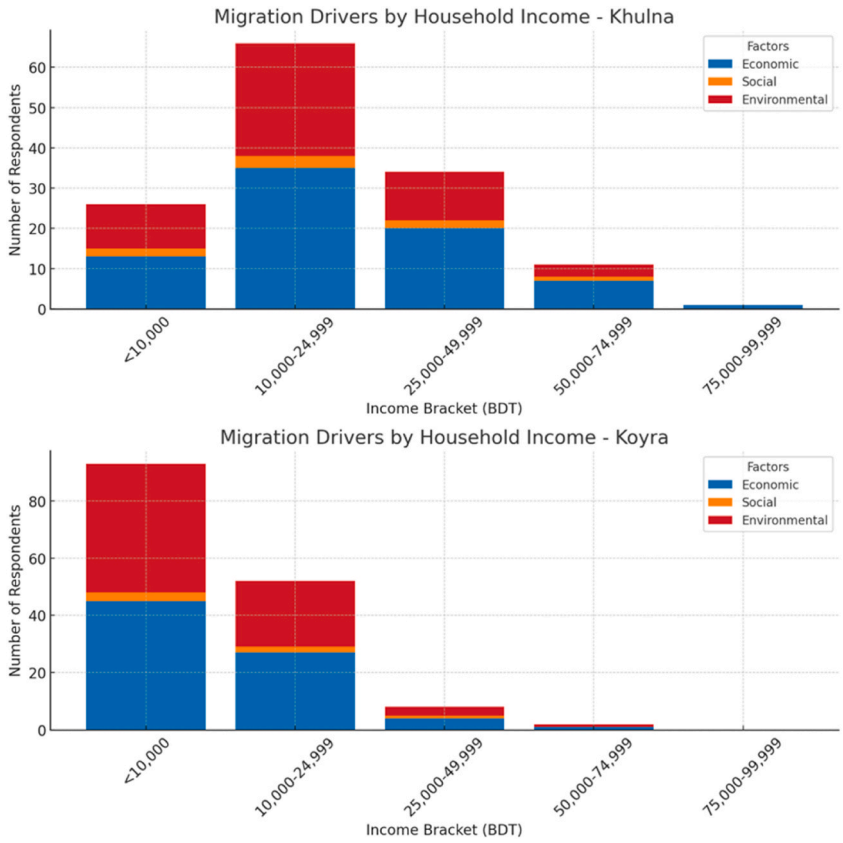

Fig. 2. Migration driving factors by income groups in Khulna City Corporation (top) and Koyra Upazila (bottom)
Note: The figure displays the distribution of migration driving factors – economic, social, political, and environmental – across income categories in the two study areas. Across both sites, economic factor was the primary push factor for all income groups.
Source: Primary household survey data, 2024.

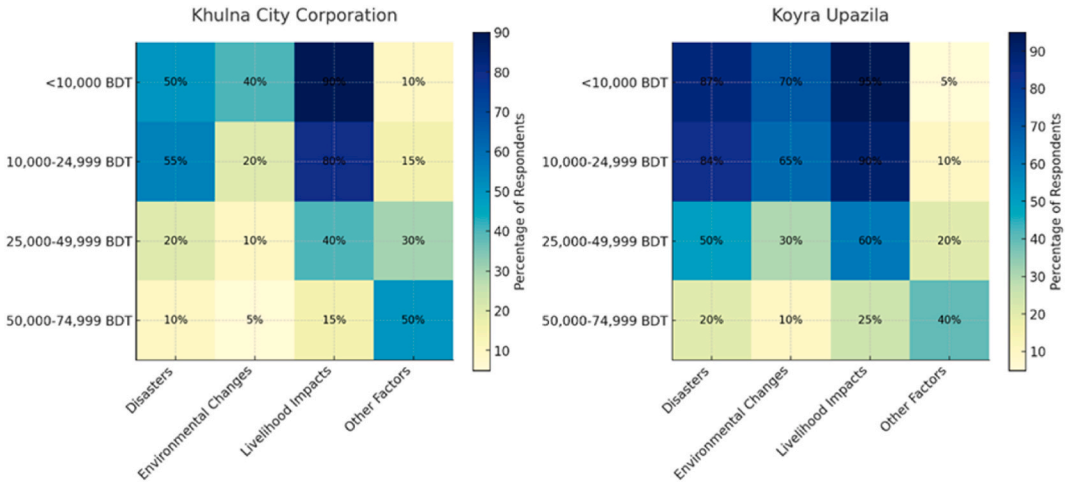

Fig. 3. Impact of income on migration decision across climatic hazards by study sites
Note: This heatmap illustrates the percentage of respondents within each income group who identified specific climate-related factors – natural disasters, environmental changes, livelihood impacts, and other factors (non-environmental factors such as better economic opportunities, personal motivation) – as key driving factors of migration. Across both sites, livelihood impacts emerged as the most critical driving factor among lower income groups.
Source: Primary household survey, 2024.

The experience exemplifies the role of debt as an important driver of migration and how economic burdens push vulnerable families to flee as a last resort.

Environmental hazards were an important push factor for migration in Koyra which is exposed to environmental hazards. Table 2 indicates that 86 % of the migrants reported environmental hazards as the primary driver for dislocation. Additionally, we find that a strong association between environmental factors as a migration driver and income level X^2 (2, $N = 150$) = 15.83, $p < .001$. In Koyra, almost all participants reported them as a reason for migration, and this was particularly pronounced for lower income households (<10,000 BDT) (Fig. 2).

Climatic disasters such as floods and storms particularly influence migration decisions of the lower income households. We find a significant association between climate hazards as a migration driver and income level X^2 (2, $N = 150$) = 12.4, $p < .002$. In Koyra, the majority of migrants (87 %) in the lowest income bracket (<10,000 BDT) considered climatic hazards as a major driver of migration (Fig. 3). It was also often (84 %) cited by the participants in the 10,000–24,999 BDT income groups (Fig. 3). In contrast, it was less important in Khulna, where the percentages were 50 % and 55 % for the same income ranges, respectively. The impact of hazards on migration decisions declines noticeably for higher income groups: their economic security buffers the effects of sudden climatic hazards.

We found a significant association between income level and environmental changes X^2 (2, $N = 150$) = 13.8, $p < .001$. Gradual environmental changes, such as sea level rise and desertification, have a limited influence on decisions to migrate in Khulna, where only 5 %–40 % of migrants considered them as migration driver depending on their income level. In Koyra, up to 70 % of the lowest income households (<10,000 BDT) considered them a driver of migration, which highlights how rural and natural resource dependent communities are highly sensitive to environmental changes, more so than urban communities (Fig. 3). One FGD participant noted,

> "The recurrent storms and saline water have made life difficult. The land is too salty to grow crops, and we don't have enough sweet water to cultivate. Many families want to stay in their ancestral land, but they are forced to relocate because they can't rebuild after every hazards."

Fig. 3 also indicates that other factors or non-environmental factors such as better economic opportunities and personal motivation were more prominent among higher income households in Khulna. Half of the participants with 50,000–74,999 BDT income responded that climatic hazards had no influence on their decision to migrate. In Koyra, 40 % of participants with higher income reported non-environmental drivers of migration (Fig. 3). Economic security enables households to migrate proactively for better opportunity, while economic vulnerability forces households to migrate reactively in response to climatic hazards.

We observed a significant association of residential status (local and migrant) and the perception of climatic hazards influencing migration decision in Khulna City Corporation and Koyra, X^2 (2, $N = 300$) = 22.53, $p < .001$. A total of 36 % of Koyra migrants considered climatic hazards "Highly influential" while in Khulna City 28 % of them did so (Fig. 4). Locals in Koyra also considered

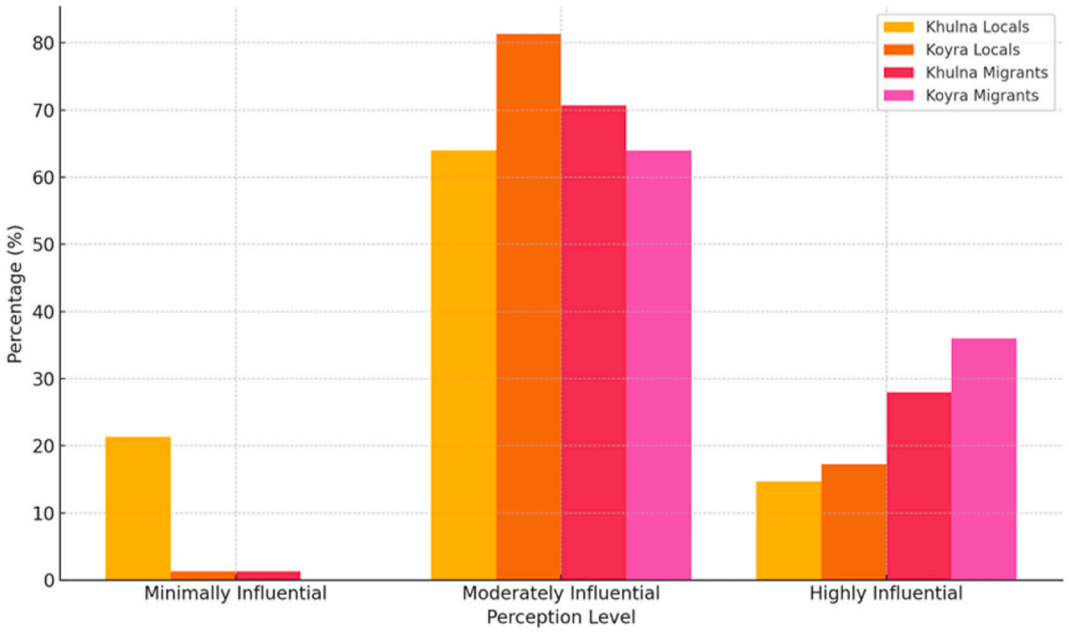

Fig. 4. Perception on Climatic hazards' influence on Migration Decision by Residential Status
Note: This figure compares how local residents and migrants from Khulna and Koyra perceive the influence of climate hazards on migration decision. Majority in all groups viewed climate hazards as a moderately influential. Though a significantly higher proportions of migrants, particularly from Koyra, rated climate hazards as highly influential compared to locals.
Source: Primary household survey data, 2024.

climatic hazards more impactful, 81.3 % considering them at least "Moderately influential" while in Khulna the figure was 64 % (Fig. 4). While 17.3 % of Koyra locals considered climatic hazards "Highly influential," only 14.7 % of Khulna locals did (Fig. 4). That is, migrants in both sites consider climatic hazards a more important driver of migration than locals, and this difference was statistically significant.

Education levels further shaped these perceptions. A strong association was observed between education level and the perception of climatic hazards influencing migration decisions, X^2 (6, $N = 300$) = 20.38, $p < .002$. In Khulna City 70 % and in Koyra 80 % of the more educated local participants considered climatic hazards "Moderately influential" for migration, indicating an understanding of multifaceted drivers of migration which includes economic and social considerations (Fig. 5). Climatic hazards were considered "Highly influential" by 25 % of Khulna migrants and 35 % of Koyra migrants (Fig. 5). This is particularly evident for the less educated households and especially in Koyra, reflecting their greater exposure to climate related hazards and vulnerabilities.

4.3. The adaptive role of pull factors

Pull factors influence decisions to migrate but differently in Khulna City and Koyra Upazila. Table 3 presents the frequency and percentage distributions of participants rankings for key pull factors measured on a 1 to 5 scale (1 = most important, and 5 = least important). Employment opportunities were the most important key pull factor in both sites, though it was more strongly prioritised in Khulna. In Khulna, all participants (100 %) (Table 3) ranked employment as the most important factor, while in Koyra 69.3 % ranked it first and 30.7 % ranked it second (Table 4). This suggests that diverse livelihood opportunities attract migrants struggling under economic pressures. Koyra offers clearly more limited options for migrants and many of them are climate sensitive.

The prospects for better life ranked higher in Koyra, where 30.7 % ranked it the most important and 58.7 % the second most important pull factor (Table 4). In Khulna, 80 % of participants ranked it the second most important factor (Table 3). Koyra migrants may value improving their living standards more in light of their more challenging situation. Access to education ranked the third most important factor (26.7 %) in both areas and healthcare facilities rank comparably. The migrants considered cultural and social factors unimportant migration drivers. These findings highlight the multifaceted drivers of migration and their context specificity.

Our qualitative findings also highlight economic opportunities as the dominant pull factor of migration. Participants appreciated Khulna's diverse job market, which provides income opportunities for everyone in the family and often higher wages than rural areas. Migrants in FGDs considered Khulna as a hub offering not only immediate economic opportunities but also pathways to capacity building and career development.

Training programs in Khulna are often residential with monthly allowances, making them attractive to low-income migrants. They span a range of options from mobile phone repair to tailoring, salon services, welding and more. Some training programs prepare trainees for overseas employment. Such opportunities are transformative for the migrants seeking economic opportunities and financial security. One participant in a migrant FGD said that:

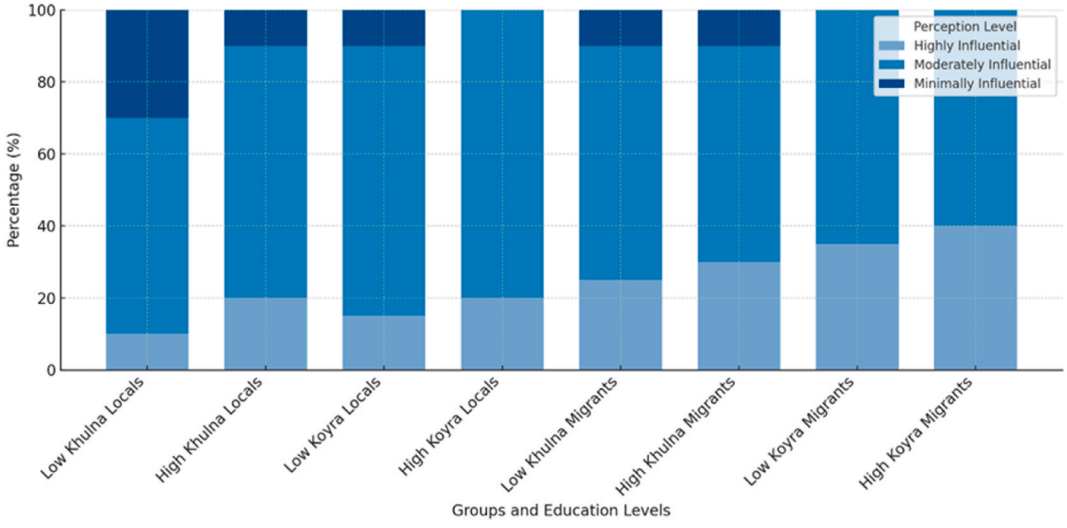

Fig. 5. Education and Perceptions of Climatic Hazards by Residential Status,
Note: This figure compares how individuals with high education (graduate and post-graduate degree) and low education (less than higher secondary or equivalent) levels perceive the influence of climate hazards across locals and migrant groups in Khulna and Koyra. Across both sites, participants with higher education background, especially among locals, viewed climate hazards as moderately influential in migration decision. Conversely, participants with lower education levels, particularly migrants in both sites, seen climate hazards as highly influential.
Key: High education (graduate and post-graduate degree) and Low education (less than higher secondary or equivalent).
Source: Primary household survey, 2024.

Table 3
Frequency and percentage of migration pull factors rankings in Khulna City Corporation.

Pull Factor	Rank 1 (Most Important)	Rank 2	Rank 3	Rank 4	Rank 5 (Least Important)
Employment	**75 (100 %)**	0	0	0	0
Better living standards	0	**60 (80.0 %)**	12 (16.0 %)	2 (2.7 %)	1 (1.3 %)
Access to education	0	2 (2.7 %)	**20 (26.7 %)**	25 (33.3 %)	28 (37.3 %)
Healthcare facilities	0	5 (6.7 %)	31 (41.3 %)	27 (36.0 %)	12 (16.0 %)
Cultural/Social factors	0	11 (14.7 %)	12 (16.0 %)	19 (25.3 %)	33 (44.0 %)

Notes.
N = 75 (migrant sub-sample).
A 5- point importance scale was used where 1 = most important, 5 = least important.
Statistical summary: Descriptive frequencies and percentages are reported.
Source: Primary household survey, 2024.

Table 4
Frequency and percentage of migration pull factors rankings in Koyra Upazila.

Pull Factor	Rank 1 (Most Important)	Rank 2	Rank 3	Rank 4	Rank 5 (Least Important)
Employment	52 (69.3 %)	23 (30.7 %)	0	0	0
Better living standards	**23 (30.7 %)**	**44 (58.7 %)**	8 (10.7 %)	0	0
Access to education	0	1 (1.3 %)	**20 (26.7 %)**	31 (41.3 %)	23 (30.7 %)
Healthcare facilities	0	0	10 (13.3 %)	26 (34.7 %)	39 (52.0 %)
Cultural/Social factors	0	7 (9.3 %)	37 (49.3 %)	18 (24.0 %)	13 (17.3)

Notes.
N = 75 (migrant sub-sample).
A 5- point importance scale was used where 1 = most important, 5 = least important.
Statistical summary: Descriptive frequencies and percentages are reported.
Source: Primary household survey, 2024.

> "Khulna has many training centres with residential support and stipends for both male and female. After training, we receive a certificate and can attend job fairs that recruits directly from the fair and trainees got privilege in the recruitment process. My nephew got a job instantly from the fair with good salary."

Another key pull factor in Khulna is access to 'Khas Jomi', government owned land provided for migrants and landless people. Migrants emphasized that it allows them to live on land for an extended period without rent. This is a relief for low-income households, reducing costs and offering stability. NGOs also support migrants during the settlement process by providing livestock, poultry, small loans to start business; and build sanitary toilet and water tanks in Khas Jomis and migrant slums. These resources not only facilitate immediate survival but also help families gain stability. One migrant explained:

> "When we moved to Khulna, we had almost nothing with us to survive. But here, we got the provision to stay on Khas Jomi without paying rent. It was a big relief for us. Moreover, we got help from an NGO to settle ourselves. We received two goats and now we have twenty goats on our farm. This assistance extremely helped us to settle here."

Social networks were another significant pull factor. Many participants said that they relocated from one to another union of Koyra, following relatives who had migrated earlier. These connections gave assurance and enabled households to adapt to the challenges of a new environment. One FGD participant explained:

> "We moved because my sister and brother-in-law had already migrated in another union. We got all the necessary information from them that encouraged us to move. Knowing someone there gave us confidence to cope with the new challenges."

Also in Khulna relatives, friends, and other familiar people offered support to new migrants. Social connections played a pivotal role in a transition for families arriving to an unfamiliar city. Relatives provided assistance for finding housing, often offering a place to stay during the early days. Networks also helped accessing employment opportunities: referrals from relatives or friends helped secure jobs more easily and quickly, particularly in sectors where informal hiring and word-of-mouth recommendations were a norm. Social connections also provided vital information about accessing resources, such as government and NGO support. They also helped migrants access public services, locate cheap markets, and adapt to the fast pace of urban life. One participant remarked:

> "When we moved to Khulna, we knew nothing about it. Our relatives helped us to access the Khas Jomi. Moreover, my cousin introduced me to his employer. Within a week, I got a job in a grocery shop. Without his recommendation, I wouldn't have got the job so easily and not even known where to look for an employment opportunity."

Environmental pressures also played a role in shaping migration decisions in Koyra, especially in the aftermath of the Cyclone Aila. Many participants explained how it left their homes submerged for long time, making everyday life impossible. One participant reflected:

> "After Aila, it was water, specifically saline water everywhere. It was in our homes, fields, roads, schools, hospitals, everywhere. There was no drinking water. We couldn't grow crops and life becomes impossible. We had no choice but to move a place where could have a dry place for better living."

This narrative highlight how acute environmental hazards acted not only as a powerful push factor but also directly shaped the characteristics of the new location people sought. Against this backdrop, the search for better living condition was not only a pull factor but a direct response to the environmental challenges they experienced. This resonates with the rank analysis according to which migrants in Koyra, ranked better living standards above economic opportunities as a pull factor. In this context, rather than operating in isolation, push and pull factors appear deeply interconnected, with environmental degradation both driving displacement and informing the criteria for relocation.

4.4. Changing migration patterns

Our qualitative findings highlighted a shift in migration patterns. Families are increasingly prioritising the migration of young adults to urban areas, which offer access to education, training, and employment. This is a deliberate attempt to achieve sustained household stability through income diversification, skill building, and improved socio-economic progress.

Participants frequently highlighted how sending a single young family member is both economically effective and strategically sound. It helps families maintain ties to their ancestral land and community while leveraging urban opportunities. Participants in both locations emphasized the importance of investing in a younger member as a means of securing long term support for the whole family. That is, migration is shifting from a being reactive survival mechanism to a proactive, strategic tool for socio-economic resilience. One participant said:

> "We decided to send our son to the city. He is staying with our relatives and joined a mobile repair course. He has already finished his course and now works full time in a mobile repair shop … he is making his future and helping us back home. Moving the whole family would have been expensive and challenging."

In conclusion, the findings of multifaceted push and pull factors and changing patterns of migration highlight the complexity of decisions to migrate in Khulna city and Koyra. Economic stressors, climatic hazards and lack of diverse livelihood opportunities in Koyra push households to relocate in search of more stable and secure lives. Migrants are also drawn to urban locations such as Khulna City by pull factors such diverse livelihood opportunities, training programs, support from government and NGOs, and social networks. The shift in patterns of migration is driven by pursuit of longer-term socio-economic resilience: migration of the young members of the household is considered an investment in the household's future rather than a short-term way out of financial precarity.

5. Discussion

We provide new evidence of the multifaceted relationships between climatic hazards, migration decisions, and socio-economic vulnerability in climate sensitive Khulna City Corporation and Koyra Upazila. We sought to answer (1) what primarily drives migration, (2) how do climatic hazards and economic conditions influence migration decisions, and (3) to what extent do the commonly cited drivers of migration apply in our study sites? Our findings indicate that migration decisions are multifaceted, shaped by climatic hazards, financial precarity, debt cycles, level of education, and social networks. These findings contribute by helping to refine migration decision frameworks and to apply them context-sensitively.

Our study applies both the push-pull model [12] and Black et al.'s [13] framework in understanding migration dynamics in Khulna city and Koyra Upazila. While the push-pull approach captures broad motivations for migration, our findings suggest that migration decisions are often more complex than a simple response to adverse conditions or attractive opportunities. The five-driver model of Black et al. allows for a more detailed analysis of migration drivers; however, our insights indicate that the relative importance of these drivers varies significantly depending on local contexts. We set out to shed light on this issue. Our findings indicate that political factors were not important in decisions to migrate in Khulna City Corporation and Koyra Upazila in contrast with the findings of Codjoe et al. [124]; Ghimire et al. [60]; Přívara & Přívarová [125], highlighted how political instability often intersects with economic and environmental pressures and drives migration. In our study, economic stressors and environmental hazards emerged as key drivers of migration, highlighting the need for a more context-specific analysis of decisions to migrate.

Our results reaffirm the role of environmental hazards in decisions to migrate, particularly in Koyra. The finding resonates with the results of earlier emergency mobility literature documenting how sudden-onset disasters such as cyclones, floods, wildfires and storms drive relocation [21,111,126–129]. Our findings also indicate that environmental stresses such as salinity intrusion, prolonged droughts and declining land productivity shape decisions to migrate even in the absence of sudden-onset environmental hazards [130–132]. Our analysis also highlights the role of economic stress alongside environmental hazards in decisions to migrate. We can frame this as the interaction between economic and environmental factors, empirically examining the interaction effects noted in Black et al. (2011). Lower-income households in Koyra were very likely to migrate after being exposed to environmental hazards, as they had little adaptive capacity. This finding resonates with earlier studies that highlighted the intersection of financial precarity and environmental stressors behind migration [1,66,67,133].

Almost all our migrant participants (98 %) considered financial stress a primary driver for their decision to migrate. In line with earlier research, we found that unviability of climate sensitive livelihoods and limited economic opportunities are key push factors [20,76]. In both study areas, climatic hazards were considered moderately influential in migration decisions by most participants.

Participants often framed their migration motivation in economic terms – lack of diverse income opportunities, job insecurity, and livelihood challenges – these vulnerabilities are frequently rooted in or amplified by environmental hazards.

However, our analysis suggest that economic and environmental drivers are deeply interconnected. These findings are consistent with national patterns in Bangladesh [121] and broader trends in climate migration literature [134]. Environmental hazards – such as frequent cyclones, salinity, flooding – frequently undermine people's livelihood, thereby intensifying economic stress and contributing indirectly but substantially to migration decisions [90,135]. This highlights the role of environmental stress not as an isolated driver, but as a factor that exacerbates financial precarity and reinforces migration pressures. The finding contradicts the widely advocated view that environmental stress is a dominant driver of migration, emphasising instead the complex interplay between environmental and economic factors in migration decisions, particularly in places vulnerable to climatic hazards.

We can also report new results on the role of indebtedness in decisions to migrate, which has largely been omitted in earlier literature. Prior studies have highlighted debt dependency linked to microfinance among vulnerable households in southwest Bangladesh [136], climate-related debt accumulation among marginalised communities in rural India [137]. Recently, Fernández et al. [138] identified debt as one of the factors driving economic migration in Bangladesh and Ghana. In the context of Bangladesh, IIED, 2025 [139] reports that climate induced migration is often financed through debt, which increases the risk of debt bondage and labour exploitation. While these studies highlight the financial precarity surrounding debt, few explicitly frame indebtedness as a direct driver of migration.

In our study areas, low-income households often take high-interest loans from microfinance institutions, informal lenders, or community-based loan schemes to cope with economic shocks and stresses. The inability to meet repayment deadlines forces many households to relocate to escape financial obligations. While the literature considers migration an income-seeking strategy, our results highlight that migration can also be a form of financial crisis management. This adds new insight by examining how indebtedness itself acts as a migration driver within households. Moreover, our finding connects to broader discussions in the literature on how financial constraints are often associated with immobility traps, often referred as "trapped population" [20,63,94,140]. Thus, our findings demonstrate that financial precarity may paradoxically serve as both a constraint and a compulsion. These results highlight the need for policy interventions that address financial vulnerabilities of low-income households-both for those who migrate and for those who are unable to do so.

Education emerged in our results as a moderating factor that shapes how individual perceive the impact of climate hazards on migration decisions. Migrants with higher educational attainment demonstrated a better understanding of long-term climate risks and adaptation strategies, whereas lower-education individuals were more reactive in their migration decisions. This contrast suggests that education enhances individuals' ability to prepare for both environmental and economic challenges, reinforcing the need for targeted educational interventions to improve resilience in vulnerable communities.

A complex interplay of push and pull factors driving migration was evident in our results. The primary push factors in Koyra Upazila were environmental hazards and economic hardships, while in Khulna City economic opportunities were a dominant pull factor. Khulna city is a hub for migrants seeking employment, better living conditions, and access to services. The rank analysis indicated that employment opportunities were the top attraction for migrants, followed by access to better living conditions. Many migrants relocate to areas where they have social networks or family or community connections to secure housing and employment upon arrival [16,141,142]. This resonates with earlier results on the role of social capital in migration, which indicate that established kinship ties lower the costs of migration and ease transitions [3,44,143].

Despite the importance of social networks, our results also indicate that access to land (Khas Jomi), diverse training opportunities, and NGO support in Khulna ease migration. While earlier research has examined the role of public policies for rural resilience [114], there is less research on how urban policies influence migration decisions. Our results stress that the above kind of safety nets reduce financial burdens of migrants and facilitate their integration. Social and institutional support structures should be given due attention and role in migration and urban planning policies in the future.

Another insight from our research is the transition in migration from reactive displacement to more strategic mobility. Migration was earlier considered primarily a crisis response [5,6,144]. Our findings indicate that migration for many is a strategic investment, where households send younger members to urban areas for education, employment, and skills development. This resonates with discussions on migration as an adaptive response, where mobility enables households to diversify sources of income and decrease reliance on climate-sensitive livelihoods [33,145]. Our results showcase how migration decisions are driven by both necessity and opportunity, shaped by education and financial status.

While were report valuable contributions to the literature, we acknowledge some limitations. First, while our mixed-method approach helped offer a nuanced understanding of migration dynamics, we drew our sample from just adjoining two locations. Future research could extend the geographical scope to examine migration across wider area. Second, while our research included both local residents and migrants, longitudinal data would provide a deeper understanding of migration trajectories. Future research could track migrant households over time to examine long-term adaptation strategies and transitions. Third, while chi-square tests were instrumental in identifying statistically significant associations between categorical variables such as income, education, and migration drivers, they come with inherent limitations. As Sharpe [146] notes, chi-square test only indicates the presence of an association, not its strength or direction. Additionally, it is also sensitive to sample size; large sample can lead to statistical significance even when the practical relevance is minimal. These factors should be considered when interpreting the statistical findings. Finally, further investigation would be needed to explore the wider implications of indebtedness in different contexts to better understand how financial policies and lending practices shape migration decisions.

To conclude, we contribute to the understanding of migration dynamics by illustrating the interconnectedness of environmental hazards, economic stressors, and adaptation strategies. While climatic hazards remain a key factor, economic hardship frequently

dictates migration decisions, highlighting that migration cannot be understood in isolation from broader the socio-economic context. Our findings also highlight the emerging shift from survival-driven migration to strategic, resilience-focused approach. This underscores the need for targeted policies that reflect both lived realities of both mobile and immobile population. Policies should focus on expanding access to affordable credit, supporting livelihood recover in climate-vulnerable regions, and ensuring inclusive urban planning for receiving communities. By addressing these recommendations in empirical evidence, we aim to inform more effective interventions by policymakers, researchers, and development practitioners working on climate adaptation and migration governance in similar vulnerable context.

6. Conclusion

We empirically examined the complex and multifaceted relationships between climatic hazards, economic stresses, and decisions to migrate in Khulna City Corporation and Koyra Upazila in Bangladesh. While climate induced migration has been extensively explored in the academic literature, which has given emphasis to environmental hazards as drivers of migration, our findings highlight that decisions to migrate are importantly shaped by economic and financial precarity and livelihood strategies. Climatic hazards such as tropical cyclones and salinity intrusion affect migration dynamics in Koyra Upazila, but economic factors such as loss of livelihoods, job insecurity, and indebtedness are decisive push factors in both study areas. Our results also indicate a shift in migration patterns, with younger household members increasingly sent to urban areas as a strategic move to ensure long-term household livelihood sustainability and resilience. These insights highlight the need to consider migration dynamics as a multifaceted and context-specific process rather than a uniform response to environmental stressors alone.

Our research advances migration scholarship by refining and adapting existing theoretical approaches to provide a more nuanced understanding of migration. While the push-pull model and the five-driver model provide a sound analytical starting point, our research underscores the need for greater attention to financial precarity as an important factor influencing household decisions to migrate. Financial precarity stemming from microfinance and informal loans is often overlooked in migration discourse but, according to our results they significantly shape migration outcomes. Migration can also function as an adaptive strategy, shaped by both social capital and social support such as NGO assistance, skill development programmes, and access to land. This highlights the broader institutional and structural contexts in shaping migration dynamics.

In the light of our results, it is important for policy makers to acknowledge the economic drivers of migration. Integrating financial support programmes, such as debt relief schemes and access to sustainable livelihoods, into adaptation and development policies. Urban planning should also ensure that migration hubs have infrastructure, training facilities, and essential services to support the integration and well-being of migrants.

CRediT authorship contribution statement

Gazi Alif Laila: Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **James D. Ford:** Writing – review & editing, Supervision, Methodology, Conceptualization. **Diana Ivanova:** Writing – review & editing, Supervision, Methodology, Conceptualization. **Jouni Paavola:** Writing – review & editing, Supervision, Methodology, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in the paper.

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Data availability

Data will be made available on request.

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