

# The implications of climate-related mobility for human security in Bangladesh's Ganges Delta: A scoping review

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## 1. Introduction

This review aims to take stock of existing research that addresses the complex relationship between climate change and variability, mobility, and human security in Bangladesh’s Ganges Delta region.

The term *mobility* encompasses various movements of individuals or households, nearly all of which are multicausal. As such, mobility outcomes are driven by a range of agentic decisions and external stimuli, and include migration, displacement, relocation, and immobility (Ober, 2020). *Climate-related mobility* refers to mobility outcomes that are at least partially influenced by climate change and/or variability. Rather than acting as a primary driver, climate risk often exacerbates non-climate risks (economic, social, political, environmental) to influence mobility outcomes (Black, 2011; McLeman 2021). The temporal, spatial, and motivational dimensions of these movements are diverse. Thus, mobility can be “temporary or long-term, short- or long-distance, voluntary or forced, and seasonal or permanent movement as well as planned relocation” (Rigaud et al., 2018). Agentic decisions about when, where, why, and how long to move for are based on individual or household risk calculations (McLeman 2021). As climate impacts are more pronounced in communities whose livelihoods are highly dependent on natural resources, climate often impacts the mobility outcomes of households with high vulnerability and low adaptive capacity (Savelli et al., 2022).

As climate—often through its effect on land, water, and food systems—has direct and indirect impacts on mobility outcomes, consideration must be given to the linkages between climate and human security, which are known as climate security. Human security refers to “the right of people to live in freedom and dignity, free from poverty and despair” (UNGA, 2012). It recognizes that “all individuals, in particular vulnerable people, are entitled to freedom from fear and freedom from want, with an equal opportunity to enjoy all their rights and fully develop their human potential” (UNGA, 2012). Human security comprises seven dimensions: *economic security, food security, health security, environmental security, personal security, community security, and political security* (UNDP’s Human Development Report 1994). Human security provides a holistic framework to address cross-cutting challenges to the survival, livelihood, and dignity of all human lives (UNGA, 2012). This comprehensive approach emphasizes the interconnectedness of human security’ components resulting threats to wellbeing (OCHA 2010).

The climate security-mobility nexus encompasses the multi-causal, bi-directional and heterogeneous linkages that can, under some circumstances, connect climate change, mobility outcomes, and violent conflict. The climate security-mobility nexus is highly contextual; its characteristics are more dependent on the impact that local political, social, economic, environmental, and demographic variables have on human security than the direct impact of climatic factors. Pre-existing insecurities and structural risk factors significantly shape emergent pathways across geographic contexts (Barnett & Adger, 2007). Common pathways include conflict as a result of climate-related disaster displacement, conflict as a result of scarcity-related mobility, conflict as a result of abundance-related migration, and conflict as a result of pre-existing tensions and migratory patterns interacting with climate change and/or variability (Savelli et al., 2022).

The study—part of the CGIAR Initiative: Securing the Food Systems of Asian Mega-Deltas (AMD) for Climate and Livelihood Resilience (CGIAR, n.d.)—explores the linkages between climate-related mobility and human security in Bangladesh’s Ganges Delta region. By exploring the available evidence through a systematic literature review, the results of previous literature are mapped and analyzed. We

then identify evidence gaps and opportunities for future research on climate-related mobility and human security in Bangladesh.

## 2. Methodology

The study adapted the methodology for scoping reviews suggested by Peters et al. (2015). First, a list of keywords for different thematic categories, including climate/environment, human security, mobility and geographic focus, was carefully constructed to ensure that all the relevant areas of climate-related mobility and human security were covered. The full list of categories and keywords used for the search strategy are provided in Appendix 1. A machine-assisted search was performed to identify relevant literature for review. An automated bibliometric scan was performed to extract relevant peer-reviewed papers from the Web of Science database. To be considered for inclusion, a paper's bibliography had to include at least one keyword from each of the four thematic categories, and the paper should be published from 2010 onwards.

Grey literature was also considered in the scoping review since these documents can provide an extensive source of information related to the topic (Godin et al., 2015). The grey literature was compiled manually through google searches and taken from reputable sources, including research institutions, public agencies, and NGOs. To avoid complication, the keywords used for searching grey literature were simplified to *"Ganges Delta" AND (migration OR displace OR relocation) AND climate AND (security OR conflict)*. The first 10 pages of Google search results were manually checked to select relevant journal articles, reports, book chapters, working papers. Most relevant documents were often found in the first 3 pages of the search results. In addition, we targeted websites of reputable organizations working on climate mobility, including International Migration Organization (IOM) and United Nations Development Programme (UNDP), to purposely look for their reports and working papers on the topic.

Once relevant peer-reviewed and grey literature was extracted, a short-list for inclusion was produced manually by the authors using Excel. This involved validating the keyword search results, confirming the literature was published between 2010 and 2022, and ensuring papers explicitly focused on Bangladesh's Ganges Delta region. Papers not meeting any of these criteria were not included for review.

Next, papers selected for review were analyzed in relation to several research questions, including:

- What methodological designs and data sources have been used to examine the connection between climate-related mobility and human security?
- Where has previous research been focused geographically?
- Which groups of people have been the focus of previous research?
- What climate events have been discussed?
- What primary drivers of mobility have been identified?
- Which components of human security were a focus of previous research?
- What conclusions have been reached by previous research?
- What research gaps have been identified?

As each paper was reviewed, key information related to each of the above questions was recorded in an Excel file. From the Excel dataset, descriptive analysis for different categories including methods, geographical focus, social groups, climate factors, migration drivers, and human security components

were conducted. Finally, key results were synthesized for identifying implications and generating recommendations for future research.

### 3. Results and Discussions

This section presents main findings of the scoping review in relation to the above research questions.

#### 3.1 Methods and data

The publications reviewed employed a range of techniques to assess climate-related mobility and human security in Bangladesh's Ganges Delta region. Of the 66 papers that were reviewed, 48.5% utilized mixed methods, 26.5% used qualitative methods, and 25% used quantitative methods. Qualitative techniques are helpful to study perceptions of climate variability and build an in-depth understanding of how local conditions influence coping strategies, and the factors that shape mobility decisions. Secondary data sources are often combined with primary data collection. Most notably, the *Bangladesh Population and Housing Census 1991-2011* is used in several studies to quantify historical migration flows. Dhaka, Gazipur, Narayanganj, and other Divisional cities have the highest in-migration rates, and northern and southern districts the highest rates of out-migration (often due to rural-migration) (Alam and Mamun, 2022; Marshall and Rahman, 2013).

Quantitative modelling is often used to predict trends in future climate-related mobility flows. A range of models have been employed, including the radiation model (de Lellis et al., 2021), regression model (Alam and Mamun, 2022), behavioral model (Martin et al., 2014), agent-based model (Hassani-Mahmooei and Parris, 2012; Bell et al., 2021), aid-centric thermal model (de Castro et al., 2021) and landslide hazard and exposure model (Emberson et al., 2021). Based on qualitative data, behavioral aspects (i.e., personal attitudes toward migration, understanding of policies that either facilitate or disincentivize migration, personal norms, and beliefs about social norms) have been used to examine individual migration decision-making processes (Martin et al., 2014), as well as the influence of prosociality on mobility decisions (Steimanis and Vollan, 2022). While some studies project limited out-migration from Ganges Delta areas by arguing that the availability of alternative livelihood options will anchor vulnerable residents in place (Bell et al., 2021), others predict significant increases in out-migration from coastal areas due to flooding and sea-level rise over coming decades, warning that Bangladesh could account for a third of all South Asian climate-related migration by 2050 under a pessimistic climate modelling scenario (Rigaud et al., 2018; Clement et al., 2021). Though projections offer some utility for policy development and planning, they are not always accurate and considered only in combination with other available evidence. In Bangladesh's Ganges Delta, it is relatively safe to assume that climate trends will lead to continued, and potentially increased, internal migration flows over coming decades.

#### 3.2 Geographical focus

Studies on climate-related mobility in Bangladesh have been conducted at multiple geographical scales. At 29%, *village level* literature was most common, followed by *national level* (24%), *district level* (23%) and *regional level* (20%). Our review also included research conducted at the *global and cross-border levels* (5%), provided it included areas within the Bangladesh's Ganges Delta region. Villages where fieldwork was conducted included Jaliakhali village of Dacope Upazila, Kutubdia Para of Kutubdia Island, Hariharpur and Padmapukur Villages of Koyra Upazilla, and Borokupot Village in Shyamnagar Upazila. At the regional level, studies on climate-related mobility primarily focused on the southwest coast of Bangladesh. In addition, several mobility studies have been conducted in the

Khulna district (Adams and Kay, 2019; Mallick, 2019; Saha, 2017). Vulnerable to the impacts of climate change, as underlined by Cyclone Aila in 2009, the role of climate hazards in encouraging migration for people of the district was frequently examined. Multiple studies focused on immobility in Khulna, especially in coastal areas (Ahsan et al., 2022, Subhani and Ahmad, 2019; Rabbani et al., 2022). Literature often divided immobile households into those who chose to remain in place and engage in *in situ* adaptation (the voluntary immobile) and those who would like to migrate outward but lack the means or opportunity to do so (trapped populations). One study on immobility in hazard-prone coastal villages of Khulna and Satkhira districts found that 88% of respondents characterized themselves as “voluntary non-migrants,” who could have migrated outward but instead chose to remain (Ahsan et al., 2022). Compared to those who considered themselves trapped, the “voluntary non-migrants” reported improved socioeconomic and sociopsychological outcomes, and more often took advantage of support from government and non-government organizations. Of the seven papers that contemplated immobility, five focused on the Khulna and Satkhira Districts of Khulna Division.

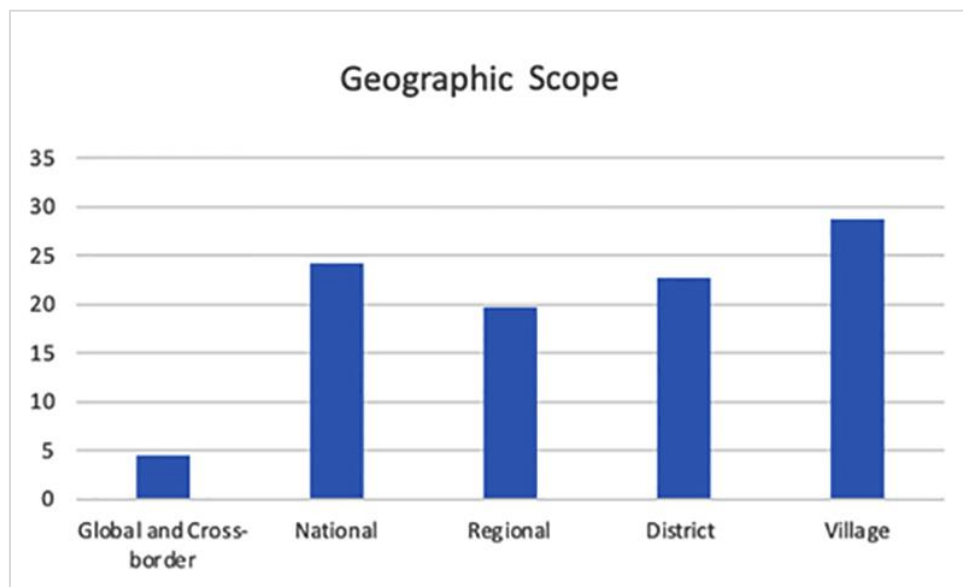


Figure 1: Percentage of reviewed literature that assesses climate-related mobility at different geographic scales

### 3.3 Social groups

When assessing which groups were most frequently the subject of research, a lack of demographic clarity becomes clear. The most frequently assessed group was *general households or residents*, which were the focus of 35% of publications. As *general households or residents* do not constitute a specific social group, their prevalence in the research indicates that many previous studies have not examined how social vulnerabilities may drive mobility and/or human security outcomes. Consisting of groups appearing in no more than two papers, the *other* category was the focus of 20% of publications. This category consists of Bengali migrants, migrant communities generally, climate migrants, informal workers, slum dwellers, settlers of the Ashrayan project, Char people, individuals impacted by Cyclone Aila, and the ultra-poor and marginalized. Further, 23% of papers examined *farmers*, which is understandable given the vulnerability of agricultural livelihoods to climate and environmental hazards. A wide variety of farming households were examined, including subsistence crop farmers, rice farmers in Khulna (Williams et al., 2016), and farmers who had migrated to urban districts (Al-Maruf et al., 2022). Fisherfolk featured in 17% of the literature. In addition to the impact of rapid-onset extreme weather events, the livelihoods of fishing communities are threatened by slow-onset hazards.

For example, increasing salinity in tidal areas is leading to the disappearance of native fish species and threatening aquaculture infrastructure (Rabbani et al., 2022). Studies examining fisherfolk focused on coastal areas, such as the Kalapara Upazila in the Barisal division (Ahmed and Eklund, 2021). The Satkhira District in the Khulna Division (Hossain et al., 2018), and the Sundarbans (Ortolano et al., 2017).

Approximately 5% of studies used a gendered lens to explore the vulnerabilities of women. These papers highlighted the consequences for women left behind when men migrate, including increased domestic burdens. Ahmed and Eklund (2021) explored how female farmers who remain in rural villages in coastal Bangladesh have a higher vulnerability to climate-related stressors than men. The study underlined that women’s vulnerability is impacted by social and economic conditions as well as physical exposure to climate hazards. Moreover, Southard and Randell (2022) identified a positive correlation between temperature variation and the likelihood that a woman works in agriculture in Bangladesh. These findings illustrate the importance of an increased gender focus in future climate-related mobility studies.

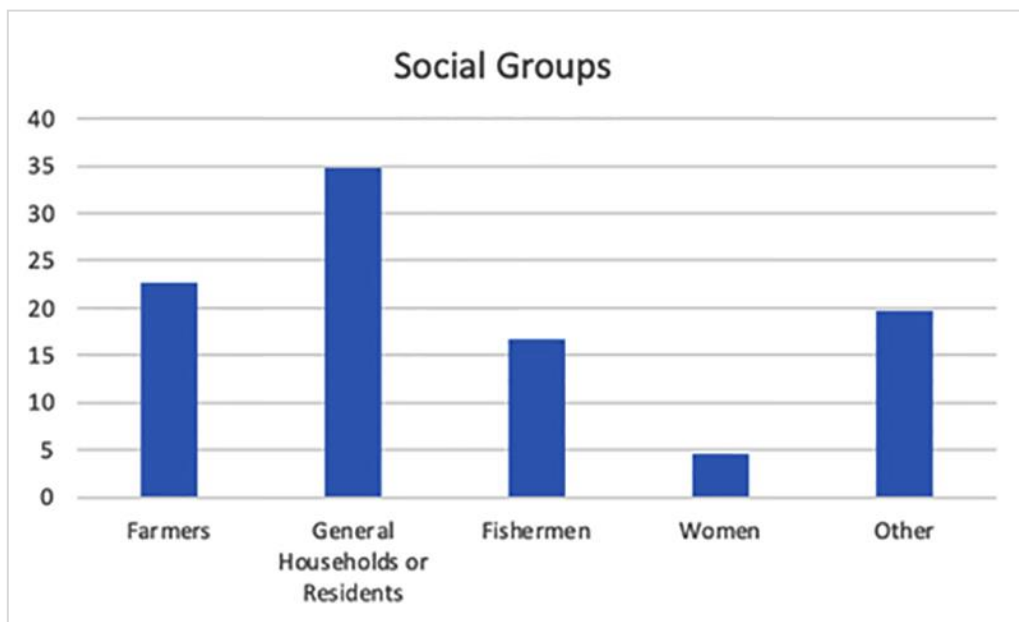


Figure 2: Percentage of reviewed literature focusing on different social groups

### 3.4 Climate hazards and mobility

Bangladesh’s climate is warm and humid, with temperatures ranging between 15°C and 34°C and an average annual rainfall of 2200 mm (World Bank, 2021). The climate is impacted by pre-monsoon, monsoon, and post-monsoon circulations. Owing to its proximity to the Bay of Bengal, Bangladesh frequently experiences tropical cyclones. The country lies at the intersection of three river basins, the Brahmaputra, Ganges and Meghna, and therefore has flat deltaic topography. All told, this leaves Bangladesh exposed to a wide variety of climatic and environmental hazards which also include storm surges, variable rainfall, flooding, desertification and sea-level rise. The Global Climate Risk Index ranked Bangladesh the seventh most climate-vulnerable country between 2000 and 2019 (Eckstein, Künzel and Schäfer, 2021).

This wide breadth of hazards communities in Bangladesh’ Ganges Delta are exposed to was reflected in the literature. *Flooding* was the most referenced environmental hazard, present in 56% of reviewed literature. Bangladesh is vulnerable to several types of floods, including pluvial, fluvial, and coastal



flooding. Regarding pluvial flooding, mean volume of rainfall and frequency of extreme rainfall events are expected to increase under climate change (Islam et al., 2022b). However, uncertainties surround events linked to pluvial flooding, including the impacts of climate change on monsoon systems and cyclones. Flooding has a detrimental impact on crop yields in Bangladesh, often inundating vast swathes of farmland, damaging infrastructure, killing livestock, and spreading water borne diseases. Fluvial flooding and coastal flooding are both expected to increase in frequency over coming decades, although this is still subject to uncertainty (Nepal and Shrestha, 2015; Dastagir, 2015).

Given the link between cyclones and flood events, it is understandable that *cyclones* were the second most commonly discussed hazard, appearing in 48% of reviewed literature. The Bay of Bengal is one of the planet's major centers of cyclone formation, owing to vast low-pressure systems created by the bay's warm water. Furthermore, the strength of the cyclones is intensified by the trough-like shape of the bay. However, uncertainty remains around the impact of climate change on cyclone formation in the region. In addition to being potentially fatal, cyclones can cause widespread damage to infrastructure, housing, and decimate livelihoods. In November 2007, Cyclone Sidr impacted 7 million livelihoods in Bangladesh (Dasgupta et al., 2010). In the 11 worst-affected coastal districts, crop losses were estimated at 95% of the total cultivated area and widespread damage to fisheries and shrimp aquaculture infrastructure were reported in Khulna, Satkhira, and Cox's Bazar Districts (FAO, 2007). Islam and Shamsuddoha (2017) and Ahsan and Özbek (2022) explored mass displacement as a result of rapid onset weather events, with the latter investigating the displacement of more than 3 million people by Cyclone Sidr. Cyclones can also encourage migration by eroding livelihoods and reducing employment opportunities. Martin et al. (2014) explored out-migration following Cyclone Aila in 2009, as many moved to nearby towns due to a lack of employment opportunities in the affected area. The findings are supported in Mallick and Vogt (2014), who argue that, following Cyclone Aila, many households had at least one member migrate outward once aid was no longer available. Whilst cyclones appear frequently in national level studies, along with associated storm surges, they are of greatest concern in the Bangladesh's southern coastal regions (Ayeb-Karlsson et al., 2016). This is reflected in the literature, which discusses cyclones in relation to study sites such as the Satkhira District, Dalbanga South, Mazer Char and Gabtola; all in the Khulna Division.

Slow-onset hazards are also discussed in the literature, with *droughts*, *riverbank erosion*, *salinity issues*, and *sea-level rise (SLR)* each cited multiple times. Salinity issues and SLR are of considerable concern in coastal regions dependent on aquatic livelihoods, like fishing. Salt water intrusion stemming from SLR also harms ecosystems on which deltaic populations depend. Approximately 40% of productive land in southern Bangladesh is projected to be lost by the 2080s, owing to a 65cm rise in sea level (World Bank, 2013). Riverbank erosion is of greatest concern in the flood plains (Ayeb-Karlsson et al., 2016). Indeed, sites selected to assess riverbank erosion included the centrally-located Singpur village (Dhaka Division) (Ayeb-Karlsson et al., 2016), and villages in the Munshiganj district (Dhaka division) (Martin et al., 2014). Not just limited to the Dhaka Division, riverbank erosion was highlighted as a risk in the Chapai Nawabganj District in northwest Bangladesh (Martin et al., 2014), and in the Bagherat District of the Khulna Division (Ayeb-Karlsson et al., 2016).

*Sudden violent storms*, similar to cyclones but lower intensity and non-revolving winds, *desertification*, which is of greater concern in Northern Bangladesh, and *heat stress* were all cursorily addressed by the literature. They are captured in the *Other* category, in Figure 3, below.

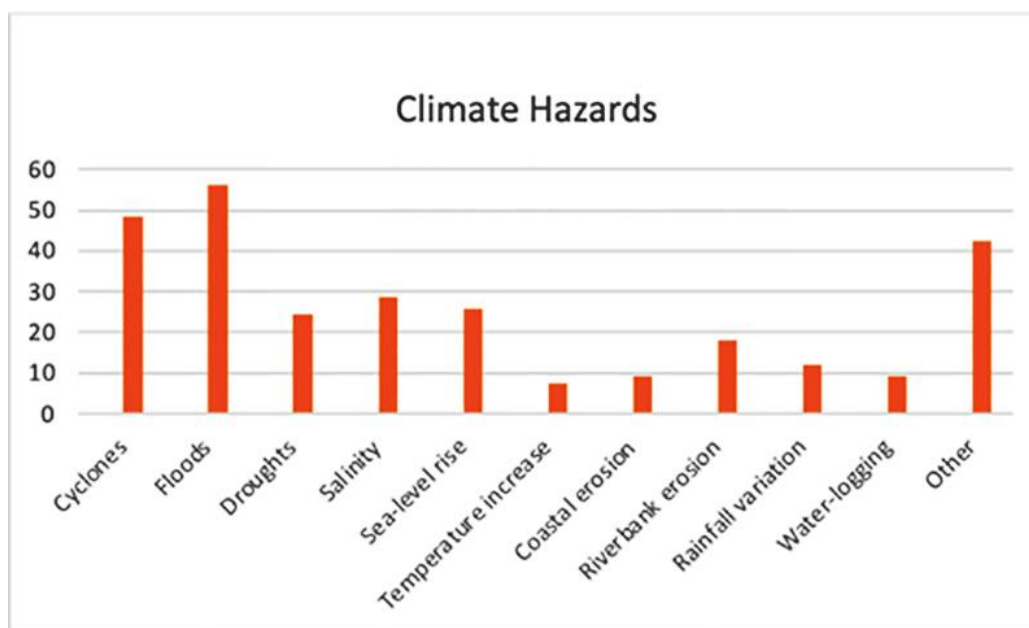


Figure 3: Percentage of reviewed literature exploring various climate hazards

### 3.5 Drivers of mobility

Due to the frequency and severity of climate and environmental hazards in Bangladesh's Ganges Delta, 73% of reviewed publications identified *environmental factors* as drivers of mobility outcomes. *Economic factors* were listed just as frequently, also appearing in 73% of papers. This comes as little surprise given the negative impact environmental hazards have on livelihoods in the region. With approximately half of national population involved in agriculture (FAO, 2022) and more than 10 percent dependent on the fisheries sector (Shamsuzzaman et al. 2017), a large portion of delta residents rely on livelihoods that are highly vulnerable to and increasingly undermined by climate hazards (Biswas and Mallick, 2021). Mallick (2019) illustrated the link between livelihood viability and mobility in communities vulnerable to cyclones in the southwest coastal region. In Shovna Village (Shovna Union, Khulna District, Khulna Division), farmers were able to cultivate rice three times per year owing to the availability of fresh water sources, adequate irrigation facilities, and low levels of salinity intrusion. This created local employment opportunities and limited the need for seasonal migration. The opposite was true for those dependent on salt-water shrimp farming in three villages in the Khulna Division: Padmapukur (Uttar Bedkasi Union), Chakdah village (Mathureshpur Union), and Vabanipur village (Islamkati Union). These households reported being unable to recover from the impacts of Cyclone Aila, and, unable to recover from having lost their livelihoods, many were forced to migrate to nearby cities (and some to India) in search of alternative income sources. An assessment of Cyclone Aila's impact on the socio-economic conditions of migrant and non-migrant households by Subhani and Ahmad (2019) highlighted differing outcomes between the two groups. Migrant households in the Koyra and Shymnagar Sub-districts of Khulna and Satkhira were better equipped to recover from cyclone-related losses related to income, housing, and food consumption than non-migrant households. The authors argue this demonstrates the important role that migration plays as an adaptation strategy for deltaic households exposed to climate hazards.

*Social factors* were discussed as drivers of mobility in nearly 20% of reviewed publications. In researching migration from Bangladesh to Malaysia, Rahman (2020) underlined the desire for improved living conditions and upward social mobility as key drivers of mobility outcomes. Social networks also play an important role. Bell et al., (2021) highlighted how social ties and contacts can act as a pull factor, increasing the possibility of migration toward certain locations. The conceptual framework of internal migration in Bangladesh, presented in Alam and Mamun (2022) articulated a

conceptual framework for understanding internal migration dynamics in Bangladesh. It presented a range of social influences including marriage, educational opportunities, familial dynamics, socio-political instability, and religious tensions.

Social networks also play a vital role in how a community responds to extreme climate events. Islam and Walkerden (2014) show that one's ability to migrate is not only dependent on economic capability but also on the socio-ecological context of the place in which one lives. Islam and Walkerden (2014) showed that support through bonding and bridging networks are vital in the immediate aftermath of a crisis as sharing food and providing comfort reduces the desirability of migration. However, such networks become less active and can even collapse after a period of time due to poverty, disaster impacts, resource competition, and conflict over access to external support. This implies that for longer-term recovery, those impacted by disasters are best served when they receive combined support from local social networks and assistance from governments, non-governmental organizations, and community-based organizations. When bonding and bridging relationships are sustainable and buttressed by local institutions, migration from impacted communities is less likely. However, Call et al., (2017) emphasized that the relationship between climate and mobility is complex, time-dependent and non-linear.

*Other* factors that influence mobility outcomes but were discussed with less regularity in the literature include political, demographic, and food security-related variables. Notably, Islam, Schech and Saikia (2021) explored the role that political factors play in internal migration flows toward the Chittagong Hill Tracts (CHT). In addition to environmental factors, such as cyclones and riverbank erosion, the study argued that government protection and settlement programs played important roles in facilitating movement.

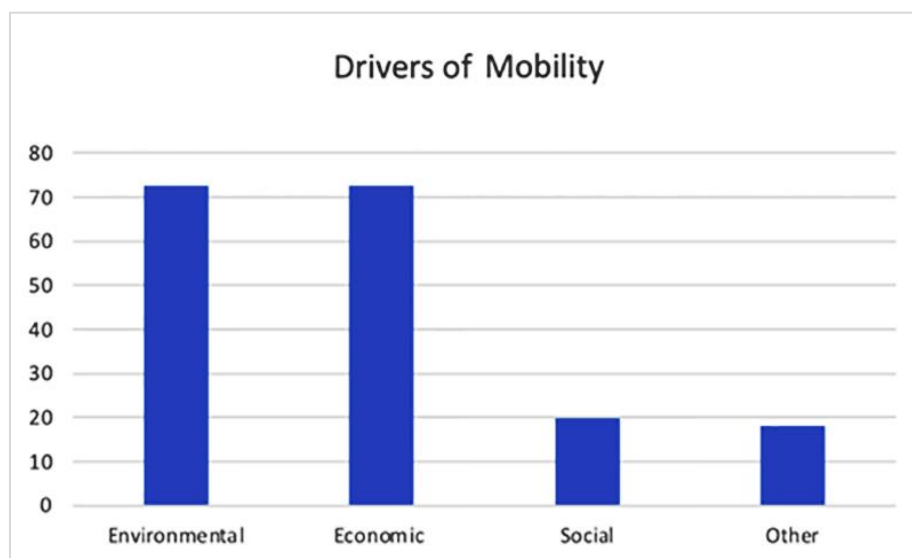


Figure 4: Percentage of reviewed literature exploring various drivers of mobility

These drivers result in mobility outcomes that encompass a variety of forms and directions. *Migration* was the most prominent form of mobility in the literature, appearing in 62% of reviewed papers, followed by *displacement* (30%), and *resettlement* (7%). Considering mobility flows, the most common direction was *rural to urban*, which appeared in 53% of papers. This type of mobility is dominant in Bangladesh and due to a number of factors, including unequal economic development between rural and urban areas (Alam and Mamun, 2022). *Examinations of rural-rural migration* was less common in the literature, appearing in just under 20% of reviewed publications. *Undetermined internal migration*

refers to instances where a direction was not specified, and appeared in 18% of publications. Finally, *temporary migration* was also presented as a coping mechanism, with examples including seasonal migration to nearby cities to engage in informal employment (Biswas and Mallick, 2021), such as working as rickshaw-pullers or masons (Bhowmik, Irfanullah and Selim, 2021).

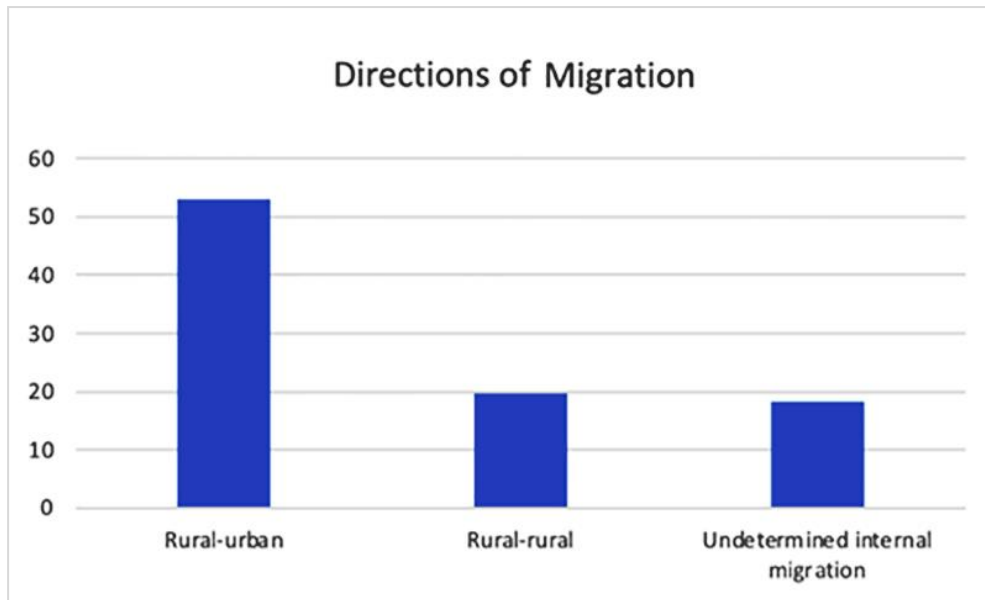


Figure 5: Percentage of reviewed literature exploring various migration flows

### 3.6 Mobility and human security

Several publications examined the relationship between climate-related mobility and human security. Adger et al. (2021) noted that migrants with longer length of residence in Chittagong feel less secure than recently arrived migrants, likely due to a lack of upward social mobility in low-income slums. Dhaka et al. (2020) described how climate migrants experience insecurity as poor health outcomes, fears of eviction, crime, sexual, racial and other harassment and prejudicial treatment as well as environmental hazards in destination areas. Migrants with limited economic resources often wind up in Dhaka's slum areas, which tend to be flood-prone. Malji et al (2022) argued that increasing rural-urban migration may lead to violence by increasing pressure on public services and resources in destination areas. However, Petrova (2021) combined Armed Conflict Location and Event Data with Bangladesh Integrated Household Survey (BIHS) data to test whether environmental migration contributes to the frequency of protests in destination areas due to either inter-group grievances or resource competition. While it was shown that flood-related asset losses increased the prevalence of internal migration, these migration flows did not necessarily result in increasing frequency of protests in migrant-hosting districts.

Because men are often the household members who engage in migration, unique security risks arise for the women and girls who remain behind. Rabbani et al. (2015) used qualitative methods to explore the impact of male migration on women in households vulnerable to various climate hazards, including increasing temperatures, erratic precipitation patterns, prolonged drought, sudden floods, frequent cyclones, and tidal surges. Women who assumed the role of household head when a male family member departed were often looked down upon by neighbors due to the absence of male family members. Some women in this situation even reported harassment, targeted theft, and physical assault. In farming communities impacted by climate hazards, women often must perform increased physical labor when male family members leave, all the while shouldering increased

domestic burdens in tandem. Similarly, Ahmed and Eklund (2021) argue that socio-cultural factors, including customs that restrict women from interacting alone with men to whom they are not related, increase female vulnerability when a male head of the household leaves.

#### 4. Research gaps as articulated in the reviewed literature

Although several studies examined the links between climate hazards and mobility outcomes in Bangladesh's Ganges Delta, additional research is needed to fully parse the details of this complex relationship. Several pieces of literature identified the need for longitudinal research to reveal the geographic and socio-economic outcomes of the climate-related mobility experiences and patterns (Etzold et al., 2014; Sarker, 2020; Call, 2017). Petrova (2021) calls for future research assessing the long-term effect of natural hazards on internal mobility and social unrest. There is also a need for long-term research of how displacement affects wellbeing in destination and origin areas; specifically, how the accessibility of public services can improve outcomes for the displaced (Mallick and Vogt, 2014), of how the experiences and outcomes of groups that migrate compare to those that adapt *in situ* (Alam and Khalil, 2022), and mechanisms through which local governments can partner with community-based organizations to improve livelihoods and access to public services for the displaced (Islam and Hasan, 2016). Moreover, further studies are needed to understand the connection between climate-related mobility and contemporary processes of agrarian transformation (Alam and Khalil, 2022). A better understanding of the complex relationship between climatic conditions, agrarian distress, and the feminization of agriculture is critical for reducing poverty and fostering gender equality amidst climate change (Southard and Randell, 2022).

#### 5. Recommendations for future research

Based on these findings, the research team has developed a number of conceptual, methodological, and practical recommendations for future studies aiming to unpack the complex relationship between climate-related mobility and human security outcomes in Bangladesh's Ganges Delta region.

##### 5.1 Future research should focus on how climate-related mobility shapes human security outcomes among vulnerable social groups, including women, youth, the poor, immobile populations, and ethnic minorities

A large portion of the literature reviewed focused generally on households or residents of the Ganges Delta region. Generalized approaches often fail to account for the intersectional vulnerabilities that marginalized social groups face. Thus, future studies should implement more comprehensive and in-depth targeting of vulnerable groups, including women, young persons, the extremely poor, ethnic minorities, and immobile populations. In particular, compared to other regions, ethnic minorities from Chittagong Hill districts are rarely considered in climate mobility research. Our analysis indicates research on this topic is largely focused on Khulna and should be expanded to additional divisions. Finally, both in relation to vulnerable social groups and more generally, improved conceptual clarity is needed to disaggregate experiences and outcomes within the mobility spectrum. Various forms of mobility—including agentic migration, forced displacement, planned relocation, immobility, and the many grey areas that exist between them—need to be clarified and centered in future studies.

## 5.2 The link between food security and climate-related mobility should be explored more deeply

Most research correctly identifies economic and environmental security as key drivers of mobility in Bangladesh's Ganges Delta. While economic factors are a key determinant of food and nutrition security outcomes, these latter comments are scarcely noted in the reviewed literature. Exploring the relationship between climate-related mobility and nutrition can provide a better understanding of how land, water, and food systems determine local human security outcomes, thus enabling evidence-based policy and programming development.

## 5.3 Mobility outcomes must be contextualized within the systemic changes occurring in Bangladesh's agricultural sector

While mobility outcomes are multi-causal, a large majority of those likely to engage in climate-related mobility rely on agricultural livelihoods under threat from a changing climate. Climatic and economic development processes are driving significant changes in Bangladesh's agricultural sector by forcing crop diversification, altering cropping patterns, spurring the adoption of technological innovations (such as high-yield rice varieties), and changing land use patterns (increasingly toward shrimp farming). Agriculture is also becoming feminized, as the out-migration of male household members drives more women to assume roles as workers and decision-makers in small-scale operations throughout the value chain. Research employing political economy and political ecology perspectives can help unpack the changing power dynamics that are transforming agrarian cultures and practices, and the impact they are likely to have on climate security outcomes.

## 5.4 Explicit attention must be paid to the linkages between climate-related mobility and human security outcomes

Despite increased attention toward the climate security-mobility nexus globally, localized research in the Ganges Delta has not explored the topic in detail. While conflict over resources and international aid in the wake of disasters has been discussed (Islam and Walkerden, 2014), additional pathways require examination, including resource competition in the context of land-use changes associated with the increasing adoption of shrimp farming in coastal communities.

## 5.5 Utilizing econometric analysis, qualitative comparative analysis (QCA), behavioural and experimental methods, or agent- or event-based modelling within mixed methods, could be key to elucidating features of the climate-mobility nexus in the Ganges Delta region

Whilst mixed methods were commonly used in the reviewed literature, they either rarely, or never, included techniques like econometric analysis, qualitative comparative analysis, behavioural and experimental methods or agent-based modelling. Such techniques are important to further understand climate-related mobility outcomes. In-depth qualitative case studies of specific contexts as well as high quality large-scale data collection on internal migration will also be crucial to increase the validity and generalizability of new findings (Petrova 2021). Combining qualitative research amongst impacted households with econometric analysis related to weather events, incomes, and population dynamics may help unpack the risk thresholds that influence household mobility outcomes.

## 5.6 Research outputs should help facilitate policy and programming interventions to ease challenges related to mobility

Several studies highlight that key national policies related to climate change, development, poverty alleviation, and disaster risk reduction/management do not frame mobility as a viable economic or adaptive strategy. To address the hardships of those exposed to climate hazards, research needs to provide evidence-based, empirically grounded basis for policy makers. Future studies should work to further unpack the diversity of household circumstances in the Ganges Delta, and generate empirical evidence on agentic and forced immobility, particularly within the context of disasters.

## 6. Conclusion

In this paper, we conducted a scoping review of climate-induced mobility and human security in Bangladesh's Ganges Delta region. In total, 66 papers were systematically identified and reviewed to answer research questions, summarize existing research gaps, and recommend how future research can work to better understand the area's climate security-mobility nexus.

Reviewed literature on climate-related mobility incorporated qualitative, quantitative, and mixed methods. Several studies employed multiple agent-based models, regression models, radiation models, and behavioural migration theory. Employed models intended to predict the mobility trends, but it is important to note that projections are not always accurate. Several climate-induced mobility studies have been conducted on the southwest coast of Bangladesh, notably in the Khulna district. With a significant portion of the population involved in agriculture, climate hazards are increasingly undermining farmers' incomes. Livelihood resilience has been found to influence the mobility decisions of people in vulnerable socio-ecological systems. Although the factors influencing mobility and immobility decisions among farmers and fisherfolk are assessed, limited attention was given to how mobility outcomes impact women and other vulnerable social groups. Flooding and cyclones were the two most-discussed climate hazards, in that order. The most frequently evaluated form of mobility was rural-urban migration. The role of social networks, both in anchoring people in place and pulling migrants toward specific destinations, has been well-documented. Importantly, comparisons of the socio-economic conditions of migrant and non-migrant households in the wake of disasters suggests that both out-migration and livelihood diversification can be successful adaptation strategies, as migrant households were generally better equipped to recover from weather-related losses than non-migrant households.

Several entry points exist for future research examining the links between climate-related mobility and human security in Bangladesh's Ganges Delta regions. Improved conceptual clarity can help disaggregate outcomes across different forms of mobility, including migration, displacement, relocation, and immobility. The use of methods such as econometric analyses, qualitative comparative analyses, and behavioural and experimental methods can help unpack the risk thresholds that influence mobility decisions. Future research should focus the specific experiences of vulnerable groups in the context of climate-related mobility and insecurity, including women, the poor, ethnic minorities and the youth—and be expanded outside of Khulna, where a large portion of existing research has been focused. The linkages between food/nutrition security and climate-related mobility outcomes also requires deeper exploration. Finally, climate-related mobility and human security should be contextualized within ongoing systemic agrarian transformation processes. Ultimately, empirical evidence gathered across geographical and socio-cultural settings in the Bangladesh's Ganges Delta is required for evidence-based policy development, program design, and decision making that improves human security outcomes within the context of climate-related mobility.

## Works referenced

- Adams, H., & Kay, S. (2019). Migration as a human affair: Integrating individual stress thresholds into quantitative models of climate migration. *Environmental Science and Policy*, 93(January), 129–138. <https://doi.org/10.1016/j.envsci.2018.10.015>
- Adger, W. N., de Campos, R. S., Siddiqui, T., Gavonel, M. F., Szaboova, L., Rocky, M. H., Bhuiyan, M. R. A., & Billah, T. (2021). Human security of urban migrant populations affected by length of residence and environmental hazards. *Journal of Peace Research*, 58(1), 50–66. <https://doi.org/10.1177/0022343320973717>
- Ahmed, B. (2018), "Who takes responsibility for the climate refugees?", *International Journal of Climate Change Strategies and Management*, Vol. 10 No. 1, pp. 5-26. <https://doi.org/10.1108/IJCCSM-10-2016-0149>
- Ahmed, S., Eklund, E. (2021). Climate Change Impacts in Coastal Bangladesh: Migration, Gender and Environmental Injustice. *Asian Affairs*, 52(1), 155–174. <https://doi.org/10.1080/03068374.2021.1880213>
- Ahsan, M.M., Özbek, N. (2022). Policy considerations on hurricane induced human displacement: Lessons from Cyclone Sidr and Hurricane Katrina. *Tropical Cyclone Research and Review*. Volume 11, Issue 2, June 2022, Pages 120-130. <https://doi.org/10.1016/j.tccr.2022.06.001>
- Ahsan, M.N., Khatun, F., Kumar, P., Dasgupta, R., Johnson, B.A., Shaw, R. (2022). Promise, premise, and reality: the case of voluntary environmental non-migration despite climate risks in coastal Bangladesh. *Reg Environ Change* 22, 1. <https://doi.org/10.1007/s10113-021-01864-1>
- Alam, A., Khalil, M.B. (2022). Gender, (im)mobility and social relations shaping vulnerabilities in coastal Bangladesh. *International Journal of Disaster Risk Reduction*. Vol 82. <https://doi.org/10.1016/j.ijdrr.2022.103342>
- Alam, M. Z., & Mamun, A. al. (2022). Dynamics of internal migration in Bangladesh: Trends, patterns, determinants, and causes. *PLoS ONE*, 17(2), 1–19. <https://doi.org/10.1371/journal.pone.0263878>
- Alam, G.M.M., Alam, K., Mushtaq, S. (2017). Climate change perceptions and local adaptation strategies of hazard-prone rural households in Bangladesh. <https://doi.org/10.1016/j.crm.2017.06.006>
- Al-Maruf A, Pervez AKMK, Sarker PK, Rahman MS, Ruiz-Menjivar J. (2022) Exploring the Factors of Farmers' Rural–Urban Migration Decisions in Bangladesh. *Agriculture*. 12(5):722. <https://doi.org/10.3390/agriculture12050722>
- Ayeb-Karlsson, S. (2020). When the disaster strikes: Gendered (im)mobility in Bangladesh. *Climate Risk Management*, 29. <https://doi.org/10.1016/j.crm.2020.100237>
- Ayeb-Karlsson, S., van der Geest, K., Ahmed, I. *et al.* (2016). A people-centred perspective on climate change, environmental stress, and livelihood resilience in Bangladesh. *Sustain Sci* 11, 679–694. <https://doi.org/10.1007/s11625-016-0379-z>
- Bashar A, Heal RD, Hasan NA, Salam MA, Haque MM. (2022) COVID-19 impacts on the Bangladesh shrimp industry: A sequential survey-based case study from southwestern Bangladesh. *Fish Sci*.



2022;88(6):767-786. doi: 10.1007/s12562-022-01630-0. Epub 2022 Sep 23. PMID: 36187420; PMCID: PMC9510452.

- Barnett, J., & Adger, W. N. (2007). Climate change, human security and violent conflict. *Political Geography*, 26(6), 639–655. <https://doi.org/10.1016/j.polgeo.2007.03.003>
- Bell, A. R., Wrathall, D. J., Mueller, V., Chen, J., Oppenheimer, M., Hauer, M., Adams, H., Kulp, S., Clark, P. U., Fussell, E., Magliocca, N., Xiao, T., Gilmore, E. A., Abel, K., Call, M., & Slangen, A. B. A. (2021). Migration towards Bangladesh coastlines projected to increase with sea-level rise through 2100. *Environmental Research Letters*, 16(2). <https://doi.org/10.1088/1748-9326/abdc5b>
- Bhowmik, J., Irfanullah., H. Md., Selim, S. A. (2021). Empirical evidence from Bangladesh of assessing climate hazard-related loss and damage and state of adaptive capacity to address them. *Climate Risk Management*. Vol 31. <https://doi.org/10.1016/j.crm.2021.100273>
- Black, R., Adger, W. N., Arnell, N. W., Dercon, S., Geddes, A., & Thomas, D. (2011). The effect of environmental change on human migration. *Global Environmental Change*, 21, S3-S11. <https://doi.org/10.1016/j.gloenvcha.2011.10.001>
- Biswas, B., & Mallick, B. (2021). Livelihood diversification as key to long-term non-migration: evidence from coastal Bangladesh. *Environment, Development and Sustainability*, 23(6), 8924–8948. <https://doi.org/10.1007/s10668-020-01005-4>
- Carrico, A., & Donato, K. (2019). Extreme Weather and Migration: Evidence from Bangladesh. *Population and Environment* 41:1-31. <https://doi.org/10.1007/s11111-019-00322-9>
- Call, M. A., Gray, C., Yunus, M., & Emch, M. (2017). Disruption, not displacement: Environmental variability and temporary migration in Bangladesh. *Global Environmental Change*, 46, 157–165. <https://doi.org/10.1016/j.gloenvcha.2017.08.008>
- Carrico, A. R., & Donato, K. (2019). Extreme weather and migration: evidence from Bangladesh. *Population and Environment*, 41(1), 1–31. <https://doi.org/10.1007/s11111-019-00322-9>
- Castellano R, Dolšak N, Prakash A. Willingness to help climate migrants: A survey experiment in the Korail slum of Dhaka, Bangladesh. *PLoS One*. 2021 Apr 22;16(4):e0249315. doi: 10.1371/journal.pone.0249315. PMID: 33886603; PMCID: PMC8062004.
- Cazcarro I, Arto I, Hazra S, Bhattacharya RN, Osei-Wusu Adjei P, Ofori-Danson PK, Asenso JK, Amponsah SK, Khondker B, Raihan S, Hossen Z. (2018). Biophysical and Socioeconomic State and Links of Deltaic Areas Vulnerable to Climate Change: Volta (Ghana), Mahanadi (India) and Ganges-Brahmaputra-Meghna (India and Bangladesh). *Sustainability*. 10(3):893. <https://doi.org/10.3390/su10030893>
- CGIAR (n.d.). Initiative: Asian Mega-deltas. <https://www.cgiar.org/initiative/18-securing-the-asian-mega-deltas-from-sea-level-rise-flooding-salinization-and-water-insecurity/>
- Dasgupta, S., Sobhan, I. & Wheeler, D. (2017) The impact of climate change and aquatic salinization on mangrove species in the Bangladesh Sundarbans. *Ambio* 46, 680–694. <https://doi.org/10.1007/s13280-017-0911-0>

- Dasgupta, S., Huq, M., Khan, Z.H., Ahmed, M.M.Z., Mukherjee, N., Khan, M.F., Pandey, K. (2010). Vulnerability of Bangladesh to Cyclones in a Changing Climate. The World Bank Development Research Group Environment and Energy Team. <https://openknowledge.worldbank.org/bitstream/handle/10986/3767/WPS5280.pdf?sequence=1&isAllowed=y>
- Dastagir, M.R. (2015). Modeling recent climate change induced extreme events in Bangladesh: A review. *Weather and Climate Extremes*, Volume 7, March 2015, Pages 49-60. <https://doi.org/10.1016/j.wace.2014.10.003>
- de Castro, M., Kuchai, N., Natarajan, S., Adeyeye, K., Fosas, D., Moran, F., McCullen, N., Wang, Z., & Coley, D. (2021). ShelTherm: An aid-centric thermal model for shelter design. *Journal of Building Engineering*, 44(March), 102579. <https://doi.org/10.1016/j.jobeb.2021.102579>
- de Lellis, P., Ruiz Marín, M., & Porfiri, M. (2021). Modeling Human Migration Under Environmental Change: A Case Study of the Effect of Sea Level Rise in Bangladesh. *Earth's Future*, 9(4), 1–14. <https://doi.org/10.1029/2020EF001931>
- Eckstein, D., Künzel, V., Schäfer, L. (2021). Global Climate Risk Index. [https://germanwatch.org/sites/default/files/Global%20Climate%20Risk%20Index%202021\\_1.pdf](https://germanwatch.org/sites/default/files/Global%20Climate%20Risk%20Index%202021_1.pdf)
- Emberson, R. A., Kirschbaum, D. B., & Stanley, T. (2021). Landslide Hazard and Exposure Modelling in Data-Poor Regions: The Example of the Rohingya Refugee Camps in Bangladesh. *Earth's Future*, 9(2), 1–22. <https://doi.org/10.1029/2020EF001666>
- Etzold, B., Ahmed, A. U., Hassan, S. R., & Neelormi, S. (2014). Clouds gather in the sky, but no rain falls. Vulnerability to rainfall variability and food insecurity in Northern Bangladesh and its effects on migration. *Climate and Development*, 6(1), 18–27. <https://doi.org/10.1080/17565529.2013.833078>
- FAO. (2022). Bangladesh. FAO Regional Office for Asia and the Pacific. <https://www.fao.org/asiapacific/perspectives/agricultural-statistics/global-strategy/results-in-the-region/bangladesh/en/#:~:text=Close%20to%2050%20percent%20of,%2Dseeds%2C%20vegetables%20and%20fruits.>
- FAO. (2007). Livelihood of over 6.7 million people adversely affected by Cyclone Sidr in Bangladesh. <https://reliefweb.int/report/bangladesh/livelihood-over-67-million-people-adversely-affected-cyclone-sidr-bangladesh>
- Godin, K., Stapleton, J., Kirkpatrick, S. I., Hanning, R. M., & Leatherdale, S. T. (2015). Applying systematic review search methods to the grey literature: a case study examining guidelines for school-based breakfast programs in Canada. *Systematic reviews*, 4(1), 1-10.
- Habiba, U., Shaw, R., Takeuchi, Y. (2011). Drought risk reduction through a Socio-economic, Institutional and Physical approach in the northwestern region of Bangladesh, *Environmental Hazards*, 10:2, 121-138. <https://www.sciencedirect.com/science/article/pii/S2212096321000024>
- Hassani-Mahmoei, B., & Parris, B. W. (2012). Climate change and internal migration patterns in Bangladesh: An agent-based model. *Environment and Development Economics*, 17(6), 763–780. <https://doi.org/10.1017/S1355770X12000290>

- Hossain MAR, Ahmed M, Ojea E, Fernandes JA. (2018) Impacts and responses to environmental change in coastal livelihoods of south-west Bangladesh. *Sci Total Environ.* 2018 Oct 1;637-638:954-970. doi: 10.1016/j.scitotenv.2018.04.328. Epub . PMID: 29763877.
- IFRC. (2022). Millions in Bangladesh impacted by one of the worst floodings ever seen. <https://www.ifrc.org/press-release/millions-bangladesh-impacted-one-worst-floodings-ever-seen>
- Islam, K. M. A., Adnan, M. S. G., Zannat, K. E., & Dewan, A. (2022a). Spatiotemporal dynamics of NO<sub>2</sub> concentration with linear mixed models: A Bangladesh case study. *Physics and Chemistry of the Earth*, 126(2), 103119. <https://doi.org/10.1016/j.pce.2022.103119>
- Islam, H.M. *et al.* (2022b) "Future precipitation projection in Bangladesh using simclim climate model: A multi-model ensemble approach," *International Journal of Climatology*, 42(13), pp. 6716–6740.
- Islam, R., Schech, S., Saikia, U. (2021) Climate change events in the Bengali migration to the Chittagong Hill Tracts (CHT) in Bangladesh, *Climate and Development*, 13:5, 375-385, DOI: [10.1080/17565529.2020.1780191](https://doi.org/10.1080/17565529.2020.1780191)
- Islam, M. R., & Shamsuddoha, M. (2017). Socioeconomic consequences of climate induced human displacement and migration in Bangladesh. *International Sociology*, 32(3), 277–298. <https://doi.org/10.1177/0268580917693173>
- Islam, R., & Walkerden, G. (2014). How bonding and bridging networks contribute to disaster resilience and recovery on the Bangladeshi coast. *International Journal of Disaster Risk Reduction*, 10(PA), 281–291. <https://doi.org/10.1016/j.ijdrr.2014.09.016>
- Islam, M. R., & Hasan, M. (2016). Climate-induced human displacement: a case study of Cyclone Aila in the south-west coastal region of Bangladesh. *Natural Hazards*, 81(2), 1051–1071. <https://doi.org/10.1007/s11069-015-2119-6>
- Malji, A., Obana, L., Hopkins, C. (2022) When Home Disappears: South Asia and the Growing Risk of Climate Conflict, Terrorism and Political Violence, 34:5, 939-957, DOI: [10.1080/09546553.2022.2069448](https://doi.org/10.1080/09546553.2022.2069448)
- Mallick, B. (2019). The Nexus between Socio-Ecological System, Livelihood Resilience, and Migration Decisions: Empirical Evidence from Bangladesh. *Sustainability*, 11(12), 3332. <https://doi.org/10.3390/su11123332>
- Mallick, B., Vogt, J. (2014). Population displacement after cyclone and its consequences: empirical evidence from coastal Bangladesh. *Nat Hazards* 73, 191–212. <https://doi.org/10.1007/s11069-013-0803-y>
- Marshall, R., & Rahman, S. (2013). Internal migration in Bangladesh: character, drivers and policy issues. *United Nations Development Programme (UNDP)*, 1–36.
- Martin, M., Billah, M., Siddiqui, T., Abrar, C., Black, R., & Kniveton, D. (2014). Climate-related migration in rural Bangladesh: A behavioural model. *Population and Environment*, 36(1), 85–110. <https://doi.org/10.1007/s11111-014-0207-2>

- McLeman, R., Wrathall, D., Gilmore, E. et al. Conceptual framing to link climate risk assessments and climate-migration scholarship. *Climatic Change* 165, 24 (2021). <https://doi.org/10.1007/s10584-021-03056-6>
- Mortoja MG, Yigitcanlar T. (2020). How Does Peri-Urbanization Trigger Climate Change Vulnerabilities? An Investigation of the Dhaka Megacity in Bangladesh. *Remote Sensing*. 12(23):3938. <https://doi.org/10.3390/rs12233938>
- Nepal, S., Shrestha, A.B., (2015) Impact of climate change on the hydrological regime of the Indus, Ganges and Brahmaputra river basins: a review of the literature, *International Journal of Water Resources Development*, 31:2, 201-218
- Ober, Kayly (2020) 'The Links between Climate Change, Disasters, Migration, and Social Resilience in Asia: A Literature Review'. SSRN Electronic Journal. [online] Available from: <https://www.adb.org/sites/default/files/publication/510651/ewp586-climate-change-disasters-migration-asia.pdf>
- Human Security Unit – OCHA (2010): Applying the Human Security Concept in Project and Programme Development, Implementation and Impact Assessment, Regional Training Workshop, San José, Costa Rica, 12-15 October.
- Ortolano, L., Sánchez-Triana, E., Ferdausi, A.S., (2017) Strategy for adapting to climate change and conserving biodiversity in the Bangladesh Sundarbans, *Climate and Development*, 9:4, 325-336, DOI: [10.1080/17565529.2016.1167660](https://doi.org/10.1080/17565529.2016.1167660)
- Petrova, K. (2021). Natural hazards, internal migration and protests in Bangladesh. *Journal of Peace Research*, 58(1), 33–49. <https://doi.org/10.1177/0022343320973741>
- Peters, M. D., Godfrey, C. M., Khalil, H., McInerney, P., Parker, D., & Soares, C. B. (2015). Guidance for conducting systematic scoping reviews. *JBI Evidence Implementation*, 13(3), 141-146. DOI: [10.1097/XEB.0000000000000050](https://doi.org/10.1097/XEB.0000000000000050)
- Rabbani, M.M.G., Cotton, M. & Friend, R. Climate change and non-migration — exploring the role of place relations in rural and coastal Bangladesh. *Popul Environ* **44**, 99–122 (2022). <https://doi.org/10.1007/s11111-022-00402-3>
- Rabbani, M.M.G., Mahmud Khan, Z., Tuhin, M. H., Naznin, Z., Emran, D.A (2015). Climate Change Migration in Bangladesh A gender Perspective, UN Women. <https://asiapacific.unwomen.org/sites/default/files/Field%20Office%20ESEA/Docs/Publications/2016/01/Climate%20Change%20Migration%20in%20Bangladesh%20A%20gender%20Perspective.pdf>
- Rahman, A. (2020). A Study on Irregular Migration from Bangladesh to Malaysia through the Bay of Bengal and the Andaman Sea. *Otoritas Jurnal Ilmu Pemerintahan* 10(2):120-131. DOI:10.26618/ojip.v10i2.4640
- Rigaud, K. K., de Sherbinin, A., Jones, B., Bergmann, J., Clement, V., Ober, K., Schewe, J., Adamo, S., Mccusker, B., Heuser, S., & Midgley, A. (2018). *PREPARING FOR INTERNAL CLIMATE MIGRATION GROUNDSWELL*. <https://openknowledge.worldbank.org/entities/publication/2be91c76-d023-5809-9c94-d41b71c25635>

- Saha, S. K. (2017). Cyclone Aila, livelihood stress, and migration: empirical evidence from coastal Bangladesh. *Disasters*, 41(3), 505–526. <https://doi.org/10.1111/disa.12214>
- Savelli A, Schapendonk F, Sarzana C, Dutta Gupta T, Caroli G, Duffy M, de Brauw A, Thornton P, Pacillo G, Läderach P. 2022. The Climate Security-Mobility Nexus: Impact Pathways and Research Priorities. Position Paper No. 2022/2. CGIAR FOCUS Climate Security. <https://cgspace.cgiar.org/handle/10568/117589>
- Sarker, M. N. I., Wu, M., Alam, G. M. M., & Shouse, R. C. (2020). Life in riverine islands in Bangladesh: Local adaptation strategies of climate vulnerable riverine island dwellers for livelihood resilience. In *Land Use Policy* (Vol. 94). Elsevier Ltd. <https://doi.org/10.1016/j.landusepol.2020.104574>
- Shamsuddoha, Md, Khan, SM Munjurul Hannan, Hossain, Tanjir, and Raihan Sajid (2011). Displacement and migration from the climate hot-spots: Causes and Consequences, Center for Participatory Research and Development and ActionAid Bangladesh, Dhaka: December, 2011 [https://unfccc.int/files/adaptation/groups\\_committees/loss\\_and\\_damage\\_executive\\_committee/application/pdf/displacement\\_and\\_migration\\_from\\_the\\_hot\\_spots\\_in\\_bangladesh\\_causes\\_and\\_consequences.pdf](https://unfccc.int/files/adaptation/groups_committees/loss_and_damage_executive_committee/application/pdf/displacement_and_migration_from_the_hot_spots_in_bangladesh_causes_and_consequences.pdf)
- Shamsuzzaman, M.M. *et al.* (2017) “Fisheries Resources of Bangladesh: Present status and future direction,” *Aquaculture and Fisheries*, 2(4), pp. 145–156. Available at: <https://doi.org/10.1016/j.aaf.2017.03.006>.
- Southard, E. M. L., & Randell, H. (2022). Climate Change, Agrarian Distress, and the Feminization of Agriculture in South Asia\*. *Rural Sociology*, 87(3), 873–900. <https://doi.org/10.1111/ruso.12439>
- Steimanis, I., & Vollan, B. (2022). Prosociality as response to slow-and fast-onset climate hazards. *Global Sustainability*, 5. <https://doi.org/10.1017/sus.2022.9>
- Subhani, R., & Ahmad, M. M. (2019). Socio-economic impacts of cyclone aila on migrant and non-migrant households in the southwestern coastal areas of Bangladesh. *Geosciences (Switzerland)*, 9(11). <https://doi.org/10.3390/geosciences9110482>
- UNGA (2012) United Nations Resolution 66/290, United Nations, United Nations General Assembly. [online] Available at: [https://www.un.org/en/ga/search/view\\_doc.asp?symbol=A/RES/66/290](https://www.un.org/en/ga/search/view_doc.asp?symbol=A/RES/66/290)
- UNDP, 1994. Human Development Report 1994: New Dimensions of Human Security. New York: Oxford University Press. <https://hdr.undp.org/system/files/documents/hdr1994encompletenostatpdf.pdf>
- Williams, L.J., Afroz, S., Brown, P.R., Chialue, L., Grünbühel, C.M., Jakimow, T., Khan, I., Minea, M., Reddy, V.R., Sacklokham, S., Rio, E.S., Soeun, M., Tallapragada, C., Tom, S., & Roth, C.H., (2016) Household types as a tool to understand adaptive capacity: case studies from Cambodia, Lao PDR, Bangladesh and India, *Climate and Development*, 8:5, 423-434. <https://doi.org/10.1080/17565529.2015.1085362>
- World Bank. (2021). Climate Change Knowledge Portal: Bangladesh. <https://climateportalqa.worldbank.org/country/bangladesh/climate-data-historical>

World Bank. (2013). Warming Climate to Hit Bangladesh Hard with Sea Level Rise, More Floods and Cyclones, World Bank Report Says. <https://www.worldbank.org/en/news/press-release/2013/06/19/warming-climate-to-hit-bangladesh-hard-with-sea-level-rise-more-floods-and-cyclones-world-bank-report-says>

World Health Organization. (2022). Bangladesh Flood 2022: WHO Collaboration with DGHS/MOHFW. <https://www.who.int/bangladesh/news/detail/23-06-2022-bangladesh-flood-2022-who-collaboration-with-dghs-mohfw>

## Appendix 1. List of keywords used in automated search query

Climate/Environment	Human Security	Mobility	Geography
Acidification	Aid	Departure	Bangladesh
Climate	Authoritarian	Displacement	
Climate adaptation	Cohesion	Exodus	
Climate change	Communal	Immigrant	
Climate mitigation	Competition	Immobile	
Climate risk	Conflict	In Migration	
Climate variability	Corruption	Migrant	
Cyclone	Crime	Migration	
Dam construction	Debt	Movement	
Desertification	Deforestation	Out Migration	
Drought	Dispute	Pull factor	
Erosion	Dissent	Push factor	
Evapotranspiration	Environmental degradation	Refugee	
Extreme weather	Ethnic group	Relocation	
Flood	Famine	Remittance	
Groundwater extraction	Fragility	Resettlement	
Heat stress	Gang	Rural - Urban	
Landslide	Grievances	Separated	
Maladaptation	Protest	Trafficking	
Natural disaster	Humanitarian	Trapped	
Natural hazard	Hunger	Urban - Rural	
Pollution	Inequality		
Rain	Land conflict		
Salination	Land degradation		
Salinity intrusion	Land scarcity		
Salinization	Land use		
Sand mining	Landgrabbing		
Sea level rise	Livelihoods		
Subsidence	Malnutrition		
Temperature	Militia		
Typhoon	Minority		
Water logging	Peace		
Water quality	Peacebuilding		
Water scarcity	Poverty		
Precipitation	Community security		
	Economic security		
	Environmental security		
	Food security		
	Health security		
	Personal security		

	Physical security		
	Political security		
	Radicalisation		
	Repression		
	Resource management		
	Security		
	Stability		
	Tension		
	Theft		
	Unrest		
	Vegetation		
	Violence		
	Exploitation		





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In response to the changes in the external environment, CGIAR has been in an almost perpetual state of reforms from the start of the new millennium to One CGIAR.

One CGIAR is a dynamic reformulation of CGIAR's partnerships, knowledge, assets, and global presence, aiming for greater integration and impact in the face of the interdependent challenges facing today's world.

As One CGIAR, scientific innovations for food, land and water systems can be deployed faster, at a larger scale, and at reduced cost, having greater impact where they are needed the most. This will provide our beneficiaries around the world with more sustainable ways to grow, catch, transport, process, trade, and consume safe and nutritious food.

The overarching objectives and principles guiding the transition have been set and we are now undertaking an inclusive and consultative process of co-creation to define the destination in further detail, and the transition pathway to reach it.



For more information, visit:

<https://www.cgiar.org/>  
<https://www.cgiar.org/food-security-impact/one-cgiar/>  
<https://www.cgiar.org/cgiar-portfolio>