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How do migration decisions and drivers differ against extreme environmental events?

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ABSTRACT

Migration is often understood to be a livelihood strategy to cope with the effects of environmental threats and climate change. Yet, the extent to which migration decisions differ due to the type, severity, and frequency of environmental events has been little explored. This paper employs household surveys in southwestern Bangladesh to explore this research gap. A multinomial regression model is used to simulate reported future migration decisions (200 sample households) in the context of both rapid-onset (i.e. cyclone and flood) and slow-onset (salinity, siltation, and riverbank erosion) environmental phenomena. Results show: i) previous disaster experience and increasing conflict in the community motivate migration in the near future in the context of slow-onset phenomena (salinity); ii) economic strength and self-efficacy increase non-migration intention in both contexts of sudden and slow-onset events; and iii) the extent and pattern of these influences on migration differ across demographics, including education, religion, and age. Importantly, this analysis shows that the relationship between migration decisions and the type, severity, and frequency of environmental events is influenced by socioeconomic conditions. Therefore, this research supports future adaptation planning specifically tailored to the type and exposure of extreme environmental events.

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1. Introduction

Migration has been identified as an adaptive strategy in the face of climate change (Black et al., 2011). Contemporary estimates indicate that climate change will cause more intense

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and prevalent environmental hazards in the coming decades (Allen et al., 2018), potentially encouraging more people to migrate (Hunter & Norton, 2015). Developing countries are at higher risk of experiencing severe climate change effects. The World Bank estimates that Sub-Saharan Africa, South Asia, and Latin America regions may face a combined total of over 140 million internal climate migrants by 2050 (Rigaud et al., 2018). Among these countries, Bangladesh is significantly affected by climate change-induced damage from sudden and slow onset environmental events. Most relevant to the context of Bangladesh are cyclones, floods, erosion, salinity, and sea level rise. Estimates suggest that climate change could displace 13.3 million Bangladeshis by 2050 (Rigaud et al., 2018).

The likelihood of environmentally motivated migration depends on social, economic, political, and cultural conditions (Bernzen et al., 2019). However, the same objective conditions may lead to different migration decisions, as people appraise environmental risks differently. Recent explorations of environmental migration highlight the importance of climate change perceptions and related subjectivities to mobility (Czaika & Reinprecht, 2022), including people's views on their own agency, risk tolerance, and personal migration thresholds (Adams & Kay, 2019; Wiegel et al., 2019). These critical perceptual factors must be accounted for meaningfully to evaluate future mobility decisions (migration and non-migration). In addition to the role of environmental perceptions, more research is needed to understand how the type, extent, and frequency of environmental events may influence mobility decisions.

To begin to address this research gap, this study investigates the effect of extreme environmental events on mobility motives against a selection of key factors influencing migration aspiration. We ask: *How does the migration aspiration of people at risk vary based on the type of extreme environmental event they perceive or experience?* In response to this question, we conducted an empirical survey and collected qualitative and quantitative data in five villages in the southwest coastal region of Bangladesh. Natural hazards in this region are divided into two main categories, (1) rapid-onset such as storms, cyclones, and floods, and (2) slow-onset such as salinity, riverbank erosion, and siltation. Our analysis shows that the type, severity, and frequency of such environmental events interact with socioeconomic conditions to influence people's future migration motivations.

2. Literature review & analytical concept

2.1. Environmental (non-)migration discourse

Environmental hazards and climate change affect human mobility in multiple ways. They can broadly be divided into four outcomes: (1) forced migration, (2) involuntary non-migration, (3) voluntary migration, and (4) voluntary non-migration (Mallick & Schanze, 2020). When the effects of a natural hazard coerce migration by rendering a household's current living place insufficient to sustain life, and when these households cannot adapt in place due to lack of capability, the resulting movement is known as forced migration (Adger et al., 2021; Cattaneo et al., 2019; Hodgkinson & Young, 2009). Low-income families may face forced migration after natural hazards as existing inequalities make them especially vulnerable to hazards and less able to adapt or recover. In Bangladesh, forced migration is more frequent after cyclones and other rapid-onset hazards that

abruptly destroy livelihoods or property, precluding the possibility of staying in place (Mallick & Vogt, 2014). Meanwhile, migration decisions caused by a slowly changing environment more often arise deliberately and gradually as people begin to feel that their living environment is depleted and livelihood opportunities are declining. Those who willingly migrate in the face of this kind of environmental change are considered voluntary migrants. As salinity increases in coastal areas of Bangladesh, many people who can afford to do so are slowly moving away or converting to more salinity-tolerant occupations like shrimp farming or saline-tolerant rice and vegetable cultivation (Chen & Mueller, 2018).

Environmental (non-)migration, a comparatively understudied phenomenon, can be described as the lack of aspiration or capability to migrate despite an environmental risk (Mallick & Schanze, 2020). Staying in place in the face of hazards, and the factors underpinning non-migration, are fundamental to the environmental migration story. In some cases, people are interested in migrating but cannot move for different reasons; principal among these are financial barriers and a lack of social contacts to help facilitate the move (Etzold & Mallick, 2016). These ‘trapped populations’ are categorised as involuntary non-migrants (Ayeb-Karlsson et al., 2020; Black & Collyer, 2014). Finally, some people decline to leave their home region, regardless of financial and social capacity. They view migration as a final recourse because they prefer to live in their birthplace, stay with their relatives, and/or are unwilling to relinquish their property (De Dominicis et al., 2015). This is defined as voluntary non-migration.

While environmental events as a motivation for migration have been explored, associations between motivations to move or stay and *specific* extreme event types within a region have seldom been quantitatively studied. In a recent example, Zander and Garnett (2020) explore the mobility decisions of Australian and Philippine subjects to find that slow-onset hazards are more likely to contribute to migration decision-making for Australians, whereas rapid-onset hazards have a negligible effect. Meanwhile, socio-demographic and economic attributes trumped hazard-type influences on migration in the Philippines. The balance of factors influencing migration aspiration has not been thoroughly examined concerning hazard types. In this study, we explore these themes by evaluating the migration motives of people at risk under different environmental stresses.

2.2. Analytical concept

Various factors influence migration decisions, including types of environmental change and hazards experienced (Carrico & Donato, 2019; Czaika & Reinprecht, 2022; Gray & Mueller, 2012). These factors have different levels and scales of influence on the migration outcome; in particular, some factors influence community characteristics, and others affect individual household attributes. Figure 1 represents a modified analytical concept of Mallick et al. (2021) on assessing factors influencing environmental non-migration. They applied ‘Protection Motivation Theory’ (Rogers, 1975) and assessed how risk perception and coping strategies influence migration decisions in coastal communities in Bangladesh (Mallick et al., 2021).

Figure 1 shows that community-level factors such as *economic conditions* and *community cohesion* play an essential role in establishing the community’s *living conditions* that

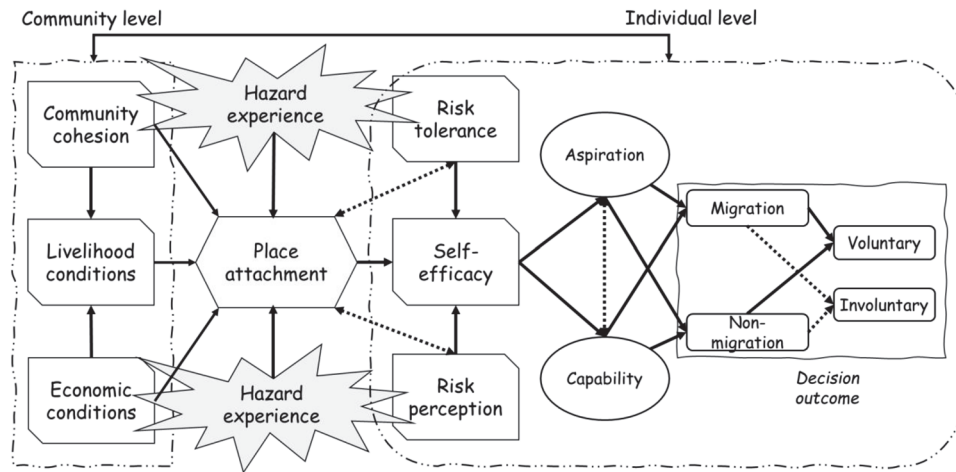


Figure 1. Analytical concept: Hazard – place attachment – (non-)migration nexus. Source: Authors' illustration and adopted from Mallick et al. (2021).

promote motivations to stay in place (i.e. *place attachment*) despite hazards. At the same time, the frequency of extreme events or experiences in tackling environmental hazards influences both perception and tolerance of the risks. Both *risk perception* and *risk tolerance* inform *self-efficacy* (i.e. perceived ability to tackle future shocks) at the individual and household levels. Self-efficacy, in turn, influences an individual's *aspiration* and *capability* to migrate or stay. Depending on the relationship between aspiration and capability, as describe, a (non-)migration decision may then be considered *voluntary* or *involuntary*. We contend that it is instructive to know how different kinds of extreme environmental events influence the described (non-)migration decision process and how their influence intersects with other migration predictors, such as socioeconomic conditions. This is of particular value in highly-affected and dynamic regions like coastal Bangladesh.

3. Methodology

3.1. Study site: Southwest coastal zone of Bangladesh

Bangladesh has a documented migration history related to British colonialisation, the establishment of the Pakistan regime, independence from Pakistan in 1971, and modern climate change impacts (Alam, 2018; Percot, 2018). Livelihood shifts arising from salinisation, sea level rise, storm surges, and shifting rain patterns compound social and political issues nationally and regionally and factor into migration decisions (Mallick & Etzold, 2015; Penning-Rowsell et al., 2013). However, migration trends as well as the severity and frequency of environmental events differ across the country. The coastal zone, which includes 19 districts and 147 sub-districts and has direct proximity to the Bay of Bengal, is more vulnerable to climate change consequences than other areas. This region is a hotspot for climate-change-related natural hazards, with public life and livelihood activities often disrupted due to cyclones, floods, riverbank erosion, or salinity ingress (Etzold & Mallick, 2016). Seasonal hazards such as north-wester,

monsoon flooding, land-slides, and riverbank erosion have produced an environmental migration profile generally characterised by temporary and inward (away from coasts) migration. Sometimes, poorer household heads or men temporarily seek work in urban areas to supplement income and address financial problems caused by the disaster while keeping their dependents in place (Biswas & Mallick, 2021).

The coastal zone accounts for 32% of the area and 28% of the population of Bangladesh, and is divided into three regions: southeast, central and southwest coast. The southwest zone, in particular, is witnessing substantial outmigration and unpredictable demographic futures (Ahsan et al., 2022; Naser et al., 2019). Migration, especially from rural to urban, is common, and past work has shown that one-third of families in this region have sent a male migrant to a nearby city (temporarily or permanently) immediately after an extreme environmental event (Ahsan et al., 2002; Mallick & Vogt, 2012).

The natural environment in the southwestern region is also unique. Since the 1960s, polders, or dams that enclose low-lying land to offer protection from flooding, have been used in the coastal region to manage flood risk. There exist 139 polders in this coastal region of Bangladesh, and these polders have contributed significantly to the socio-economic and environmental conditions of this region (Masud et al., 2017). Riverbank erosion is also notable in the area, though not everyone is affected by this highly localised hazard. Exposure to cyclones and salinity encroachment into groundwater are challenges in this region. These complex factors related to the population, natural environment, and built environment have made the region of southwest coastal Bangladesh a prime area for environmental migration studies (Ahsan et al., 2022; Mallick & Vogt, 2014; Penning-Rowsell et al., 2013).

We have selected this southwestern coastal region of Bangladesh as the study area due to the prevalence of environmental changes in recent decades and the associated migration and non-migration profile. While selecting the study communities to survey, we considered the environmental conditions that influence livelihood conditions. For instance, proximity to a river has an impact on household vulnerability (Ahsan & Khatun, 2020) in a poldered community (Auerbach et al., 2015). Soil salinity also impacts agricultural production, household income (Chen & Mueller, 2018), and land-use change (Parvin et al., 2017). People living close to the coast are more vulnerable to cyclone hazards; distance from the coast is also an essential aspect of livelihood vulnerability. We consider the zoning of 'severity to cyclone hazard' provided by the government of Bangladesh as one of the major selection criteria for study villages. We selected two villages from the high risk of cyclone zone, two villages from the moderate risk of cyclone zone, and one village from the less risk of cyclone zone. Thus, the factors considered for the selection of the study villages are (1) cyclone disaster trends - high to low, (2) salinity amount - high to low, (3) land-use type, (4) proximity to the river, and (5) the presence of a polder.

Accordingly, five villages (i.e. Chakdah, Nathpara, Padmapukur, Panchakari, and Vabanipur) from the three southwestern districts (i.e. Bagerhat, Khulna, and Satkhira) were selected for this study. Figure 2 maps the surveyed households where each village is located. Identified as the high-risk cyclone zones, Chakdah stands on the international border, whereas Padmapukur is on the verge of mangrove forest Sundarbans. Nathpara and Vabanipur are in the medium-risk zone, and Panchakari is in the low-risk cyclone zone. Such locational characteristics influence the livelihood resources and economic conditions of the people and contribute to their mobility decisions.

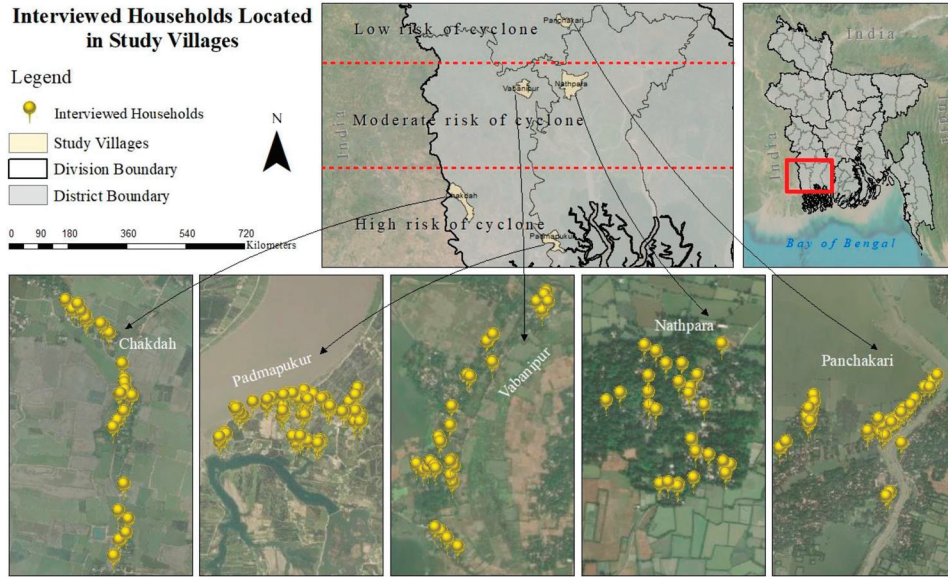


Figure 2. Study area.

3.2. Sampling and data collection

A stratified sampling procedure was used to select households within the selected villages. The total number of households across the five selected villages was $N = 852$. Using 95% confidence level and a 6% margin of error, we set the target sample size at $n = 195$ households. In doing so, we used an adjusted sample size calculation formula (equation 2, where n_0 is calculated by using equation 1), which calculates the sample size by a given desired level of precision, desired confidence level, and the estimated proportion of the attribute present in the population.

$$n_0 = \frac{Z^2 pq}{e^2} \quad (1)$$

$$n = \frac{n_0}{1 + \frac{(n_0 - 1)}{N}} \quad (2)$$

Where,

n_0 is the sample size, n is the adjusted sample size, e is the margin of error, p is the (estimated) proportion of the population, q is $1 - p$, N is the population size, and the Z -score range from -3 standard deviations up to $+3$ standard deviations.

Then, total samples were proportionately distributed amongst the selected villages. However, data collectors could not fulfil their targets in Nathpara and Padmapukur villages due to the unavailability of respondents and time limitations. They conducted extra surveys in Chakdah village to achieve the targeted sample size. The first author of this research paper supervised the field research activities. Table 1 provides the field-level data collection details.

Table 1. Sample size, socio-demographic statistics and future migration intention of the sample households.

Characteristics	Descriptions	Nathpara	Panchkori	Vabanipur	Chakdah	Padmapukur
Total population (3881)		931	965	498	225	1262
Total households (852)		164	184	128	49	327
Expected sample size (195)		28	42	29	11	75
Surveyed sample size (195)		27	42	31	29	66
Gender (%)	Male	85.2	83.3	80.6	58.6	75.8
	Female	14.8	16.7	19.4	41.4	24.2
Religion (%)	Muslim	51.9	23.8	16.1	41.4	54.5
	Hindu	48.1	76.2	83.9	58.6	45.5
Education (%) [highest level of schooling of the household head]	Illiterate	0.0	4.8	22.6	3.4	6.1
	<10 years	59.3	78.6	61.3	72.4	63.6
	> 10 years	40.7	16.7	16.1	24.1	30.3
Occupation across the villages (%)	Farmer	35.5	26.4	25.0	22.2	19.8
	Fishermen	17.1	21.4	29.1	26.1	27.5
	Wage-earner	22.3	29.3	21.9	27.6	26.0
	Business	15.2	15.4	17.9	21.1	23.2
	Others	9.7	7.8	6.1	3.4	3.1
Would like to migrate in the near future? (%)	Agree (like to migrate)	19.6	19.5	26.7	16.7	34.7
	Neither agree nor disagree (neutral)	7.4	9.8	13.3	10.0	13.6
	Disagree (like to stay)	73.0	70.7	60.0	73.3	51.5

Data was collected through an interviewer-administered questionnaire answered by household heads using the Kobocollect toolbox. Survey work was conducted with the verbal consent of the respondent. Before issuing the survey, respondents were described the study and informed they would not be given any financial compensation for participation. Field research was conducted from March to April 2018. Inclusion criteria for the interview were as follows: (1) at least 18 years of age and (2) able to answer questions about the problems of the local community. On average, respondents took 40 min to complete the survey. Ethics approval was obtained from the Dhaka University of Bangladesh.

3.3. Measures

The selected predictors (e.g. Figure 1) are outlined below, with their relevance to this study.

(i) Place-attachment

The duration of living in a place and the resulting affinity for the landscape and community (i.e. place attachment) influences future mobility aspiration (De Dominicis et al., 2015). Place attachment is a broad concept comprising social, psychological, and affective dimensions, which may bolster subjective adaptive capacity in scenarios of environmental risk, thereby discouraging migration (Swapan & Sadeque, 2021). Studying a Peruvian community affected by climate change, Adams (2016) found that many people who declined to migrate despite dissatisfaction felt strong bonds to their homeland and community that diminished the desire to leave. Similarly, in a

drought-affected Iranian community, Khanian et al. (2019) found that place attachment tilted response away from migration in favour of in-situ adaptation. Here, we use the duration of residence in the community as an approximation for households' place attachment.

(ii) *Environmental risk perception*

Previous research shows a significant relationship between risk perception and migration decisions. Risk perception emerged as the dominant factor motivating relocation intention among residents of a wildfire-prone wildland-urban interface in Colorado. Following a fire event, those perceiving higher risks reported being more likely to move (Nawrotzki et al., 2017). This risk perception aspect is also relevant for explaining non-migration in climate-vulnerable areas. This study has been derived from the respondents' perception of changes in salinity, siltation and land-fertility compared to the previous year within the community.

(iii) *Risk tolerance*

Risk-taking preferences influence migration decision-making as migration for any reason constitutes a risky behaviour due to the social, economic, and personal uncertainties entailed (Williams & Baláž, 2013). Staying in a disaster-vulnerable community also entails risks, which are balanced against the risks of migration and other adaptive measures. In the Bangladeshi context, lower risk tolerance has been linked to a lower attachment to land (as a motivator for migration) (Mallick et al., 2021).

(iv) *Self-efficacy*

Self-efficacy describes one's ability to withstand or reduce susceptibility to the impacts of a hazard through their own actions. It is correlated with adaptive behaviour (Mertens et al., 2018). In southwestern Bangladesh, those who feel they possess self-efficacy to cope with upcoming climate-induced stresses have expressed a greater inclination to non-migration as they believe they have the capacity to absorb forthcoming shocks while staying in place (Mallick et al., 2021).

(a) *Economic conditions*

Economic motivations tend to underpin migration in rural Bangladesh, irrespective of the presence of environmental factors. Regarding environmental migration, economic conditions are identified as one of the five key drivers determining migration decisions (Black et al., 2011). Migration is one key instrument for improving economic conditions (Bardsley & Hugo, 2010; Gamlen et al., 2018). Thus, it is expected that people facing hazards that threaten their livelihood would be likelier to choose migration, while economically solvent people will stay put. Therefore, we consider whether respondents perceive shifts, i.e. deteriorations, in their economic conditions as a factor influencing migration decision-making.

(vi) Living conditions

We also consider changes in living conditions as an influence on migration aspirations. Living conditions, including health, infrastructure, and access to services and amenities, broadly encompass the determinants of well-being and living standards beyond economic status (Vainio, 2020). People's appraisal of these conditions significantly influences whether they migrate or stay in the face of livelihood challenges. Environmental migration may arise at different 'thresholds' of declines in living conditions (McLeman, 2017).

(vii) Community cohesion

Social harmony and cohesion play a vital role in disaster resilience, preparation, and recovery (Vainio, 2020). In turn, these factors are likely to influence future mobility outcomes. It was found that participatory and self-organisation capacity among affected communities was crucial for effectively accommodating flood risks in Semarang Bay, Indonesia, enabling locals to stay in place for longer following a flood event (Bott & Braun, 2019). While social networks are key to facilitating migration, strong social ties can also ameliorate the stresses of environmental change, discouraging migration by boosting the coping mechanisms of people at risk (Torres & Casey, 2017).

(viii) Hazard experience

Prior experience of hazards can contribute to migration decisions in the face of hazard-induced livelihood challenges. Following Hurricane Sandy in 2012, personal experience of flooding and sea level rise motivated mitigation measures, including relocation (Bukvic & Owen, 2017). Equally, previous experience can discourage mobility as people perceive they are able to weather hazards by alternative measures, having done so before (Mallick et al., 2021). The experience of slow-onset hazards versus rapid ones may have differing impacts on mobility decisions (Zander & Garnett, 2020). We hypothesise that as prior experiences vary across hazard types, they will likely inform migration responses to future hazards differently.

3.4. Model description

The dependent variable of this study is the future migration motive, which we have interpreted as '*whether there is an intention to move outside one's own community*'. That means it is any place outside their current community. To capture this, we ask, 'As there is more opportunity outside your village, do you agree that you would like to migrate from here?' This question has three response options: '*disagree*', '*neither agree nor disagree*', and '*agree*', which have been replaced by '*like to stay*', '*neutral*' and '*like to migrate*', respectively. Thus, we employ a multi-nomial logistic regression (baseline category) model with 'future migration motive' as the dependent variable (baseline chosen as 'like to

migrate') and consider as:

$$\begin{aligned}\pi_1 &= \text{probability of liketo stay}; \pi_2 = \text{probability of neutrality}; \text{and } \pi_3 \\ &= \text{probability of like to migrate}\end{aligned}$$

The equation is presented below (Equation-3).

The multi-nomial logistic regression model is defined as.

$$\text{Log} (\pi_j|\pi_3) = \beta_{0j} + \beta_{1jx_1} + \beta_{2jx_2} + \dots \dots \dots (3)$$

where $j = 1, 2 \dots$ indicates the individual respondent and the x 's represent the predictor variables, including any interactions, where these predictors do not depend on j .

We then assess how future mobility motives vary across different environmental hazards and the relation between specific hazards and the other predictors.

We want to know how the 'probability of neutrality' differs between the 'probability of like to stay' and 'probability of like to migrate'. Table 1 shows this 'neutral' group ranges from 7.4 percent to 13.6 percent, which is relatively small compared to 'like to migrate' (16.7 percent to 34.7 percent) or 'like to stay' (51.5 percent to 73.3 percent). Given such small proportion of this 'neutral' group in our sample, it would have been better to run a logistic regression model using a binary choice: disagree or agree i.e. stay or migrate. But we stick with multi-nomial logistic regression because it provides some valuable insights into the effects of predictors on 'the probability of neutrality' and explains its implications for inclusion in future research.

3.5. Socio-demographic characteristics of the sample households

The summary socio-demographic statistics of respondents are presented in Table 1. The gender distribution of the respondents is 76.9% male and 23.1% female. Concerning the religion, Vabanipur and Chakdah show a majority Hindu religion. Nathpara shows a comparatively higher number of respondents having more than 10 years of schooling, while most villages show around 60% of respondents with less than 10 years of schooling. Compared to others, Vabanipur has the largest proportion of illiterate residents (22.6%) (Table 1).

The most common primary occupation among the respondents is farming, followed by fishing and wage-earners. 30% of the respondents from Panchkori are wage earners as their main occupation, while 29.1% of respondents in Vabanipur report fishing as their main occupation. Farming is the majority occupation in Shovna (35.5%), followed by wage-earners (22.3). Fishers (27.5%) and wage earners (26%) constitute close to the same proportion of respondents in Padmapukur. In Panchkoiri, wage-earner (29.3%) is the most common occupation, followed by farming (26.4%).

Regarding the desire to migrate, Padmapukur reports the highest intent of migration (34.7%) followed by Vabanipur (26.7%), whereas the lowest score is for Chakdah (16.7%). However, over 60% of the respondents (except village Padmapukur) would not like to migrate, while the remaining respondents expressed neutrality regarding future migration. Most respondents are unwilling to migrate (55% of the sample) despite knowing that other villages have economic opportunities.

4. Results

4.1. Migration motives against predictors of migration outcomes

Table 2 presents descriptive statistics of the non-hazard factors across the three levels of the dependent variable. Within respondents who do not wish to migrate, a total of 72.7% expressed that their economic conditions had somewhat or significantly improved since the last year. However, 71.2% of those agreeing to future migration aspirations also experienced improved economic conditions, while 57.9% of participants who felt neutral did the same. This suggests that, overall, economic conditions among the communities were perceived to have improved in the year preceding the survey. After pre-testing the survey instrument, we consider the preceding years' knowledge because it was easier to recall for the respondents than 5 years earlier.

Regarding place attachment, more than 60% of the respondents have been living in these study villages since before their 4th generation, indicating strong socio-spatial attachment to these localities. Regarding living conditions, between 60–66% of all three groups expressed that conditions were somewhat or much better than one year earlier, while approximately 15–20% of all groups noted no difference. This indicates that, like economic conditions, living conditions have generally improved across the

Table 2. Interrelationship between the independent and dependent variables.

Dependent variable: As there is more opportunity outside your village, do you agree that you would like to migrate from here?

Independent variable	Disagree (i.e. like to stay)	Neutral	Agree (i.e. like to migrate)
<i>Place attachment (%)</i> [When did your family first come to this village?]			
Since after grandfather – up to 3 rd generation	22.0	7.5	10.0
Since before grandfather – 3 rd plus generation	33.0	11.5	16.0
<i>Economic conditions (%)</i> [Looking back, how do you rate your economic conditions now compared to 12 months ago?]			
Worse	10.9	15.8	13.5
Same	16.4	26.3	15.4
Better	72.7	57.9	71.1
<i>Living conditions (%)</i> [Looking back, how do you rate your living conditions now compared to 12 months ago?]			
Worse	23.6	18.4	13.5
Same	16.4	15.8	21.2
Better	60.0	65.8	65.3
<i>Community cohesion (%)</i> [Looking back, how do you rate the harmony in the community (conflicts related to security, a religious minority, fighting etc.) now compared to 12 months ago?]			
Worse	5.5	10.5	9.6
Same	22.7	18.4	23.1
Better	71.8	71.1	67.3
<i>Self-efficacy (%)</i> [The environment is changing and affecting your sources of livelihood, but your family can survive such changes – do you agree?]			
Disagree	14.55	26.32	34.62
Neutral	21.82	13.16	19.23
Agree	63.64	60.53	46.15
<i>Environmental risk (%)</i> [derived from a composite index of (i) the amount of saline water, (ii) the amount of siltation, and (iii) the rate of land fertility]			
Increased	33.64	23.68	36.54
Neutral	46.36	50.00	40.38
Decreased	20.00	26.32	23.08
<i>Risk tolerance (%)</i> [People take all kinds of short or longer-term risks. In general, how easy or difficult is it for you to accept taking risks?]			
Difficult	57.27	52.63	61.54
Neither easy nor difficult	30.00	42.11	28.85
Easy	12.73	5.26	9.62

Source: Field survey, 2018.

communities. There is no clear directional relationship between living conditions and migration motive. However, a notable proportion of the respondents (19%) who disagreed with future migration expressed that living conditions had gotten somewhat worse.

Approximately 71% of those who do not wish to migrate or feel neutral and 67.31% of those who do wish to migrate perceived greater community cohesion since the previous year. It is notable that over half of those not wishing to migrate reported that social cohesion had gotten *much* better.

The majority (over 60%) of respondents who disagree to future migration and feel neutral had confidence in their self-efficacy. The proportion of people who felt they did not possess self-efficacy in their current situation was twice as high among people who aspired to migrate than those who aspired to stay, reinforcing previous observations that self-efficacy may disincentivise migration.

Across all three migration motivation responses, more people (40-50%) felt that their villages were at a moderate level of risk from natural hazards. People who responded neutrally about future migration were slightly less likely to perceive an increased level of risk than both people who agreed and disagreed with migrating. Thus, there is no clear relation between risk perception and migration motive.

In the case of risk tolerance, a majority (57.5%) of people feel that it is difficult to take risks, irrespective of future migration motives. However, this proportion is slightly higher (61.5%) for people who agree to migrate than those who disagree, implying risk-taking ability may be higher among stayers and that migration is not seen as particularly risky behaviour.

4.2. Future migration motives against different hazards

Table 3 shows the desire to migrate according to if the respondents have experienced each of the extreme environmental events of interest. Most of the respondents experienced floods (62%) followed by salinity (61%), cyclones (46%), siltation (44%) and river-bank erosion (42%). In the case of cyclones, 24.1% of the respondents who have not experienced a cyclone would like to migrate. However, there is a high proportion of respondents who would not like to migrate even if they have experienced a cyclone (51.1%). Of the respondents who have experienced flooding events, the majority do not desire to migrate (53.2%).

Table 3. Future migration motives against environmental events.

Environmental event	Status (%)	Like to stay (%)	Neutral (%)	Like to migrate (%)
Salinity	Not experienced (39)	55.4	19.6	25.0
	Experienced (61)	54.9	18.8	26.4
Erosion	Not experienced (58)	56.9	17.2	25.9
	Experienced (42)	52.4	21.4	26.2
Siltation	Not experienced (56)	61.6	16.1	22.3
	Experienced (44)	46.6	22.7	30.7
Flood	Not experienced (38)	57.9	19.7	22.4
	Experienced (62)	53.2	18.5	28.2
Cyclone	Not experienced (54)	58.3	17.6	24.1
	Experienced (46)	51.1	20.7	28.3

Source: Field survey, 2018

More than half of the respondents express the desire to stay whether or not they have directly experienced salinity encroachment. For siltation, the highest proportion of those who have not experienced siltation do not desire to migrate (61.6%). However, the highest number of respondents who were neutral with respect to migrating are those who have experienced erosion (21.4%), siltation (22.7%), and a cyclone (20.7%). The pattern is similar for the case of erosion; the highest proportion of respondents who do not wish to migrate have not faced erosion. Overall, the experiences of any extreme environmental event show that almost one-fourth of the respondents have an intention to migrate. The following section presents the results of a regression model comparing migration aspirations related to these environmental threats while controlling for others migration predictors.

4.3. How predictors of future migration motives differ across extreme environmental events

In the analytical framework (Figure 1), we highlight that community cohesion and economic conditions influence the livelihood conditions of the people at risk. Livelihood conditions, in turn, influence place attachment and self-efficacy. Thus, there may be a theoretical problem of multicollinearity between some of the predictors. However, we measured each predictor by an unique question instead of creating a index from several indicators, and our data does not shows any multicollinearity between the predictors. Thus, we used all the predictors identified in our analytical framework in a multinomial regression model. By using the multinomial regression model, we can estimate the extent to which the different extreme environmental events predict migration aspirations. Table 4 summarises the results and the respective reference category of the predictors.

Results of the model indicate that number of hazards experienced does not have any significant influence on mobility decision, except for the case of salinity and erosion. People with experience in tackling salinity intrusion and riverbank erosion were more likely to stay compared to the people who did not have past experience with these hazards.

Results of the model indicate that place attachment does not have a significant role in determining mobility decisions in the case of riverbank erosion. In the case of cyclones, first-generation residents are more likely to agree to migrate compared to people whose families have lived in the village since earlier generations. In the case of flooding, another rapid-onset event, respondents whose families have been living in the village for two generations are more likely to agree to migrate compared to other community members. The significance of being the second generation in a community on the outcome of migration aspiration was also found for those experiencing siltation and salinity threats, with a greater correlation in the case of siltation.

According to the model results, environmental risk perception is significant to migration decision-making only for those experiencing siltation. This may be an artifact of the specific factors used to derive the measure of risk perception in this model, including the amount of saline water, siltation, and land fertility, as these factors are highly relevant to siltation generally. Respondents who believed that siltation, salinity, and issues



Table 4. Results of multi-nomial regression models. Here, highlighted cell indicates the significance level at * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Predictors	Slow onset						Rapid onset					
	Salinity			Erosion			Siltation			Flood		
	Neutral	disagree	Neutral	Neutral	disagree	Neutral	Neutral	disagree	Neutral	disagree	Neutral	disagree
Hazard experience	0.0552 (0.0595)	0.182*** (0.0619)	-0.00600 (0.0648)	0.161* (0.0920)	0.0793 (0.0997)	Estimate (SE)	-0.00106 (0.0760)	0.0959 (0.0724)	0.0366 (0.101)	0.0759 (0.0716)		
Place attachment (reference: 1 st generation 4th plus generation)	1.341 (0.960)	1.137 (0.816)	1.026 (1.466)	0.193 (1.336)	0.179 (1.552)	1.134 (1.475)	-0.201 (1.083)	1.410 (1.004)	0.530 (1.478)	1.424* (1.203)		
	-1.388 (1.090)	1.626** (1.074)	-2.067 (1.493)	-1.817 (1.607)	1.248 (1.351)	1.020* (1.272)	-2.759** (1.319)	-0.713 (1.145)	-1.394 (1.389)	-1.056 (1.199)		
2 nd generation	-0.421 (0.812)	-0.641 (0.653)	-1.134 (1.481)	-0.444 (1.044)	-0.230 (1.131)	-0.757 (0.930)	-1.983** (0.960)	-0.106 (0.890)	-1.449 (1.227)	-1.506 (1.029)		
3rd generation	0.358 (0.583)	0.263 (0.572)	1.603 (1.070)	-0.740 (0.959)	0.658 (0.698)	1.621* (0.930)	0.795 (0.689)	0.471 (0.620)	0.652 (0.728)	-0.332 (0.709)		
Risk tolerance (reference: Easy)	-1.561 (0.973)	0.370 (0.711)	0.654 (1.363)	-0.338 (1.517)	-0.378 (1.200)	1.130 (1.112)	0.0933 (1.182)	-0.0538 (0.805)	-15.42*** (1.378)	0.319 (1.329)		
Neither easy nor difficult	-1.318 (1.032)	-0.712 (0.799)	-2.797** (1.308)	-2.880** (1.411)	-0.938 (1.489)	-3.596*** (1.119)	-0.902 (1.139)	-0.710 (0.795)	-0.229 (1.167)	-0.161 (1.034)		
Disagree	-0.981 (0.730)	-1.921*** (0.694)	-1.978 (1.235)	-2.086** (1.027)	-0.759 (0.983)	-1.975** (0.843)	-0.762 (0.771)	-1.286** (0.611)	-0.980 (0.917)	-0.892 (0.864)		
Neither agree nor disagree	-0.0226 (0.944)	-0.552 (1.111)	-2.024 (1.616)	-6.702*** (1.986)	1.301 (1.411)	1.905 (1.799)	-0.154 (1.534)	-0.477 (1.166)	0.356 (1.417)	-2.768** (1.336)		
Same	-2.033** (0.879)	-0.646 (0.910)	-1.194 (1.133)	-2.731** (1.126)	-0.0730 (1.109)	0.756 (1.690)	-1.048 (1.195)	-0.810 (1.023)	-1.399 (1.169)	-1.987* (1.080)		
Better	0.836 (1.187)	1.842** (0.900)	4.214** (1.854)	2.063 (1.585)	0.586 (1.262)	1.558 (1.070)	-0.344 (1.368)	2.171** (0.911)	-1.287 (1.599)	0.698 (1.166)		
Living conditions (reference: Same worse)	1.861** (0.861)	1.307* (0.700)	2.589 (1.770)	1.018 (0.921)	0.690 (0.814)	1.316 (1.059)	0.437 (0.819)	1.490** (0.690)	1.089 (1.163)	0.897 (0.953)		
	-1.731 (1.085)	-1.393 (0.958)	-4.944*** (1.875)	-1.131 (1.328)	-24.02*** (2.975)	-21.99*** (2.688)	-3.392*** (1.293)	-1.541* (0.917)	-0.833 (1.596)	0.373 (1.369)		
Conflict and community cohesion (reference: Much worse)	-1.469* (0.848)	-1.469* (0.857)	-1.469* (1.435)	-1.469* (1.058)	-1.469* (3.003)	-23.27*** (2.894)	-1.109 (1.104)	-1.344* (0.805)	-1.147 (1.389)	-0.515 (1.107)		
Environmental risk (reference: Same decreased)	0.593 (0.689)	0.0410 (0.752)	1.015 (1.046)	0.738 (0.950)	20.78*** (2.880)	1.807* (1.071)	0.249 (0.795)	0.0228 (0.696)	-0.600 (1.232)	-0.750 (1.187)		
Increased	-0.0277 (0.898)	0.910 (0.844)	0.884 (1.219)	3.052** (1.234)	20.06*** (2.840)	1.678 (1.270)	0.396 (1.097)	0.569 (0.754)	-0.0496 (1.413)	0.0575 (1.251)		

DV: As there is more opportunity outside your village, do you agree that you would like to migrate from here? [Reference: agree, i.e. like to migrate]

Age of the respondent (reference: Above 60 years)	Below 40 years	1.346** (0.560)	0.992* (0.541)	0.967 (0.850)	2.251*** (0.814)	1.613 (1.021)	1.107 (0.729)	1.211* (0.628)	0.773 (0.591)	1.283 (0.938)	1.478** (0.622)
	40- 60 years	0.231 (0.878)	0.833 (0.794)	-0.708 (2.132)	3.692** (1.519)	0.882 (1.322)	2.076* (1.141)	-2.385* (1.267)	0.739 (0.819)	-15.53*** (1.359)	-0.435 (1.634)
Education (reference: More than 10 years of schooling)	Illiterate	1.475* (0.856)	1.014* (0.581)	2.776 (2.222)	0.548 (0.987)	1.960 (1.211)	0.275 (0.855)	19.15*** (0.862)	1.365* (0.700)	2.888*** (1.087)	1.044 (0.635)
	Less than 10 years of schooling	1.103 (0.890)	0.486 (0.707)	2.213 (2.222)	-1.039 (1.091)	1.958 (1.239)	0.167 (0.920)	18.46*** (0.853)	0.802 (0.776)	2.651** (1.085)	0.409 (0.936)
Religion (reference: Hindu)	Muslim	0.0631 (0.646)	-1.522*** (0.513)	0.173 (0.854)	-0.760 (0.736)	0.224 (0.838)	-1.739* (0.929)	0.0865 (0.707)	-1.212** (0.500)	-0.625 (0.860)	-0.731 (0.679)

with land fertility had decreased were less likely to agree to migrate from their community in response to siltation induced livelihood challenges.

The model shows that respondents whose economic conditions were worse compared to 12 months ago were more likely to agree to migrate in the face of cyclone hazards. Similarly, respondents whose economic conditions were unchanged or somewhat better were less likely to agree to migrate in the face of a cyclone. Similarly, the respondents whose economic conditions were unchanged or somewhat better compared to 12 months ago were less likely to agree to migrate in the face of riverbank erosion. The respondents whose economic conditions were better compared to 12 months ago were less likely to express an aspiration to migrate in the face of salinity-induced livelihood challenges.

The results suggest that risk-taking ability significantly influences migration decision-making in the case of slow-onset hazards. Thus, risk tolerance is a more significant predictor of migration aspirations for people affected by siltation, salinity and riverbank erosion.

There is a significant relationship between self-efficacy and respondents' willingness to migrate. In the case of flooding, siltation, riverbank erosion, and salinity, people who did not have confidence in their self-efficacy were more likely to agree to migrate. The model shows that respondents who rated their community cohesion as 'same' or 'better' compared to 12 months ago were less likely to agree to migrate from their community in the face of floods, siltation and riverbank erosion.

While economic conditions play a role in the case of cyclones (and to a lesser extent, riverbank erosion), changes in living conditions are significant for floods, riverbank erosion, salinity and siltation. The model shows that respondents whose living conditions were somewhat better compared to 12 months ago were less likely to agree to migrate from their community in the face of flooding and salinity. On the other hand, respondents whose living conditions were the same compared to 12 months ago were less likely to aspire to migrate due to riverbank erosion.

Finally, the model shows that previous hazard experience influences the likelihood of agreeing to migrate in the case of salinity and erosion. Here, for a one-unit increase in hazard experience (number of hazards faced), the odds of 'aspire to migrate' versus the 'aspire to not-migrate' are 1.912 and 1.839 greater in the case of salinity and erosion, respectively, when all the other variables in the model are constant. Regarding other extreme events, previous hazard experiences do not have any significant influence on migration decision-making.

In terms of demographic variables, education plays a significant role in mobility aspiration in the context of any of the extreme environmental events. Compared to the respondents who attended more than ten years of school, other respondents were more likely to agree to stay for the case of salinity, floods, and cyclones.

Religion plays a role in migration decisions. For all environmental events barring cyclones and erosion, Muslim respondents are more likely to agree to migrate in the future. For example, Muslim respondents were two times more likely than Hindus to agree to migrate from their community in the face of salinity-induced livelihood challenges. Regarding age, respondents were grouped into three categories: below 40 years, 40–60 years, and 60 plus years. The reasons for such classification are that people under 40 have a higher chance of taking the risk of migrating, while people

aged between 40–60 (family caretaker group), and especially those over 60, are more settled in their lives and less likely to migrate unless forced (Mallick et al., 2021). Young people are more likely to migrate in the face of any environmental events. The model shows that the family caretaker group (40–60) was more likely to agree to migrate in the face of cyclones and floods. Meanwhile, the unsettled group (below 40) was less likely to agree to migrate due to the slow-onset events of salinity, riverbank erosion and siltation.

The following section summarises the model's results concerning the directionality of the influence of different extreme environmental events and predictors on migration motive.

5. Discussion

As this work highlights, migration aspirations and their socioeconomic predictors differ depending on the type of extreme environmental event. Table 5 summarises how these hazards and predictors intersect with migration motives positively (towards staying) or negatively (towards leaving).

Analysing place attachment, being first-generation influences people towards migration in the case of cyclones, while being the second generation does the same for those threatened by flood, siltation, and salinity. These results could be explained by the livelihood dependence of second generations on activities directly impacted by siltation and salinity, such as farming and fishing. Hence, these households may be more likely to migrate to find better economic opportunities if an extreme environmental event negatively impacts their livelihood. Across extreme environmental event types, households living in a place for longer are more likely to prefer to stay despite extreme

Table 5. Summary of predictors and their influences, where green colour with positive sign represent staying, and orange colour with negative sign represent migrating.

Predictors	Measurement	Slow onset			Rapid onset	
		Salinity	Erosion	Siltation	Flood	Cyclone
Hazard experience	Number of hazards	(+)	(+)			
Place attachment	1 st generation					(+)
	2 nd generation	(+)		(+)	(-)	
	3 rd generation				(-)	
Risk tolerance	Difficult			(+)		
	Neither easy nor difficult					(-)
Self-efficacy	Disagree		(-)	(-)		
	Neither agree nor disagree	(-)	(-)	(-)	(-)	
Economic conditions	Same		(-)			(-)
	Better	(-)	(-)			(-)
Living conditions	Same	(+)	(+)		(+)	
	Better	(+)			(+)	
Conflict and community cohesion	Same		(-)	(-)	(-)	
	Better	(-)	(-)	(-)	(-)	
Environmental risk	Same			(+)		
	Increased		(+)	(+)		
Age of the respondent	Below 40 years	(+)	(+)		(+)	(+)
	40–60 years		(+)	(+)	(-)	(-)
Education	Illiterate	(+)			(+)	(+)
	Less than 10 years of schooling				(+)	(+)
Religion	Muslim	(-)		(-)	(-)	

events, which supports earlier findings related to place attachment in migration research (De Dominicis et al., 2015).

There is also a positive relationship between low self-efficacy and migration aspiration for flooding, siltation, and salinity but a negative relationship for siltation. That self-sufficient people desire to stay compared to people who lower self-efficacy aligns with previously observed attitudes among non-migrants (Mallick et al., 2021).

The significant relationship between *no* economic improvement and aspirations to stay (non-migration) also coheres with findings regarding the inclination of households that have experienced riverbank erosion not to move unless physically necessary and to reestablish their livelihoods nearby in the same community when possible (Paul et al., 2020). Risk tolerance in the cases of cyclones, flooding, riverbank erosion, and salinity may not have been strongly significant because a high proportion of the respondents have not faced these phenomena (Table 5). Moreover, respondents may feel that the rapidity of cyclones and flood events obviates the importance of risk-taking ability (Paul et al., 2020). One reason could be that the rapidity and severity of cyclone damages require more economic strength to recover from, while flooding and other slow-onset events may not require as much (Paul, 2009). It is inferred that people whose livelihoods depend on the natural environment, such as those who depend on agriculture or fishing, have a range of strategies to cope with changes, of which migration is only one. Therefore, respondents affected by salinity may consider alternatives other than migration, such as shifting to salinity-resistant crops, irrespective of their risk tolerance.

While the relation between social cohesion and likelihood of staying is anticipated, the correlation between improved social conditions and willingness to migrate among some respondents may indicate that these people are lone migrants who are more likely to move if they feel confident about the wellbeing of the family members they leave behind in the community. This may indicate that improved living conditions equip them to assume the cost of migration and seek greater opportunities elsewhere (Mallick et al., 2020).

Overall, there are more significant predictors that positively influence migration aspiration than those that influence people away from migration (non-migration). Place attachment, self-efficacy, and community cohesion emerge as predictors that significantly affect the propensity to migration. Economic conditions and living conditions tend to be more negatively associated with aspiration to migrate. Considering extreme environmental events, the predictors analyzed here are most likely to be significant to people's migration aspirations in the context of slower onset events such as riverbank erosion and siltation. As we asked about their experience of changes over the preceding year, they cannot relate to long-term land accumulation through the siltation process, which could be an opportunity to stay.

6. Conclusion

Our analytical framework (Figure 1) explains various factors that influence future migration motivations in the context of different types of environmental change and hazards. Regardless of the type of environmental hazard, most respondents in the community disagree to migrate (70.6%), while the remaining 29.4% agree to migrate,

suggesting a strong preference towards non-migration in this study group. Migration aspirations vary most for salinity and siltation, rather than for rapid-onset events. Generally, improvement in community harmony and cohesion motivate respondents to non-migrate, with 50% of respondents disagreeing to migrate when the conflict conditions in the community got much better. Respondents who have faced flood events, high salinity encroachment, and siltation are more likely to migrate, most likely because of the dependence of their economic activities like farming and fishing on environmental conditions. Respondents who have farming as a significant source of livelihood are highly affected by the increase of salinity in soils and reduced crop yields, and are therefore, most vulnerable to these natural hazards (Rabbani, Rahman, & Mainuddin, 2013). These vulnerable households may rely on temporary migration as an adaptation strategy and therefore consider migrating in the future. The respondents who have not faced erosion and cyclones strongly disagree to migrate, most likely because their livelihoods have not been impacted. Beyond experience with hazards, improving living conditions, economic opportunity, community harmony, and self-efficacy all increased non-migration intention in the study area. Future research can focus on how the building of intergenerational resilience could enhance place-attachment and intensify future non-migration despite different hazards.

This work provides evidence of the importance of considering the unique interactions between specific environmental events and migration, especially in the context of a highly dynamic natural environment that experiences multiple hazards such as Bangladesh. However, there are several important limitations. Firstly, this analysis reveals interesting and important associations between a range of predictors, environmental hazards, and willingness to migrate, but we are not currently able to assert a causal relationship between variables. Next, it is not currently clear if these results are more broadly applicable outside of the study area in southwestern Bangladesh, as migration and its underlying drivers are largely context specific. As with many social phenomena, the decision to migrate or stay is highly complex, and therefore, we can never fully capture its dynamics through survey data and regression analysis. To address these limitations, future work might consider a more detailed qualitative investigation of households in this region.

To formulate future adaptation plans, it is necessary to consider how different extreme environmental events are linked to migration aspirations, as well as the modulating effects of socio-economic conditions. Thus, a policy aimed at facilitating non-migration should focus on economic opportunities and community cohesion, but interventions should depend on the types of extreme environmental events and the level of exposure caused by them.

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