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# “I can migrate, but why should I?”—voluntary non-migration despite creeping environmental risks

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‘Environmental non-migration’ refers to the spatial continuity of an individual’s residence at the same place despite environmental risk. Moreover, this is a largely under-researched topic, especially within the climate change adaptation discourse, but is increasingly coming to the attention of scientists and policymakers for sustainable adaptation planning. So far, there exists hardly any conceptual and methodical guidelines to study environmental non-migration. Considering this research gap, this paper explores environmental non-migration based on the notion that factors of livelihood resilience can partly explain the decision to non-migration. Here, livelihood resilience is seen as an outcome of the interactions between societal and environmental conditions of an individual household. These conditions inform the decisions (to stay or to migrate) taken in case of a hazard or creeping environmental change. Their influence generalises the spectrum of migration decision-making (to stay or to migrate), which is conceptualised by four broad outcomes categorised into voluntary and involuntary, and non-migrants and migrants. This analytical concept is operationalised through an empirical example in southwest coastal Bangladesh. The results suggest that the Livelihood Resilience Index (LRI) relates to the voluntary nature of migration decisions once they are made. Still, only a household’s resilience cannot predict the decisions the household makes to stay or migrate. The paper concludes that the proposed analytical concept, with its exemplary factors, maybe an initial means to holistically explore migration decisions in the context of natural hazards and climate and environmental change. However, environmental non-migration remains complex and multi-faceted, and its assessment requires deeper examination at various scales.

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## Introduction

Environmental risks (e.g., water security, air quality, hazards, etc.) will continue to exert an ever more pivotal influence on human migration because of their interplay with social, economic, political, and other interlinked drivers (Black et al., 2011a). The high mobility rates currently anticipated in climate-vulnerable regions worldwide encourage us to understand the diverse forms of environmental migration and non-migration, especially to direct attention to non-migration as an under-attended point in environmental migration discourses (Mallick and Schanze, 2020). Examining (non)-migration as an adaptation strategy encourages us to consider how policy initiatives can interact with mobility trends to equip the best migrants, non-migrants, and communities for a climate-resilient future.

Hence, ‘environmental non-migration’ is referred to the process of being non-migrants despite environmental risks. Non-migration describes the process of not-migrating despite an environmental threat. It explains the series of progressive and interdependent steps taken by the individual in a household, under their capabilities and aspirations, where the outcome is ‘staying’. Thus, voluntary ‘non-migration’ is a composition of ‘being capable to stay’ and ‘aspiring to stay’ (Mallick and Schanze, 2020). This understanding of ‘environmental non-migration’ is carried through the remainder of this research.

The International Organization for Migration (2018) stated that a far higher percentage of people facing climate risks did not migrate. This might either be due to people not having the necessary means to move or people consciously making the decision to stay, e.g., voluntary non-migrants. Recent studies give attention to this ‘voluntary non-migrants’ and reasons for place attachment, family commitments, and socio-cultural identity as the critical factors for them to pursue in situ adaptation (Adams, 2016; Farbotko et al., 2020; Farbotko, 2018; Kelman et al., 2019; Suliman et al., 2019; Zickgraf, 2019; Hauer et al., 2020; Mallick and Schanze, 2020; Thornton et al., 2020). However, the specific knowledge about decision-making that informs why people choose not to migrate still remains unknown. Therefore it is difficult to claim how far the factors driving environmental migration are relevant for environmental non-migration. The widely spoken drivers of migration decisions are: social, demographic, economic, political and environmental (Foresight, 2011). These drivers are derived from the societal and environmental conditions of the individual and the multiplicity of these drivers that jointly influence migration decisions (either to stay or to migrate) and thus require further consideration (Black et al., 2011). Thus, the consisting research on non-migration has received multiple observations. Firstly, current research often has limited focus of the economic drivers of non-migration, leaving out other important drivers provide an incomplete analysis of the non-migration decision-making process (Wiegel et al., 2021), and most of research on this topic “environmental non-migration” focuses on the inverse relationship between migration and non-migration. Lastly, there has been increasing urgency on debates regarding the threat of climate change. Environmental stress factors are becoming increasingly prevalent in global research as well as in policy concern, even though the choice of non-migration within the environmental context has yet received little policy attention. Taking these complexities into consideration and based on a literature review, analytical concept and empirical evidence, this study focuses on two main objectives:

- (i) To explain how the factors (in terms of societal and environmental) drive non-migration decisions, based on the examples of the voluntary non-migration experienced, and how these factors are related to adaptive capacity and resilience.
- (ii) To explore the relationship between non-migration and livelihood resilience and its spatial variability.

In doing so, this study analyses empirical data collected from five vulnerable communities in southwest Bangladesh that were affected by cyclone Aila on 25 November 2009. As a consequence of this cyclone a few affected households experienced migration. The case study defines both migrant and non-migrant households. It considers households that reported at least one-member migrating temporarily or permanently because of cyclone Aila as migrant households and the rest as non-migrant households. Then the study categorises voluntary and involuntary migrants and non-migrants based on their aspirations and capabilities for migrating on the eve of cyclone Aila. The study explores and compares past and future migration motivations in the second stage. Livelihood-associated scopes and limitations partly explain a divergence in migration motivations at the individual, household, and community levels on the future migratory behaviour of the individual household. Thus, livelihood resilience may determine responses to future environmental shocks. A livelihood resilience index has been calculated using a multi-criteria-based indexing method. This index has both societal and environmental dimensions and is employed to decipher the changes in migration decisions at the household level, temporarily and spatially.

Section “Literature review” explains the research gap based on an unsystematic literature review. On this basis, section “Analytical concept” provides an analytical concept for assessing environmental non-migration and its operationalisation. Section “Empirical example” presents the results from an indicative assessment, while section “Discussion” discusses how far such an analytical concept is useful and further research necessary.

## Literature review

**Environmental non-migration discourses.** Non-migration in the face of environmental threats is not well-explained. Authors note how non-migration has been problematically characterised as ‘left behind’, or the ‘inverse’ of migration (Hjälml, 2014; Erickson et al., 2018). This literature draws attention to the nuances of non-migration by examining the reasons for, consequences of, and experiences of non-migration, demonstrating that non-migration is a rich phenomenon in its own right (Stockdale and Haartsen, 2018). Much of the literature emphasises psychosocial notions of place attachment as a critical reason for non-migration (Adams, 2016; Hamilton et al., 2016; Erickson et al., 2018). For example, Haartsen and Stockdale (2018) show how rural immigrants who have lived in their place of migration for many years even demonstrate ‘elective belonging’ by becoming self-identified ‘stayers’, emphasising their lack of place attachment to the urban areas from which they originate. Barcus and Shugatai (2018) and Ye (2018) highlight non-migrants’ key role in maintaining cultural narratives and being proactive community members, contrasting the assumptions in mobility literature, which regard non-migration as immobility or a lack of action. Mata-Codesal (2018) study of Mexican rural stayers suggests temporary migration is used as a strategy to stay put in the longer term, highlighting the significance of non-migration itself as an aspiration or end goal. The issue of non-migration in areas affected by environmental change has been addressed by Huntington et al. (2018) in their study of Arctic Alaska. They demonstrate ‘attachment, alternatives, and buffering’ as three possible coping strategies that, in combination, explain the lack of out-migration from the arctic regions despite increasing climate hazards. Likewise, the aspiration and capability model describes the importance of behavioural characteristics of the individual migration decision. By employing this model, Carling (2002)

explained that many of the same individual characteristics that affect the aspiration to migrate also affect the ability to migrate at the individual level. Using the notion of aspiration or lack thereof, Bates (2002) importantly argues that environmental migration should be conceptualised as a continuum from voluntary to involuntary.

Similarly, non-migration may also be placed on a continuum. So-called ‘trapped’ populations cannot realise their migration aspirations away from vulnerable places as they lack resources, social networks, and institutional support (Foresight, 2011; Black et al., 2013; Call et al., 2017; Zickgraf, 2019; Mallick and Schanze, 2020). However, ‘voluntary non-migrants’ choose to remain in situ despite emerging climate risks for the reasons of place attachment, family commitments and social networks, and the continuity of heredity and cultural identity (Adams, 2016; Farbotko et al., 2016; Farbotko, 2018; Kelman et al., 2019; Suliman et al., 2019; Zickgraf, 2019; Hauer et al., 2020; Mallick and Schanze, 2020; Thornton et al., 2020). Environmental non-migration in such contexts remains under-examined, and this study empirically contributes to fill this gap. In particular, this considers livelihood resilience as the core ability for voluntarily staying at risk.

**Livelihood resilience as key to voluntary environmental non-migration.** Broadly, people migrate because their livelihood opportunities are declining individually, for their household, or in their community. This means migration is taking place in a resource-scarcity situation. In contrast, people’s non-migration decisions can indicate a coping capacity for tackling the shortage of resources. Here notions of vulnerability, resilience and adaptive capacity come into play in the context of environmental (non-) migration (McLeman and Hunter, 2010). These concepts have been defined broadly across different (sub-)disciplines. For instance, Cutter (1996) found 18 definitions of ‘vulnerability’ across socio-environmental papers, and Thywissen (2006) identified 36 definitions in the disaster risk research literature. ‘Resilience’ has even been denoted as a ‘boundary object’ due to the diversity of interpretations (Brand and Jax 2007). In addition to the broad scope of understanding for each of the terms, their interrelations remain fuzzy. Hence, a few authors propose conceptual delineation and assignment (e.g., Gallopín, 2006). As follows, this study uses the linked definitions according to Schanze (2016): ‘Vulnerability’ is a characteristic of a system at risk determined by value or function, susceptibility, and coping capacity, where value or function is in regards to the societal meaning or purpose of the system, susceptibility depicts its propensity to experience harm, and coping capacity describes the ability to regain the initial state after external stress’ (Blanco-Vogt and Schanze, 2014). The latter involves ‘resilience’ as the ability of a system to regain characteristic features (maybe undergoing reorganising) and to continue development after disturbance (sudden) or change (creeping) of boundary conditions (Schanze, 2016). It puts particular emphasis on the dynamics of recovery. ‘Adaptive capacity’ (or adaptability) in a narrow sense is about the alteration of a system and can be recognised as the ability to (autonomously or consciously) alter its characteristic features (notably susceptibility) to changing circumstances in the sense of (co-) evolution (e.g., Smit and Wandel, 2006).

In contrast to environmental hazards, all three concepts emphasise the internal characteristics of an individual, household, or community (Gallopín, 2006). These characteristics need to be specified for the kind of hazards and events and depend on the wider socio-economic context being studied (Cutter et al., 2008; Huntington et al., 2018). The environmental non-migrants who can cope with environmental threats can be considered ‘resilient’

because of the manner of their livelihoods, even if they are otherwise as vulnerable to harm as others. Likewise, migrants who decide to and can enact migration adapt through different means.

Again the ‘livelihood resilience’ is defined mainly by integrating ‘livelihood’ and ‘resilience’, that considered as ‘the capacity of all people across generations to sustain and improve their livelihood opportunities and well-being despite environmental, economic, social and political disturbances (Tanner et al., 2015)’. In the following section, this study employs an understanding of ‘livelihood resilience’ to analytically conceptualise environmental migration decisions.

### Analytical concept

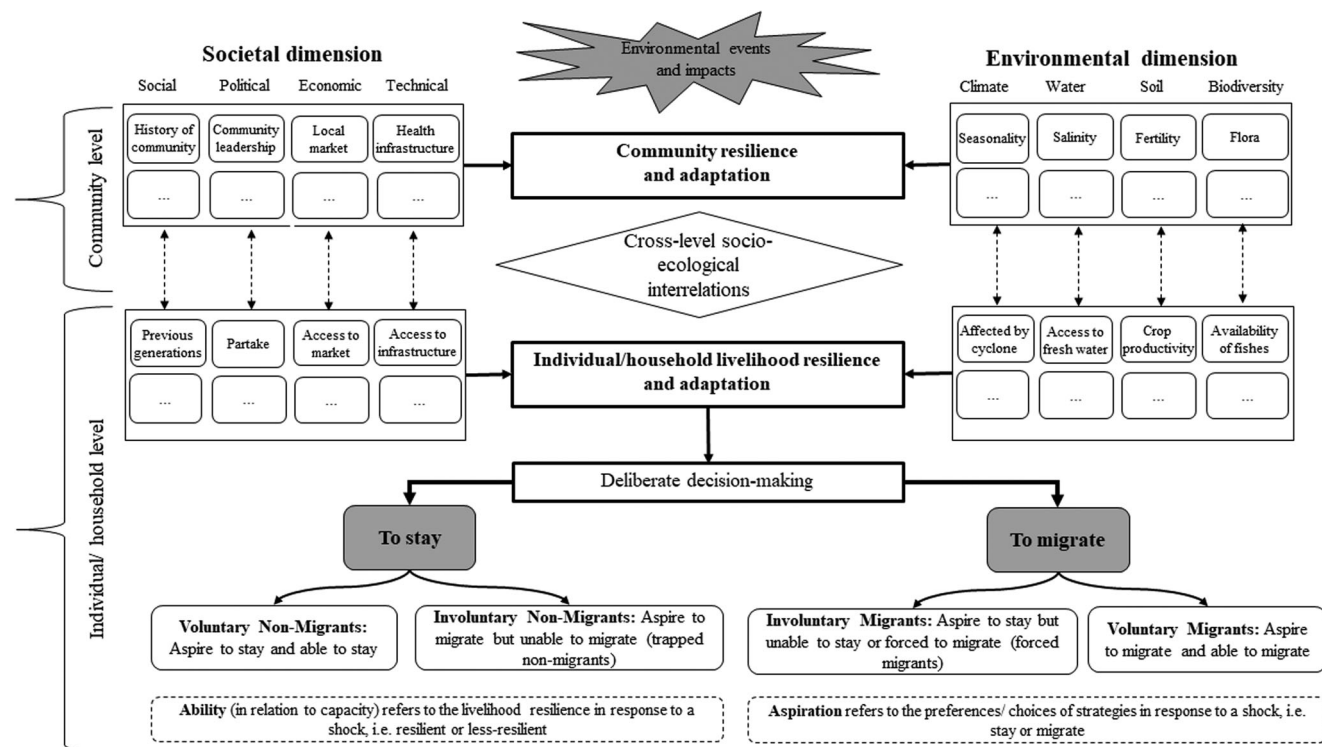
**Concept.** According to the previous discussion, ‘environmental non-migration’ may be understood as the result of a decision-making process considering the livelihood resilience of individuals and households with their communities under threat from environmental changes. Therefore, assessing environmental non-migration decisions requires exploring factors affecting livelihood resilience and their operationalisation by indicators. Accordingly, this study proposes an analytical concept with a hierarchical and systematic structure to facilitate this exploration (see Fig. 1).

First, the context in which decisions are made is established to determine how an environmental non-migration decision is affected by personal and household characteristics. Following this, the societal and environmental attributes on the community-level can be considered. Once the resilience of the individual/household to the specific hazard or disaster is determined, its impact on their decision to migrate/not migrate is addressed. It is assumed here that people do not migrate if their livelihood is resilient to extreme events in the place where they are living.

Resilience is context-specific (Hinkel, 2011)—i.e., resilience of what, to what, for whom, and in which context—is an essential step in defining livelihood resilience. It is proposed that a working definition of ‘resilience of the individual/household to disaster’ that is rooted in the specific context in question should be devised (Schanze, 2016; Weldegebriel and Amphune, 2017), based on the interaction of the livelihood dimensions in the following model. Then its linkage to the aspiration to migrate or to not migrate should be assessed. Here the assumptions are:

- (i) environmental non-migration occurs when livelihood risks are not increased after an extreme event because of the institutional, environmental, social, economic, and political characteristics of the community and also the demographic characteristics of individual households;
- (ii) long-term non-migration occurs as individuals migrate seasonally and trans-locally, thus increasing their household-level resilience to unexpected extreme events (McLeman and Hunter, 2010).

As discussed earlier, environmental non-migration decisions of individuals and households are embedded in communities’ societal and environmental contexts. The societal dimension includes social, political, economic, and technical factors, whereas the environmental dimension comprises climate, weather, water, soils, and biodiversity. Both these societal and environmental dimensions also influence household and individual livelihood through specific factors. For example, the social sub-dimension may include factors related to the previous generations, social networks, place attachment, education, and other demographic information. And the climate and weather sub-dimension refers to the characteristics of seasonality, summer length, etc., which affect household activities. Usually, these factors are the context of building the livelihood resilience of individuals and households, and therefore, they also contribute to designing adaptation



**Fig. 1 Analytical framework for the assessment of environmental non-migration decisions considering livelihood resilience.** Source: Author's illustration (2020).

strategies. Deliberate decision-making on non-migration and migration occurs beyond these context conditions at the community-level, as it additionally depends on livelihood resilience and adaptation strategies at the level of individuals and households. The individual/household-level factors of 'aspiration' and 'capability' condition the four different outcomes, as visible at the bottom of Fig. 1. Aspiration and capability to migrate often depend on the sub-dimensions of societal and environmental dimensions as well as on economic, political, and legal obstacles (Carling, 2002; Carling and Schewel, 2018; Mallick and Schanze, 2020); thus, these influences shape the nature of the migration decision (to stay or to migrate).

The result of the interrelation of these factors can be broadly organised into one of four outcomes. Outcomes 'to stay' can tend towards a deliberate decision to stay by resilient non-migrants who can overcome stressors and remain stable, or alternatively, an outcome of the lack of agency of less resilient non-migrants (i.e., trapped population) who do not have the means to migrate despite the necessity to improve their livelihood (Black and Collyer, 2014; Black et al., 2015; Bennet et al., 2019; Zickgraf, 2019). Likewise, outcomes 'to migrate' also vary in the aspirations and capacities involved. Migration is a decision for those who are more resilient and able to realise their migration motivation. Or a situation where less resilient people, who may not have migration aspirations, are forced to migrate in the face of an environmental event due to a lack of adaptive capacity in-place (i.e., Bates' (2002)'s environmental 'refugees'). It is often poor and disadvantaged people (i.e., low resilience) who are forced to migrate in the aftermath of a disaster (Mallick and Vogt, 2014; Black and Collyer, 2014; Hunter and Norton, 2015).

It should be noted that these four categories are deliberate simplifications intended to help trace migration-related decisions; resilience with the respective agency is more accurately an ongoing process (Cutter et al., 2008) that exists on a continuum

(Bates, 2002) rather than within discrete categories. Moreover, as the left-hand side of Fig. 1 implies, decision-making levels are actually interrelated—ranging from individual, household, community, regional, national or international. Focusing on the community and individual/household levels does not ignore the macro-level conditions affecting migration-related decisions.

The role of the two different non-migrant ('to stay') groups is also contextual. 'Voluntary non-migrants', those who are resilient to shock and are not migrating, are a vital target population of research in climate change adaptation policy and planning as they are considered a stabilising presence (Van et al., 2018; Zickgraf, 2019). This is important to remember in the context of the concept as stakeholders, including planners and development agendas, can influence individual migration decisions (Suliman et al., 2019).

**Operationalising the concept.** The analytical concept suggests factors for analysing the circumstances of people regularly struggling with environmental threats and factors influencing their (non-)migration decisions. Thus, it requires the specification of these various factors and operationalisation through indicators. Here, migration and non-migration in the context of an environmental disaster are interpreted as an outcome of declining livelihood resilience. While a migration decision can be understood as an adaptation strategy to mitigate exposure and vulnerability, resilience may allow for non-migration.

**Factors and indicators for (non-)migration decisions.** According to Fig. 1, the factors and indicators are distinguished and distributed into societal (e.g., social, political, economic, and technical) and environmental (e.g., climate, water, soil, and biodiversity) dimensions. The societal dimension includes factors related to place attachment, social network and connectedness, immobile capital (e.g., land ownership, residential house), access to financial resources and institutions (e.g., credit, savings), association and



**Table 1 Examples of factors and indicators of the livelihood resilience of an individual household and their relevance to environmental non-migration.**

Dimension affecting livelihood resilience	Sub-dimension	Factors	Indicators (examples)
Societal dimensions	Social	Place attachment, social network, education, gender, culture	Dependency on the neighbours, connection to the local leaders, literacy rate, number of female members, household size, etc.
	Economic	Type of livelihood, wealth, and assets	Farmer, fishermen, land ownership, etc.
	Political	Trust, conflicts, and cohesion	Membership in the political institute, faith in local decision-making etc.
Environmental dimensions	Technical	Road, embankment, shelters etc.	Shelters, nature, and usage of dams and embankments, etc.
	Climate & weather	Seasonality, summer, monsoon, winter	Rainfall, temperature, duration of summer, duration of monsoon
	Water	Salinity, water stress, access to safe water,	Access to safe drinking water, proximity to rivers, etc.
	Soils	Soil fertility, siltation, crop productivity	Frequency of rice production per year, the intensity of shrimp-farming etc.
	Biodiversity	Cultivated crops, reared animals, loss of biodiversity,	Decreased/increased fishes in the river, loss of production, changes in cropping pattern, livestock etc.

Source: Author's illustration.

memberships (e.g., clubs, community association, water management committee), conflict and cohesion (e.g., security, harmony, trust), demographic (e.g., religion, education, gender), and technical (i.e., refugee shelters, institutions, road-network), so on. The environmental dimension includes seasonality, siltation, access to drinking water, soil fertility, cropping pattern, loss of biodiversity, etc. All these factors combinedly affect the livelihood choices.

By employing this analytical concept, environmental non-migration decisions are understood as a result of multi-layered and multi-factorial influences of different factors of the society and environment, as perceived through individual household capacities. This is an integrative process of assessing livelihood resilience to determine the deliberated decision on migration or non-migration for the specific individual or household under the given circumstances.

While employing this model in the context of a natural hazard or climate/environmental change, the data for understanding 'environmental non-migration' should be (i) spatially, (ii) contextually, and (iii) temporally differentiated. Here temporally differentiated refers to data from at least two periods—pre-event and post-event, where a hazard event caused migration. Spatially differentiated means data from at least two different communities, and contextually differentiated refers to the data level i.e., individual household or community. Using individual household-level data makes it possible to measure livelihood resilience at the household level (before and after a disaster). Similarly, the community characteristics that lead to non-migration can be assessed.

*Interlinkages between resilience and (non-)migration factors and indicators.* The interlinkages between an individual/household's resilience and societal/environmental factors determine the (non-)migration decision outcome. Table 1 outlines the examples of these factors that can be used to assess them and determine their linkage with individual household resilience. For instance, under the social sub-dimension, strong neighbourhood ties and more connections to local leaders can indicate a high level of place attachment, which leads to non-migration. In the economic sub-dimension, wealth can be characterised by assets/land ownership and the source of livelihood, where poorer households are more likely to be displaced or forced to migrate. In the technical sub-dimension, higher quality roads and shelters indicate better

infrastructural support, fostering non-migration by reducing the risk of damage from natural hazard events and climate and environmental change. The biodiversity and soils sub-dimension includes changes in biodiversity and landscape that have differentiated effects depending on the livelihood source. For example, lower crop yield may lead to a migration decision for farmers; a higher fish population in the rivers may influence a non-migration decision by fishermen.

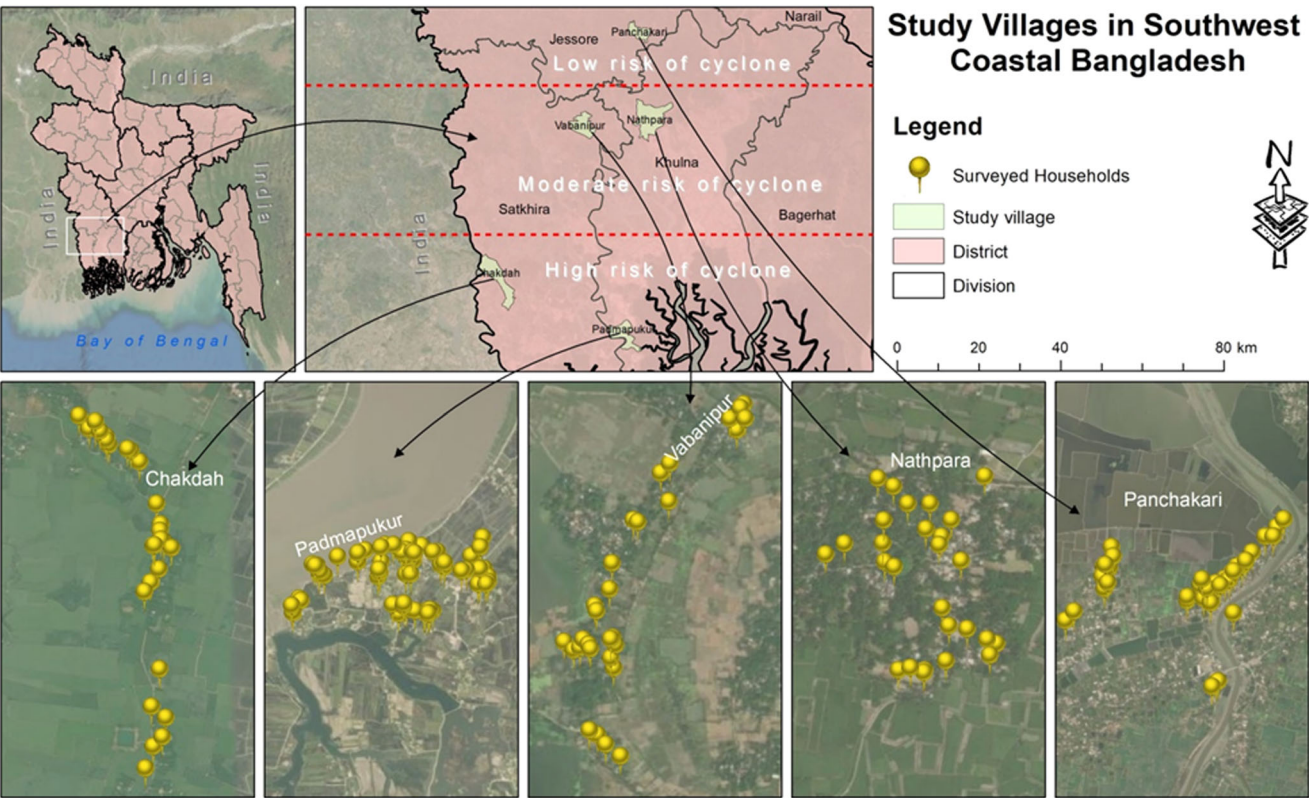
This examination of resilience recognises the spatial and temporal relationships between the aspects of livelihood that make people resilient at the individual or household level and allow them to decide not to migrate. The following section describes an empirical case study implementing the operationalised analytical concept to explore its utility.

## Empirical example

### Materials and methods

*Study area: Southwest Coastal Bangladesh.* Bangladesh is ranked as the fifth-most climate-vulnerable country in the world due to its unique geographical location, high population density, and low climate resilience. Each year the country is hit by at least one climatic event that displaces millions of people from their traditional habitat, adversely affecting their lives and livelihoods. It is mostly those living in coastal areas that are affected. 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 community, we consider the environmental conditions influencing livelihood. A field study was conducted in five villages in the southwest coastal region. These villages were selected based on the extremity of their exposure to cyclones (Fig. 2): two highly exposed villages (Padmapukur and Chakdah from Uttar Bedkashi and Mathureshpur union, respectively); two moderately exposed villages (Nathpara and Vabanipur from Shovna and Islamkati union, respectively); and one less exposed village (Panchakari from Nehalpur union).

*Survey.* All the villages were affected by cyclone Aila in 2009; therefore, the temporal changes' baseline was set to cyclone Aila. Both quantitative and qualitative surveys were conducted in the five villages in March–April 2018. In particular, in-depth interview (ID) and group discussion (GD) methods were employed. A



**Fig. 2** Study area, southwest coastal Bangladesh. Source: Authors’ presentation using the data collected from GoB.

Table 2 Empirical data across sites.					
Data collection method	Padmapukur	Vabanipur	Chakdah	Nathpara	Panchkori
In-depth interviews (38 individuals)	11	6	5	12	4
Group discussion (7)	2	1	1	2	1
The household survey (195)	66	31	29	27	42

Source: Field survey 2018.

total of 38 individual interviews and 7 group discussion sessions were conducted. A total of 195 household heads (or in their absence, their spouse) were interviewed using a structured questionnaire (Table 2). Five data collectors conducted the survey using the Kobocollect toolbox on Android mobile phones. The data was then imported to R and analysed accordingly.

The structured questionnaire includes both the societal and environmental dimensions of livelihood resilience. Topics covered in the survey include: (i) socio-economic characteristics (e.g., religion, age, gender, education, occupation, income, expenditure, and debt), (ii) housing conditions, demographic characteristics (household size, male-female ratio), (iii) place attachment, social networks and interdependencies, (iv) associations, roles and politics, (v) frequency of cyclone, (vi) crop production and seasonality, (vii) soil salinity, water stress, siltation, and erosion.

*Socio-demographic summary of the data.* Most villages have Islam as the majority religion (between 53 and 62 percent), whereas Vabanipur is a Hindu-majority village (92 percent). There is no significant variation in literacy rates across the villages. The main livelihood choices were agriculture and aquaculture (50–70 percent), followed by wage-earners, small businesses, and others. The

percentage of fishing is highest in Padmapukur village (49 percent), while the percentage of farming is highest in Chakdah village (52 percent). The communities’ secondary employment source of wage-earning is highest in Vabanipur (32 percent). Fish trading, business, livestock rearing, remittance, and additional sources of livelihood appear to a very minimal degree.

*Measuring livelihood resilience.* The overall robustness of a household is considered here as an outcome of the factors related to societal and environmental dimensions that influence a household’s vulnerability and resilience. The complete list of factors used in measuring livelihood resilience is listed in Table 1 in the supplementary material; a total of 45 indicators from eight factors under the two dimensions are used. This data is employed to calculate the ‘resilience index’ (RI) by following three steps: (i) screening to detect missing data, removing outliers, identification of multicollinearity among the selected indicators, and standardisation of the indicators; (ii) weighting the indicators; (iii) aggregation of data and calculation of RI value.

In doing the standardisation of the data, this study follows the Max–Min normalisation process though there are many normalisation methods. The Max–Min process transforms all values to

scores from 0 to 1, i.e., the normalised data point within the range of 0 to 1. The following Eq. 1 is used

$$I_a = \frac{S_a - S_{\min}}{S_{\max} - S_{\min}} \quad (1)$$

where  $I_a$  is the standardised value of each indicator.  $S_a$  is the sub-component for household  $a$ ,  $S_{\min}$  is the minimum value of the indicator across all households, and  $S_{\max}$  is the maximum value of the indicator across all the households.

Many studies apply simple additive weighting (SAW) with equal weights for its simplicity (Joerin et al., 2012; Bailey and Buck, 2016; Weldegebriel and Amphune, 2017). This study applied this SAW weighted arithmetic aggregation due to its simplicity and to ensure transparency. After each indicator was standardised, the average value of each component was calculated using Eq. 2.

$$M_a = \frac{\sum_{i=1}^n I_{ai}}{n} \quad (2)$$

where  $M_a$  is one of the eight factors that influence the livelihood resilience for household  $a$ .  $I_{ai}$  indicates the sub-components index by  $i$ , which builds each major component, and  $n$  is the number of sub-components of each major component.

After obtaining values of each of the eight factors, the household-level RI was obtained by combining the components using Eq. 3.

$$RI_a = \frac{w_{\text{soc}}SOC_a + w_{\text{pol}}POL_a + w_{\text{eco}}ECO_a + w_{\text{tech}}TECH_a + w_{\text{clm}}CLM_a + w_{\text{soil}}SOIL_a + w_{\text{wtr}}WTR_a + w_{\text{bio}}BIO_a}{w_{\text{soc}} + w_{\text{pol}} + w_{\text{eco}} + w_{\text{tech}} + w_{\text{clm}} + w_{\text{soil}} + w_{\text{wtr}} + w_{\text{bio}}} \quad (3)$$

where,  $w_{\text{soc}}SOC_a$  refers to the total weighted value of social factors, similarly  $w_{\text{soc}}$  is the total number of indicators of the social factor,  $w_{\text{pol}}POL_a$  refers to the total weighted value of political factors, similarly  $w_{\text{pol}}$  is the total number of indicators of the political factor,  $w_{\text{eco}}ECO_a$  refers to the total weighted value of economic factors, similarly  $w_{\text{eco}}$  is the total number of indicators of the economic factor,  $w_{\text{tech}}TECH_a$  refers to the total weighted value of technical factors, similarly  $w_{\text{tech}}$  is the total number of indicators of the technical factor,  $w_{\text{clm}}CLM_a$  refers to the total weighted value of climate and weather-related factors, similarly  $w_{\text{clm}}$  is the total number of indicators of the climatic factor.  $w_{\text{soil}}SOIL_a$  refers to the total weighted value of soil-related factors (i.e., land), similarly  $w_{\text{soil}}$  is the total number of indicators of the immobile asset factor,  $w_{\text{wtr}}WTR_a$  refers to the total weighted value of water-related factors, similarly  $w_{\text{wtr}}$  is the total number of indicators of the water-related factor,  $w_{\text{bio}}BIO_a$  refers to the total weighted value of biodiversity factors, similarly  $w_{\text{bio}}$  is the total number of indicators of the biodiversity factor, and  $RI_a$  is the livelihood resilience index for household  $a$ , which equals the weighted average of 8 factors (45 indicators), as there are no standard weights for the variables (Kontokosta and Malik, 2018). It guarantees that all sub-components contribute equally to the total RI. This is done by simple aggregation approach. The final scores of the RI summarises the equally weighted average variable scores for each dimension (Burton, 2015). Using the normalised process the calculated RI scores are then ranges between -1 and 1, where -1 represents the analysis unit (i.e., a household) with the lowest livelihood resilience, and 1 represents the household unit with the highest livelihood resilience (Burton, 2015; Kontokosta and Malik, 2018).

According to the methods of construction of the Scale-Specific Resilience Index (Song et al., 2020), we then classified the RI scores based on the standard deviations from the mean, which highlights the percentage of units at a particular scale (i.e.,

household level) that perform pretty well or exceptionally poorly with respect to their resilience. Accordingly, an RI value less than 0 is considered as less resilient, 0 to 0.4 considered as moderate, and above 0.4 value as resilient. It results: resilient (18 percent), moderate (31 percent), and less resilient (51 percent) households in the sample. The categories are devised as such because there is a large group not on either end of the scale, thus a 'moderate' categorisation provides a control group to help assess the influence and viability of the categories in the conceptual framework.

## Results

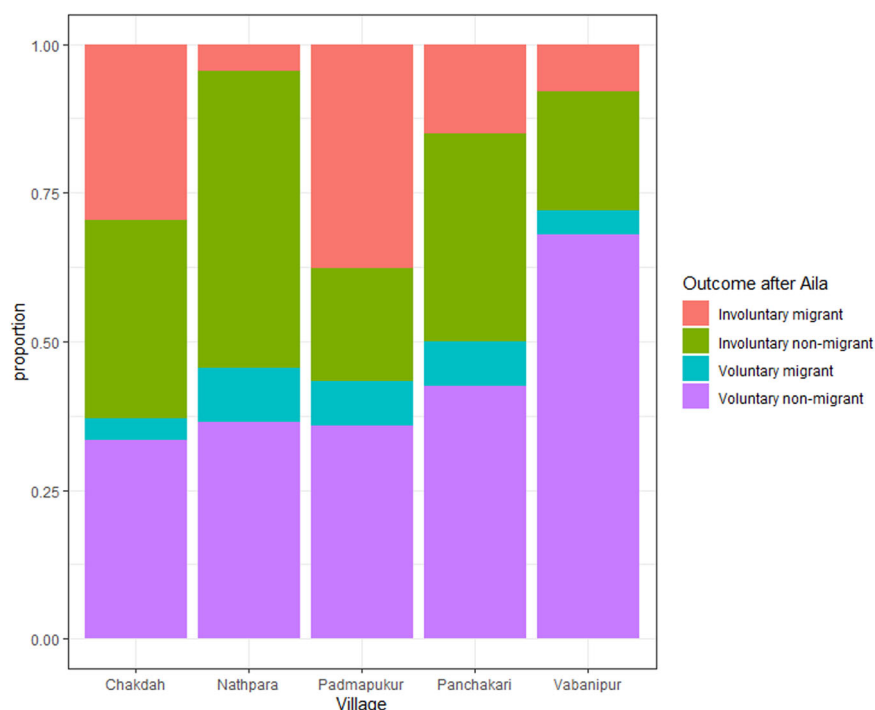
*Non-migrants and migrants after cyclone Aila, 2009.* The respondents who reported that at least one family member migrated (outside their community) after cyclone Aila for alternative income sources are considered as 'migrants' in the analysis. Similarly, the respondent who did not report such out-migration after Aila is considered 'non-migrant'. Similar to previous studies (Mallick and Vogt, 2012; 2014), this study finds that around 40 percent of the respondents reported that at least one family member migrated outside their community for alternative income sources. Data shows that almost fifty percent of the respondents' families in Padmapukur village sent at least one-member outside their village, followed by Chakdah (33 percent) and Panchakri (24 percent) villages. The higher rate of out-migration after cyclone Aila in these villages occurred due to long-standing water stagnation inside the villages due to a dam breach. However, almost every migrant household (94 percent) reported that their migrant family members had returned as soon as the dam was repaired (more or less 1 year after cyclone Aila).

Following the analytical concept as presented in Fig. 1, the respondents are classified into four types of migrants and non-migrants: (i) voluntary migrants, (ii) voluntary non-migrants, (iii) involuntary non-migrants ('trapped'), and (iv) involuntary migrants ('forced'/'displaced'). Their distribution in the five villages is presented in Fig. 3.

This distribution considers the classification of migrants and non-migrants as presented in the analytical concept. It shows that many sample respondents wanted to migrate after Aila but could not realise their aspirations. They were forced non-migrants. Nathpara and Padmapukur villages share the highest and lowest cases, respectively. Involuntary migrants were highest in number at Padmapukur village. Overall, most respondents were voluntarily non-migrants after cyclone Aila in 2009. Based on the qualitative interviews, the following section describes the community-level factors related to societal and environmental dimensions (presented in Table 1) and their relevance to such voluntary non-migration.

*What factors related to societal dimensions drive non-migration, and how?* Being able to stay in one's birthplace (i.e., home community) is especially important for many people, which is visible in this study. In the previous section, the majority of affected households remained in place. A few people mentioned that they did not think about any place where they could migrate. A schoolmaster of Padmapukur village said, "We had to fight six more months to reconstruct the dam. During cyclone Aila, the dam was broken, resulting in twice the daily inundation of our courtyard, kitchen, and cattle house. There were problems at first, but I got used to this condition after a while. What is the way? I didn't want to go anywhere else, hopefully not in the future.". The reasons people prefer to remain at such vulnerable locales include place attachment, availability of food security (though after cyclone Aila it was not the case), and ease and familiarity of living in their own premises.





**Fig. 3 (Non-)migrants type according to the analytical concept.** Source: Authors illustration, field data 2018.

Additionally, people feared living in uncertainty in new places after migrating, which might have exposed them to more risks. A woman in Chakdah village explained, “My husband wanted to go to town after Aila, but I wouldn’t let him go. Because none of us were in that town, not even today—all my relatives are living in this village and in the next village. Who knows what danger it would be to go to the city—we will all stay here”. This demonstrates the importance of security and social networks while migrating.

Even those who do not own any land prefer to stay in their present community. A day labourer in Nathpara village stated, “I do not know where to move, though I do not have any land in this village, but I can earn food for my family working at other farms. I have a house on the dam, it is government land, and nobody will force me to leave this place. We will try to stay here as long as we can and may buy land in the future here”. They like their village life, social associations, festivals, and opportunities of fishing and farming, all of which constitute belongingness to the places. Talking about what he likes about his village, a farmer in Vabanipur explained, “I like everything in our village. You see—how much greenery, how much vegetation and how much rice. You can also fish in the river. Although my condition is not very good, I have no land, I still have no shortage of rice. Working on other people’s land, I can procure rice. My son goes to school; I can pay for his education. The people in our village are all pretty good—if one is in danger, the other comes forward.” Thus, the importance of working opportunities, education opportunities, connections to people, neighbours and the land, and the holding power of the place are some critical factors related to societal dimensions that influence staying.

Moreover, the improved communication system also plays a vital role in future generation migration decisions. Talking about what she likes about her village compared to Khulna city, a young student (female, aged 19) in Panchkori village replied, “I heard from my parents that there was no paved road from our village to go to Khulna city twenty years ago. Everyone had to go to town by boat on the river. But now it only takes an hour to reach Khulna city—the road is paved—there is a public bus direct to Khulna. Our village is much improved now. How much garbage is in the

town? But you see our village is pretty clean! There is no need to stay in the city if the communication system is good at the village. After finishing my studies, I will work in city but stay in the village.” The social cost of separating families and logistical difficulties while living in a city life influence the staying decision.

What factors related to environmental dimensions drive non-migration, and how? Those living in Padmapukur village thought that breaking dams around their village was more of a problem than climate change. A fisherman (aged 45 years) explained, “I am hearing about climate change after cyclone Aila; before that, I never heard about it. We used to reconstruct our embankment during monsoons because it is important. What will be the consequences of climate change? I heard that there would be more water in the sea, and consequently, water may overflow the dam into the village. As my family lives near the dam, my grandsons may face some difficulties in the future. But you know, heightening the dam will not be an issue. We have been doing this since our forefathers were living here.” In Nathpara, where there is very little chance of flooding due to sea-level rise, a housewife (aged 32 years) claimed, “I like this village to live in because it is far away from city. It has no pollution from vehicles, and food and vegetables are fresh. Most of the people in our village are healthy because they eat more local fresh food and fish, besides they can work at their farmland to keep them physically fit.” Thus factors like lack of pollution and noise, having access to healthy food and vegetables, and a healthy living environment influence staying motivations. However, increasing water-salinity decreases rice production and increases the drinking water scarcity that sometimes influences out-migration aspirations. While talking to a shopkeeper (aged 43 years) at Chakdah village about water quality and soil salinity, he mentioned, “The problem of salt water in our village is increasing daily. In fact, after cyclone Aila, the number of shrimp farms has increased—everyone is fairly involved in saltwater shrimp farming. Those who do not have land go to the next city and drive a rickshaw or work as labour in construction sites. Here, plants are dying due to salt in the water. But where do we go while staying with salt water is nothing new for us. My



ancestors drank salt water. None of us will leave the village for this water problem. Actually, salt water is not a problem for us.” It seems adapting to some environmental problems may reduce the intention to migrate. Compared to migrated life in the city, day labour (aged 42 years) in Panchkori village explained, “Both air and water are all good in the village. The house is not built, crowded like a city. Lots of light and air here. I have to live in a slum if I go to town, I’m fine in my village environment and have decided not to go anywhere.” Thus the living environment is a pull factor against migration decisions. Although the respondents claimed that the seasons are changing, no one really wanted to change their place of residence. The temperatures are warmer than before, the summer is hotter, and human disease is on the rise. Yet, villagers believe the village environment is better than the city enough to decide to stay put.

All such factors related to societal and environmental dimensions firmly contribute to livelihood resilience and have a very influential role in migration decisions. Based on the quantitative survey data in the following section, this study assesses the influence of livelihood resilience on past and future migration intention at the individual household level and how it varies between study villages.

*Livelihood resilience and future migration decisions: temporal and spatial context at individual household level.* As described in section “Measuring livelihood resilience”, the respondents are categorised into three categories based on their livelihood resilience index (LRI) scores: resilient (18 percent), moderate (31 percent), and less resilient (51 percent). Data shows that after cyclone Aila, of households who reported their family members migrated, 77 percent were from the less resilient category. In contrast, migrants from moderate and resilient types comprised 21 percent and 2 percent, respectively. Thus, the more resilient people avoided migration influenced by the impacts of cyclone Aila in 2009.

The results show the livelihood resilience index does not differ significantly between the villages. As expected, the overall livelihood condition (about index value) is higher in Vabanipur, followed by Nathpara, Panchakari, then Padmapukur, and Chakdah. Similar findings are observed from the group discussion. A group discussant in the Chakdah village stated, “Due to huge shrimp farming, our soil is salinized, and we cannot cultivate rice here. Last time cyclone Aila was there, we were severely affected as we did not have any trees, and all around us was water. We were inundated. But you know, we do not have an alternative, we continue shrimp farming.” Regular and continuous rice production creates economic stability for the household and the community. Group discussion data confirms that the livelihood resilience conditions in Nathpara and Panchakari villages are comparatively better than the other villages, as people produce rice thrice and twice yearly in Nathpara and Panchakari, respectively.

However, compared to Vabanipur, most people in Padmapukur and Chakdah have negative LRI scores. It means that in Padmapukur, some people are less resilient than in other villages. Amongst these five villages, Nathpara has the fewest people with a negative LRI score. This indicates that most of the respondents in Nathpara are resilient compared to the respondents in other villages. Except for the Padmapukur case, Fig. 4b also shows that respondents with low LRI scores prefer to migrate in future, whereas those with higher LRI scores prefer to stay. It supports the hypothesis that better livelihood conditions may promote non-migration.

The results show that most migrants belong to households with a lower resilience index, and in the more resilient categories, people did not migrate in all villages except Padmapukur. Because of the severity of damages and long-standing water-logging in Padmapukur village caused by cyclone Aila of 2009, most people temporarily migrated to nearby cities. Moreover, most of those

living in a village where the primary income source is shrimp farming-related activities thought themselves unable to realise any migration aspirations after cyclone Aila and stayed put. The reasons given for their inability were lack of capital, social networks, and technical skills. They also thought they had to pay a middle-man for executing their migration decision, which would reduce the margin on their profit, with the result that they would ultimately be unable to save enough to handle future shocks. Findings show that most respondents (almost 90 percent) have experienced natural hazards constantly from a very early age and are mainly used to coping with them. Therefore, they do not think much about extreme events and are even worried about climate change and migration.

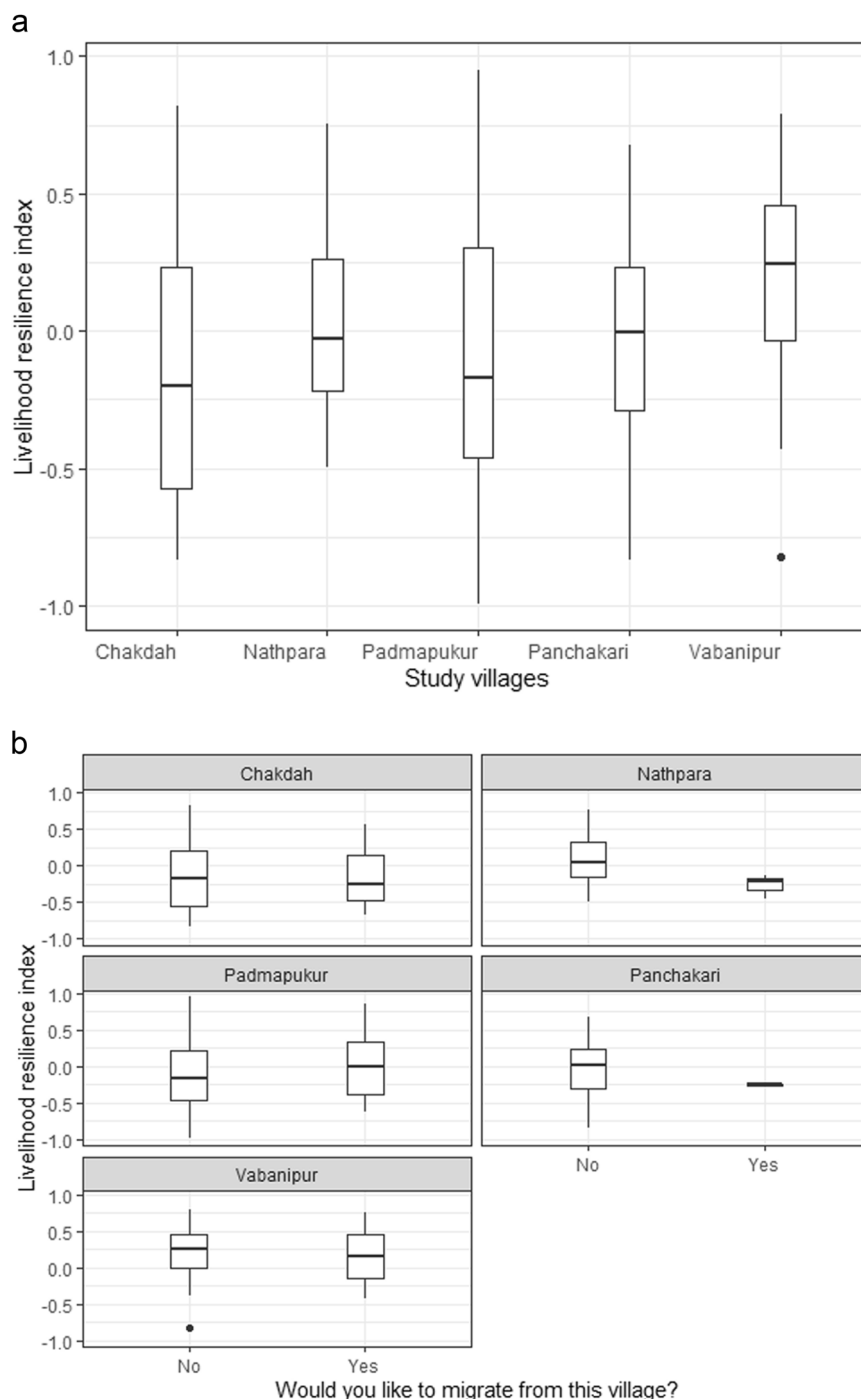
When compared to the resilience livelihood index of respondents, involuntary migrants and non-migrants share the lowest level of livelihood resilience. In contrast, the voluntary groups possess comparatively better livelihood conditions (Fig. 5). This supports the theory that livelihood resilience influences the individual’s/household’s aspiration of migration or non-migration.

However, during the group discussions at Padmapukur village, respondents reported that after Aila, at least five households migrated into their current communities and lived on the embankments. They immigrated to the locality where they thought there were opportunities to live comfortably through fishing in the Sundarbans and receiving support from ongoing governmental and non-governmental rehabilitation projects. No other immigrant families were reported in discussions with the other four studied villages. Respondents in Padmapukur and Chakdah villages practiced temporary migration. One interviewee (32 years, day labour at Padmapukur) mentioned, “I used to go to Khulna during boro-rice harvesting for 3 or 4 weeks, and I’d get so much rice that I could support my family almost three to four months. Besides, we used to go for working in the agricultural field on demand”. Similar observations occurred in Chakdah. Many migrate once or twice at a particular time of the year, usually when their native communities have no available employment. Others practice circular migration, meaning they regularly migrate to earn money so their families can stay in their place of origin. Both seasonal and circular migration are long-term strategies for staying in one’s place of birth.

While the analysis so far suggests a relationship between LRI and voluntary migration or non-migration decisions, such a relationship does not mean future aspirations are fixed. Some exceptions exist, such as today’s voluntary non-migrants aspiring to migrate shortly (Fig. 6), which also indicates the continuum between livelihood resilience and migration decisions.

In investigating possible future migration decisions (“would you like to migrate from your village?”), it becomes evident that almost every four out of five respondents’ families (79.2 percent), of those who migrated after cyclone Aila of 2009, would like to stay, and one-fifth would like to migrate (Table 3). On the contrary, only 12 percent of those who did not migrate after cyclone Aila would like to migrate. Furthermore, it is notable that of the less resilient population, 83 percent would like to stay, the same percentage as the resilient population, despite their differences in coping ability (Table 3). The results show more than every four out of five less resilient families desired to stay put (Table 3).

According to the analytical concept, those who stay put may be ‘involuntary non-migrants’ (‘trapped’) if they desire to migrate but are forced to stay due to a lack of capability to migrate. However, this is not the case for this population, who are not so resilient but would like to stay put in the first place. Thus, it is not easy to conclude the type of migration (i.e., the four categories) simply based on resilience. Rather, the reasons that influence capacities and aspirations have a more complex influence on the decision to stay put despite environmental changes and climate



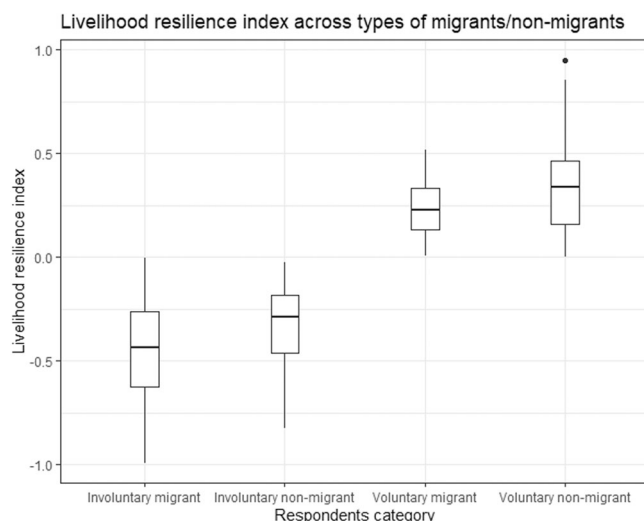
**Fig. 4 Livelihood resilience index and migration across the villages. a** Livelihood resilience index across villages. **b** Migration aspiration, livelihood resilience index across villages. Source: Field survey 2018.

risks. It is likely personal and psychosocial factors directly relate to aspiration (Massey et al., 1999; Adams, 2016). Identification of those factors requires more extensive and explorative research that considers the dynamic characteristics of the decision-making process of an individual or a household.

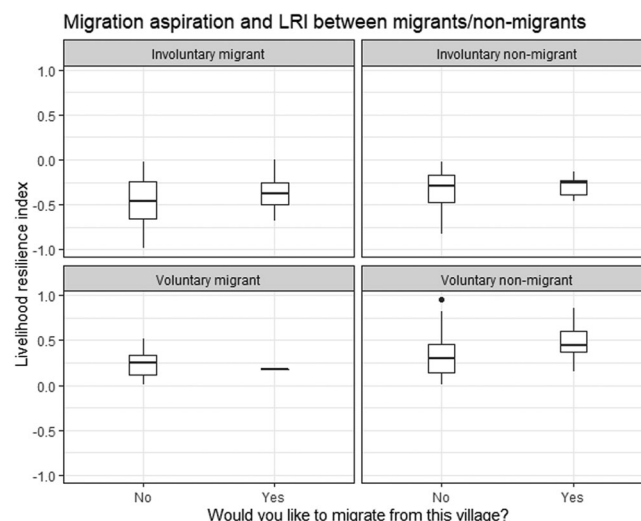
## Discussion

Since the first publication of reports by the Intergovernmental Panel on Climate Change (IPCC) in 1990, many researchers, particularly human geographers and other climate change researchers (Hugo, 1996; Massey et al., 1999; Bates, 2002; Smith, 2007; Mortreux and Barnett, 2009; Warner et al., 2010; Black et al., 2011; Grey, 2011;

Grey and Mueller, 2012; Mallick and Vogt, 2012; Joarder and Miller, 2013; Hunter et al., 2015; Etzold and Mallick, 2016; Thiede et al., 2016; Piguet, 2018) consider both sudden onset events (e.g., extreme environmental events such as cyclones and floods) and slow onset changes (e.g., environmental degradation through salinity, erosion, sea-level rise etc.) as primary reasons for environment-related migration away from peoples' ancestral homes. This paper has considered 'environmental non-migration' as a distinct phenomenon and proposed an analytical concept through which it may be studied. Though the reasons for non-migration are not identical to the reasons for migration, they can be explained only to some extent by simple 'push' and 'pull'-style frameworks.



**Fig. 5 Livelihood resilience index across types of migration/non-migration.** Source: Author's illustration field data 2018.



**Fig. 6 Migrants and Non-Migrants with their LRI and future migration aspiration.** Source: Field survey 2020.

**Table 3 Status of respondents after cyclone Aila, their future migration decision, and resilience status.**

Status after cyclone Aila (100 percent)	Future migration decision	
	Like to migrate (percent)	Like to stay (percent)
Households reported as migrants (40 percent)	20.8	79.2
Households reported as non-migrants (60 percent)	12.6	87.4
Household livelihood resilience status (100 percent)		
More resilient (18 percent)	16.7	83.3
Moderate (31 percent)	7.8	92.2
Less resilient (51 percent)	16.7	83.3

Source: Field survey 2018.

**Reflections on the analytical concept and results.** Here, livelihood resilience is considered a necessary basis for understanding the non-migration of at-risk people. The analytical concept proposes an integrative process of assessing livelihood resilience to determine the deliberated decision on migration or non-migration for the specific individual or household under the given circumstances. The model succinctly describes four types of environmental migration decisions and traces their origins based on livelihood resilience and the aspiration and ability to migrate, key concepts well-established in the literature (Carling, 2002; Carling and Schewel, 2018; Mallick and Schanze, 2020). Using a scale-specific resilience index (according to Song et al., 2020) to operationalise the concept allows us to examine the continuum of resilience at three fixed points—less resilient, moderate, and more resilient, and the relationship between migration and livelihood resilience. The case study discussions show how many livelihood factors (societal and environmental) drive non-migration and how these factors relate to adaptive capacity, resiliency, and place attachment. It demonstrates how resilience is spatial, contextual, and temporal, and also just one component of a migration decision, along with aspiration and capability. Environmental non-migration is, therefore, a continuum regarding the aspiration and capability involved (Van et al., 2018). The role of aspirations and capabilities as a pillar of migration decision-making is not absent in the proposed model; instead, it measures capabilities as a feature of the resilience value.

Furthermore, people's own identity and the cultural, and social values that are tied to a place also play a vital role in the mobility decision. All these factors represent the 'livability' in a place (Bas-solas et al., 2019), in which the social and cultural factors—with different characteristics—place attachment and their relations to the social network plays a vital role in staying. Whereas, the same factors also help in voluntary migration (Li et al., 2017) by ensuring socio-economic opportunities and security in the destination place (Jacobs, 1961; Wiegel et al., 2021). It would be beneficial for further research to focus on understanding these sub-factors at macro-, meso-, and micro level—which in turn are to inform inclusive climate adaptation policies that prove effective across translocal, regional and global scales, within times of increasingly rising urgency for such policies.

This accumulated knowledge reinforces the extent to which locals rely on coping capabilities and resilience, and the way in which adjustments following environmental disasters can be made (e.g., building shelters after a cyclone). Now what is to be accounted for when considering climate adaptation policies, is that there is a discrepancy between factual environmental hazards and the subjective perception of hazards, for instance, building upon indigenous knowledge and using resilience strategies, environmental hazards are not always perceived as a motivation to migrate. Rather, many locals adopt adaptive strategies to improve their livelihoods at the risk-prone residential area, as we have seen in our paper. Thus, policy should focus on resilient and adaptive strategies, rather than considering migration as the sole solution of dealing with environmental hazards. With this research, we hope to contribute to the still sparse literature on voluntary non-migration concerning climate changed and environmental hazards induced risk.

**Outlook.** Research on migration as a consequence of climate change exacerbating environmental hazards has been a field of interest for years. However, the exploration of environmental non-migration and its recognition as not only an eventually but also an active, voluntary decision has only found its way into research quite recently (Mallick, 2019; Wiegel et al., 2021; Ahsan et al., 2022). Still, the pull factors of 'staying' are evasive and complex and, therefore, hard to capture in models and analyses (Adams and Kay, 2019). Certain migration modes (short-term, seasonal) are also implicated in the overall non-migration strategy for many households (e.g., Mata-Codesal, 2018). Practically, to understand 'non-migration', it is vital to consider the



fundamental elements of human migration decisions, the locale (origin/destination), and the person (individual/ household). Thus, environmental non-migration is better explained by the context-specific and person-specific factors of livelihood resilience associated with each environmental event, as described by the concept. Lastly, there are multiple ways to operationalise the initial concept presented here, of which the formulation of a Resilience Index, as in section “Empirical example”, is just one. A longer-term/temporal observation of the socio-ecological system and the changes in the individual household, one that accounts fully for factors affecting aspiration and ability, maybe one of the best methodological advancements for this concept of ‘environmental non-migration’.

The analytic concept and its application in the case study presented by this paper suggest resilience is influential too, but not the sole determinant of, migration decisions. Instead, LRI has a relationship to the voluntary nature of decisions once they are made. Still, a household’s resilience cannot predict the decisions the household will make to stay or migrate. As evidenced by both the results of the case study and the wider literature, non-migration decisions specifically rely strongly on aspirations (to stay), which are likely based on a household- and community-oriented place attachment (Adams, 2016). This unique psychosocial element warrants further exploration, separate from the study of livelihood resilience dimensions, which form a large component of this particular conceptualisation. The impact of the characteristics of the environmental event (e.g., slow- or fast-onset) on the decision to migrate is also unexplored by the operationalisation of the analytical concepts applied. For example, in a fast-onset event, the ability to recover from the event quickly plays a role in the decision to stay. The severity of losses from extreme events also changes the livelihood conditions as well as the resilience to future shocks. Therefore, further research is required to explore such temporal variations in these factors to explain environmental non-migration.

## Data availability

Data will be available upon request. Correspondence and requests for materials should be addressed to Bishawjit Mallick.

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## Author contributions

BM conceptualised/designed the study, developed the study tools, led the data collection, cleaning and analysis, and contributed in writing, reviewing and editing the manuscript; CP contributed in writing, reviewing and editing the manuscript; JS participated in reviewing and editing the manuscript. All authors read and approved the final manuscript copy before the submission.

## Competing interests

The authors declare no competing interests.

## Ethical approval

The data used in this study was obtained from a field survey. The procedures used in the study followed the ethical principles of research formulated by the Institutional Review Board (IRB) of the TU Dresden (TUD), Germany. The contents of the questionnaire were all multiple-choice questions with clear instructions and did not involve ethical issues. The Author is respected for the autonomy, privacy, and dignity of all participants involved in the survey. The datasets contain no personal identities for the participants with their informed consent.

## Informed consent

Informed consent was obtained from all participants by clarifying the information about the researchers, objectives, data uses, and the voluntary attribute of participation at the beginning of the questionnaire interface. No identifying information was collected during the survey.

## Additional information

**Supplementary information** The online version contains supplementary material available at <https://doi.org/10.1057/s41599-023-01516-1>.

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