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Investigating critical relationships among vulnerability, livelihoods, and non-migration strategies at the fishing communities in the Sundarbans

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Abstract
This article investigates non-migration of fishermen communities living adjacent to the Sundarbans in Bangladesh. While analysing the regular livelihood patterns of these communities, this article explores a symbiotic relationship among livelihoods, risks, and natural resources in understanding fishermen's choice of locations in the vulnerable areas. We have adopted a mixed method approach in conducting questionnaire survey, interviews, and focus group discussion at household level. We have employed a triangulation system in the study, i.e. collected data from different sources to compare and then used diverse methods to check whether the information was consistent. Upon analysing the data obtained from field investigation, it can be concluded that the critical relationships exist among livelihoods, risks, and immobility of fishermen community in the Sundarbans. Therefore, fishing households' non-migration can be explained in-between voluntary and in-voluntary decision-making process. The study claims that the decision-making process depends on a symbiotic relationship between livelihoods, vulnerability, and natural resources management. The findings reveal that fishing households utilise assets and opportunities to build a blended livelihood strategies including natural resource extraction; diversifying income sources; borrowing and investment; asset pooling; and building social capital. Finally, this study concludes that this process of combining and transforming different assets for livelihood strategies can be explained as an autonomous adaptation process in the face of climate change. Particularly, the study accomplishes that this autonomous adaptation process defines the nature and dynamics of non-migration strategies of fishing communities.

Keywords Coastal communities · Bangladesh · Migration decision · Natural resources · Climate change

1 Introduction

Bangladesh exhibits a significant susceptibility to the impacts of climate change, as evidenced by the occurrence of six prominent climate-induced disasters within the past two decades. These disasters encompass four instances of flooding and two instances of

Extended author information available on the last page of the article

cyclones, resulting in the widespread disruption of livelihoods and affecting a substantial population numbering in the millions (Hossain & Rahaman, 2018a). The coastal region of Bangladesh encompasses around 20% of the country's geographical area and comprises over 30% of its arable land. However, it is confronted with significant challenges arising from the harsh climatic conditions resulting from global climate change. Salinisation is an increasingly prevalent issue in coastal regions, posing a significant threat to the livelihoods of rural populations heavily reliant on agriculture and its associated economic opportunities, such as agricultural labour, shared cropping, and fishing. The phenomenon of climate change has further intensified this situation. The accumulation of salt in the soil has been exacerbated by rising sea levels, increased frequency and duration of drought seasons, lack of fresh water, and the presence of significant quantities of shallow saline groundwater (Netherlands Enterprise Agency, 2020). Furthermore, the augmented frequency and severity of cyclonic occurrences would result in a disproportionate escalation of vulnerability among the coastal populace, as opposed to individuals residing in other rural areas of Bangladesh (Ahmed & Khan, 2022; Dasgupta et al., 2018). The agricultural and fishing communities residing in the coastal regions of Bangladesh face significant risks due to the impacts of climate change. These people are particularly vulnerable to climate-induced disasters, which have a profound impact on their lives and livelihoods (Alam & Mallick, 2022). The capacity to effectively manage and adapt to climate calamities significantly impacts individuals' migration choices (Gaibazzi, 2010). When a hazardous event occurs, economic activities are adversely affected in proportion to the severity of the occurrence. This issue gives rise to concerns over social security. Individuals begin implementing strategies to recuperate from setbacks and reinstate their customary routines. The potential triggering of quick decision-making regarding movement remains uncertain; however, individuals may initiate a search for other locations and livelihood opportunities. When individuals discover a more favourable alternative for their living conditions and means of sustenance in another location, the prospect of migration becomes significantly probable. Hence, there is a notable increase in the migration of working-age individuals, particularly males, from households in search of alternative means of sustenance in areas impacted by salinity and climate-induced disasters, in comparison with unaffected districts. Despite limited attention in the field of climate change and development studies, the concept of non-migration as a climate adaptation strategy has been explored by researchers such as Biswas and Mallick (2020), Mallick (2019), Mallick and Schanze (2020), and Mallick et al. (2022). It is suggested that non-migration could serve as an adaptive approach for individuals residing in areas vulnerable to both gradual environmental threats and abrupt occurrences (Renaud et al., 2011). This study centres around the examination of factors that impact the resilience of individuals facing precarious circumstances, as well as the role of livelihood resilience in shaping the decision-making process of vulnerable populations with regard to migration.

Human migration is a multifaceted phenomenon that is characterized by the interplay of various intricate causes and exhibits dynamic patterns over extended periods of time. The degradation of the environment has emerged as a significant catalyst for human displacement, as the consequences of such activities have gained paramount importance. According to Brown (2008), the migratory process is greatly influenced by environmental changes, particularly climate change, which is regarded as the most substantial factor. According to Kartiki (2011), the phenomenon of migration arises when climate shocks

and strains intensify the susceptibility of a household's livelihood, hence exacerbating pre-existing challenges such as heightened fragility of livelihoods, inadequate social or community protection, and deficiencies in infrastructure. Consequently, the adverse impacts of climate change have a significant influence on the escalation of human migration as individuals seek a more secure environment that may provide sustenance and enhance the welfare of their households (Kartiki, 2011; Mukaddim et al., 2020). Hence, it is not possible to ascribe a singular factor as the primary catalyst for this phenomenon. The comprehensive character of migration poses challenges in terms of its categorization within a certain theoretical framework. In light of this, the phenomenon of human mobility has been examined and analysed from various theoretical frameworks and academic perspectives within the existing body of scholarly literature. According to recent economic theory, the determination of human migration decisions is not exclusively based on an individual's calculations aimed at maximizing their utility (Black et al., 2011; Rahman et al., 2018). The extent of the impact is contingent upon the reaction of individuals or households to abrupt fluctuations in income or employment, as well as the limited yields observed across various markets such as labour and credit (Massey et al., 1993; Rahman et al., 2018; Stark, 1991). Therefore, in cases where a collective of individuals experiences displacement, particularly if the displacement appears to be a prolonged event, it becomes pertinent to examine such migration via the lens of network theory (Massey, 1999; Massey et al., 1993). Nevertheless, it is worth noting that in the process of conceptualizing and theorizing the relationship between climate change and migration, the aspect of non-migration or populations that are unable to migrate has been overlooked (Biswas & Mallick, 2019; German Environment Agency, 2020; Mallick, 2019; Mallick & Schanze, 2020; Mallick et al., 2020). Within the present setting, the primary objective of this research is to investigate the underlying reasons behind individuals' inclination to remain in a precarious area. This study aims to enhance our comprehension of various manifestations of non-migration choices.

Non-migration can be understood as the antithesis of migration within the literature, wherein this term is employed to elucidate the act of not undergoing migration and instead remaining in one's current location (Jónsson, 2008; Malmberg, 1997). The concept of immobility, defined as the lack of migration, has been extensively examined by scholars (Coulter et al., 2016; Gray, 2011; Hjälm, 2014; Mata-Codesal, 2015; Preece, 2018; Schewel, 2019). According to Hjälm (2014), the concept of immobility can be seen as a multifaceted and intricate phenomenon, comparable in complexity to the act of mobility. Carling (2002) has proposed the 'aspiration/ability framework' as a theoretical construct to elucidate the concept of immobility. Within this framework, three distinct forms of immobility are delineated: (i) 'mobility,' which refers to the condition where an individual possesses both the aspiration and ability to relocate; (ii) 'involuntary immobility,' which pertains to situations where an individual possesses the aspiration to migrate but lacks the necessary means to do so; and (iii) 'voluntary immobility,' which characterizes instances where an individual possesses the ability to move but lacks the aspiration to do so. The German Environment Agency (2020) has classified immobility into two distinct categories. The first category encompasses those who voluntarily choose to remain in their current location of residence, referred to as the immobile population. The second category includes individuals who lack the ability or resources to relocate, sometimes referred to as the trapped people. Hence, it should be noted that populations that remain immobile cannot be automatically categorized as vulnerable populations, as their decision to remain in vulnerable situations may be influenced by factors such as access to

livelihood opportunities, emotional connection to their place of residence, place identity, sense of place, and place dependency (Mulvaney et al., 2020; Rabbani et al., 2022). Furthermore, in their study, Rabbani et al. (2022) have recognized the concept of 'place obduracy' as a significant component within the specific context of coastal Bangladesh. This factor has been found to exert effect on the voluntary non-migration decisions made by those who are at risk in this region. This study also hypothesized that the decision of fishing households residing in the Sundarbans, who face various dangers, to not migrate is predominantly driven by voluntary factors rather than involuntary factors. This decision is contingent upon their ability to access natural capital assets and pursue alternative livelihood possibilities.

The concept of trapped populations in vulnerable contexts refers to those who lack the necessary assets to migrate and are consequently unable to escape their circumstances. This notion has been acknowledged by the German Environment Agency (2020), which highlights crucial asset categories required for migration. These assets encompass financial capital (including income, savings, and access to institutional credit), social capital (encompassing extended family or social networks in desired destinations), and human capital (encompassing knowledge, physical prowess, and skill sets). A novel perspective on migration and non-migration, offered by Mallick and Schanze (2020), contributes to a broader comprehension of voluntary non-migration. Their framework identifies voluntary non-migrants as individuals or households who actively choose to remain in their present locations, driven by aspirations to do so. Notably, this decision hinges on particular capabilities that facilitate non-migration, regardless of the capacity to relocate. Further elaboration is provided by Mallick et al. (2020), who posit that non-migration should be viewed as a strategic livelihood adaptation. This adaptation not only diminishes household vulnerability but also lays the foundation for future livelihood prospects. Biswas and Mallick (2019) provided an explanation on the ways in which livelihood diversification methods lead to the prolonged non-migration of individuals residing in areas with numerous dangers. During their research conducted in the southwestern coastal region of Bangladesh, scholars have observed that the local population adopts various livelihood strategies, including shrimp farming, engaging in business activities, extracting natural resources from the Sundarbans, and fishing in the canals and rivers (Biswas and Mallick, 2019; Rabbani et al., 2022). Despite this, there remains a dearth of knowledge about the interplay between risk, livelihood, and non-migration. It is imperative to elucidate the extent to which livelihood assets, capabilities, and opportunities impact the decision of individuals facing climate risks to refrain from migrating. This study explores the correlation between livelihood, risks, and natural resources and investigates the impact of livelihood assets and capabilities on individuals' decisions to remain in their respective locations despite ongoing exposure to climate change and climate extremes. This study seeks to examine the factors influencing the decision of impoverished and disadvantaged households in a fishermen community residing in the outskirts of the Sundarbans region in Bangladesh to remain in an area characterized by elevated climate risks. This article aims to address the subsequent inquiries while providing a response to the overarching umbrella question. (i) What are the obstacles encountered by fishing communities and how does climate change exacerbate these challenges? (ii) What are the livelihood assets, capabilities, and livelihood opportunities that contribute to the resilience of individuals and communities in the face of climate change and climate-induced extreme weather events? The objective of this study is to examine three key factors: (i) the relationship between livelihood resilience and the decision of fishing communities to voluntarily refrain from migration in the face of climate risks, (ii) the extent to which livelihood resilience influences this decision, and (iii) the mechanisms through which livelihood resilience contributes to the non-migration choice of fishing communities in the context of climate hazards.

2 Understanding the relationship between vulnerability, livelihoods, and non-migration

Sustainable livelihoods approach became a holistic view of the problems of poverty and ways of tackling those problems, in which it places poor people and their priorities at the centre of the development process (Scoones, 1998). The SLA is a multidimensional approach that involves the assessment of households' assets and the livelihood strategies they undertake to make livelihood outcomes such as food security, household well-being, livelihood resilience. It considers as a pragmatic understanding of the poor households' livelihood and what drives livelihood vulnerable or resilient situation. Thus, the SLA helps us to determine the extent to which vulnerability, assets, policies, and institutions affect people's livelihood. We modified and used the 'Sustainable Livelihoods Approach (SLA)' in understanding the complex relationship between vulnerability, livelihoods, and non-migration. Following Scoones (1998), we analysed how the fishing households within a given socio-ecological context combine livelihood resources and capabilities and opt to take critical non-migratory decision. We have modified the existing 'Sustainable Livelihood Framework' (e.g. Bebbington, 1999; DFID, 1999; Scoones, 1998) to demonstrate a complex relationship among vulnerability, livelihoods, and non-migration. The modified sustainable livelihood framework shown in Fig. 1 highlights socio-ecological system and livelihood adaptation as part of the structures and processes that directly influences livelihood strategies.

In order to comprehend the interplay between vulnerability, livelihoods, and non-migration, it is imperative to initially focus on the intricacies of the vulnerability context and its impact on migration choices. In order to comprehend the vulnerability context of a household and its impact on mobility outcomes, we have utilized the two-step vulnerability model proposed by Chambers (1983, 1989, 1993), which has been extensively utilized in the field of poverty and livelihood research (e.g. Ellis, 2003; Hossain & Rahman, 2018a, 2018b; Hulme et al., 2001). In Chambers's (1993) study, an examination is conducted on

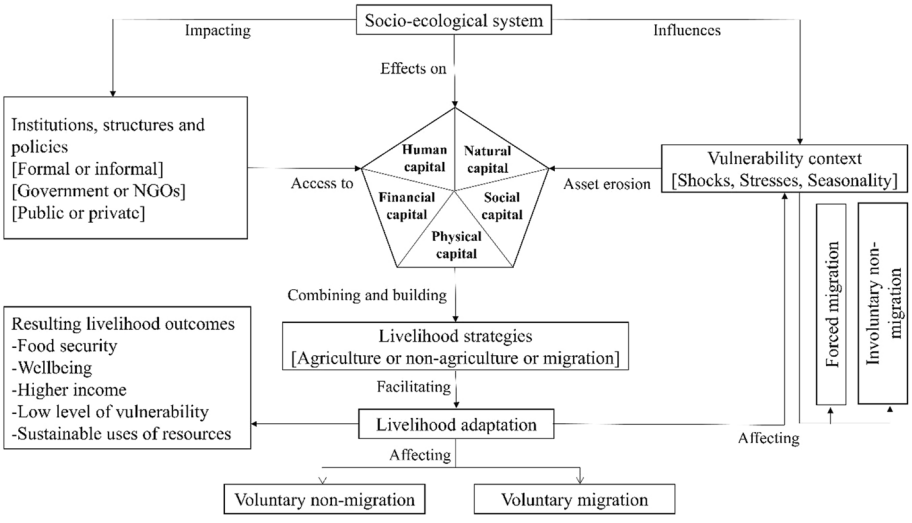

Fig. 1 The conceptual framework of vulnerability, livelihoods, and non-migration nexus

a framework that encompasses the vulnerability of both sides. This framework consists of two components: firstly, the exposure to risks or shocks in the external side, and secondly, the internal side's defencelessness, which refers to the limited assets and capacities available for coping with or recovering from these shocks. The correlation between climate-induced shocks, pressures, seasonality, and migration or non-migration is intricate. Environmental factors, particularly climate change and climate extremes, have a significant role in compelling individuals to migrate or become displaced. The correlation between a climate extreme and an individual or household's coping skills is contingent upon both the frequency and degree of the extreme. Climate extremes are causing dynamic relationships to be challenged, leading to either forced migration or situations where individuals are unable to migrate (Ellis, 2003; Foresight, 2011; German Environment Agency, 2020; Mallick & Schanze, 2020; Scott, 2006). Migration is a phenomenon that arises from the implementation of effective measures that have been previously employed to address the anticipated consequences resulting from catastrophic events. The impact of climate change on individuals, households, communities, and regions might render conventional risk sharing methods, typically reliant on extended family or social networks, outdated, leading to migration (Vernon, 2008). It should be noted that the decision to move is often contingent upon the degree to which individuals or households are impacted by climate change, climate extremes, or other environmental occurrences. According to the findings of Mukaddim et al. (2020), the occurrence of an environmental event does not necessarily lead to a choice on displacement. Instead, the decision to migrate is influenced by a variety of factors that often interact with one another. This concept posits that climate change may not be the sole catalyst for motivating migration. The determination of whether or not to remove individuals is contingent upon the nature of the event and its subsequent consequences. Furthermore, the decision to migrate for individuals or households can be influenced by their incapacity to adapt to post-disaster situations.

In a vulnerable situation, the phenomenon that stands in contrast to migration is referred to as a trapped population. In situations where individuals are unable to leave a particular setting due to a lack of necessary assets, such as human capital or social capital, they are classified as a trapped population (Foresight, 2011; German Environment Agency, 2020; Mallick & Schanze, 2020). The population that is confined to a specific location exhibits a preference for remaining in their place of origin, although having a limited desire to do so. However, their inability to relocate is primarily due to a lack of resources and talents. The groups in question are frequently classified as involuntary non-migrants (Mallick & Schanze, 2020). Ionesco et al. (2017) have identified several factors that may impede an individual's ability to transition from surroundings that are prone to hazards or experiencing slow degradation. These factors include poor health, restricted access to information, marginalization, and socio-spatial inequality. However, examining the phenomenon of non-migration through the perspective of poverty dynamics enhances our comprehension of involuntary non-migration. The dynamics of vulnerability and adaptation are often influenced by poverty, leading to the implementation of short-term and sometimes detrimental adaption techniques by individuals living in poverty, ultimately perpetuating cycles of poverty. In order to delve deeper into the connection between vulnerability and poverty, Hossain and Rahman (2018a, 2018b) posit that individuals belonging to disadvantaged or marginalized groups experience formal or informal institutional arrangements that may impede their access to assets necessary for asset adaptation. For instance, women who are widowed, divorced, or abandoned are regarded as a vulnerable demographic due to their limited access to resources, which is constrained by various formal and informal institutional frameworks. These frameworks may involve the exclusion of widows or divorced women

from community credit groups, or the elderly women being excluded from extended family assistance or government social protection programs.

Building upon the preceding discourse, it is imperative to underscore the significant impact of the socio-ecological system on the prevailing vulnerability framework, hence compelling individuals to choose between coerced migration or involuntary abstention from migration. The 'Sustainable Livelihood Framework (SLF)' categorises capital assets as the resources that enable individuals to sustain their livelihoods in a vulnerable situation. Individuals aggregate the financial resources at their disposal, over which they exercise agency, in order to establish and sustain their means of subsistence. The components encompassed in this category consist of individual competencies, tangible resources, and intangible resources (Chambers & Convey, 1992). The SLF (Sustainable Livelihoods Framework) places emphasis on five distinct categories of capital assets, namely human, social, financial, physical, and political capital assets. It has been suggested by Siegel (2005) that an individual's or household's collection of assets can have an impact on their ability to escape poverty and contribute to economic growth (Siegel and Alwang, 1999). In order to shift away from a livelihood-centric approach and prioritize strategies and solutions for addressing climate change, it is possible to adopt Moser's (2010) asset-based adaptation framework. This framework recognises the role of assets in enhancing the adaptive capacity of households and communities within vulnerable contexts that are influenced by socio-ecological systems. Moser's (2010) concept of asset adaptability is intricately linked to the notion of assets and capabilities. Low-income households or communities employ their resources and capacities to develop strategies for asset adaptation in order to mitigate the adverse impacts of climate change and extreme weather occurrences. The institutional structure, whether official or informal, in which impoverished households and communities' function can either hinder or facilitate the poor's access to resources and their ability to modify their assets (Moser, 2007). Various institutions at different levels provide incentives or create a conducive environment for impoverished households and communities to adapt to climate change (Moser, 2010; Moser et al., 2010; Young et al., 2005). Hence, the asset-based paradigm posits that fishing households possess the capacity to formulate diverse asset adaptation strategies in response to climate change.

While the available scholarship on the topic is scarce, several academics have identified a connection between asset adaptation and intentions to not migrate (Biswas & Mallick, 2019; German Environment Agency, 2020; Mallick, 2019; Mallick & Schanze, 2020; Mallick et al., 2020). The study conducted by Mallick et al. (2020) uncovers a correlation between the desire to not migrate and the available means of sustenance within different socio-ecological settings in which individuals or households reside. The authors elaborated on the fact that the decision of an individual or household to not migrate is contingent upon the resilience of the household in the face of climate-induced shocks and strains. According to Mallick (2019), the concept of livelihood resilience can be seen as the outcome of the socio-ecological system in which an individual or household is situated. The determination of whether to migrate or remain in one's place of origin is contingent upon various aspects associated with the socio-ecological system and their impact on the capacity to withstand climate change or extreme climatic occurrences (Mallick, 2019; Mallick et al., 2020). Therefore, individuals make the choice to remain in their location of residence when their means of subsistence demonstrate resilience. The establishment of livelihood resilience is contingent upon the availability of livelihood assets and capabilities, which are influenced by institutional processes. Gaining a comprehensive comprehension of institutional processes enables the identification of constraints or obstacles as well as potential avenues for enhancing livelihood resilience. The access to assets and capabilities, which

are essential for livelihood diversification and resilience, is mediated by a variety of organizational structures. These structures can be formal, such as government safety nets, non-governmental organizations' asset transfer programmes, and credit facilities, or informal, such as extended family networks (Scoones, 1998). Hence, the focus of the SLA lies in the examination of institutional processes and organisational structures as fundamental factors for comprehending livelihood outcomes such as resilience and the absence of migration. In light of this, the article examines the role of institutions and social norms in facilitating or constraining fishing communities' access to livelihood capital assets and competencies that enhance their resilience to the dangers they encounter. The relationship between vulnerability, livelihoods, and non-migration was conceptualised within the framework depicted in Fig. 1. This conceptualisation posits that the decision of vulnerable households or communities to migrate is influenced by the extent of their resilience to external shocks. Therefore, an analysis can be conducted on the socio-ecological system and livelihood chances of fishing households in order to identify the elements that influence their decisions to not migrate.

3 Research strategy

3.1 Study area

The data collection process focused on two Unions, Chila and Banishanta, located adjacent to the Chandpai and Dhangmari Forest Stations within the Sundarbans. This encompassed four administrative forest ranges: Chandpai, Sarankhola, Nalian, and Burigoalini, as well as sixteen forest stations across Bangladesh (Fig. 2). The geographical distribution included Chandpai and Dhangmari forest stations situated in distinct sub-districts, Mongla and Dacope, respectively. Mongla Upazila (sub-district) spans an area of 1461.20 sq. km, with 1083.00 sq. km constituting the Sundarbans Reserve Forest. Geographically, it lies between latitudes 21°49′ and 22°33′ north and longitudes 89°32′ and 89°44′ east (BBS, 2015a). Its boundaries are defined by Rampal sub-district to the north, Morrelgonj and Sarankhola sub-districts to the east, Dacope sub-district to the west, and the Bay of Bengal to the south. The second study area, Dacope Upazila (sub-district), covers 991.56 sq. km. Within this, the Reserve Forest occupies 494.69 sq. km. This sub-district spans latitudes 22°24′ to 22°40′ north and longitudes 89°24′ to 89°35′ east (BBS, 2015b). Its borders are delineated by Batiaghata Upazila to the north, the Pashur river to the east, Rampal and Mongla Upazilas of Bagerhat District to the east, the Bay of Bengal to the south, and Shibsa river, Paikgachha, and Koyra Upazilas of Khulna District to the west.

3.2 Data collection

A convergent parallel mixed method design (Creswell, 2009; Creswell & Creswell, 2017) was employed to thoroughly analyse the vulnerability context, livelihood capital assets, and institutional context. The fishing households' livelihood patterns and diversification possibilities bore a significant resemblance to the factors that affected their decision not to migrate. The convergent parallel mixed method design involved the simultaneous implementation of quantitative and qualitative research methodologies. Data collection was conducted in the field, with both quantitative and qualitative data being gathered within a comparable time period. Regarding the quantitative data, our analysis focused on individuals

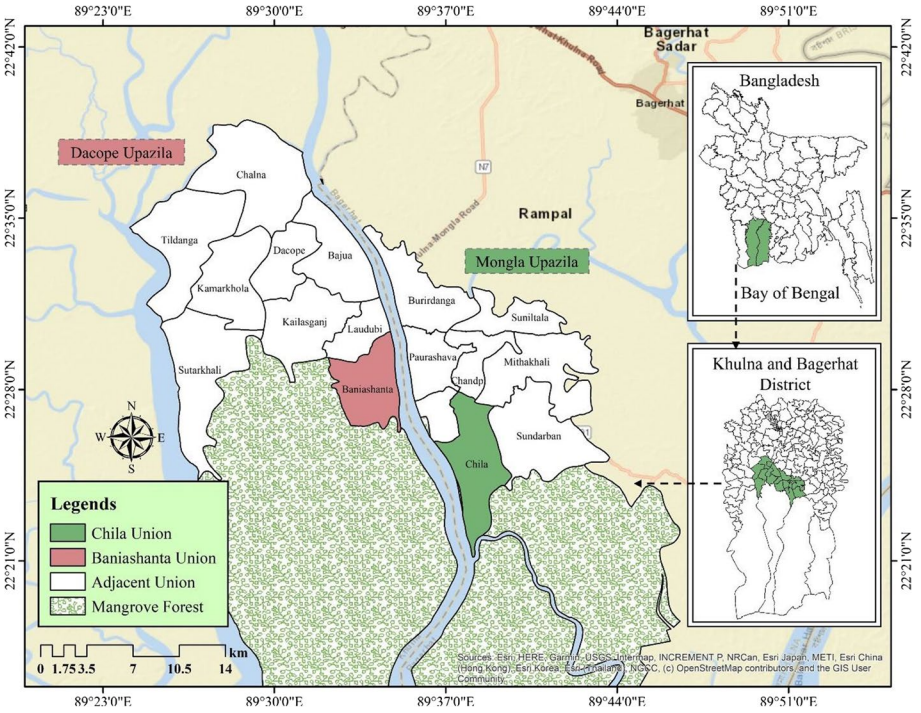

Fig. 2 Locational map of the study area

who rely predominantly on the Sundarbans for their sustenance and who predominantly reside in close proximity to the Sundarbans, namely within a buffer zone ranging from 250 m to 1 km in distance from either the river or the Sundarbans itself. In order to get samples for this study, a sampling frame consisting of 1000 families engaged in fishing was utilized. This sampling frame had been compiled by the Community Development Centre (CODEC), a non-governmental organisation, in collaboration with the United Nations Development Programme (UNDP) and the Bangladesh Forest Department around one year before to the research. During the process of beneficiary selection for the project supported by the Global Environment Facility (GEF), a database of fishing households was generated. A total of 965 houses residing within a 250 m radius of the river, which had been designated as the Dolphin sanctuary region, were chosen as the recipients. However, the remaining thirty-five households engaged in fishing were chosen at a distance greater than 250 m from the sanctuary area. The primary focus of analysis in this study was the household. Specifically, the sample frame for this research consisted of all households residing in two study regions, namely Chila and Banishanta Unions. This encompassed a total of 1000 families. The sample size in this study was chosen using Yamane's (1967) formula, which has been commonly employed in social science research when the population appears to be finite, but the variance is unknown. The sample size of 288 was acquired from a total population (N) of 1000, with a precision/error margin level of 0.05. Therefore, a dataset of 288 fishing homes was obtained by the administration of a questionnaire survey.

In the context of qualitative research methods, this research employed various data collection techniques, including the organisation of focus group discussions (FGDs),

conducting in-depth interviews, and engaging in key informant interviews within the chosen two Unions. The opinions of fishing communities were obtained through the facilitation of two participatory brainstorming sessions. Subsequently, an extended focus group discussion was conducted with fishermen (see Fig. 2 for the spatial locations of these activities). During the participatory sessions, a total of twenty people were considered for each session. Following the completion of the Focus Group Discussion (FGD) during the initial portion of each day of the field visit, a storytelling session was organised with four fishing households. The objective of this session was to get insights into the experiences of these households in terms of both successful and unsuccessful livelihood diversifications. In addition, we conducted a total of fifteen comprehensive interviews with members of the local population residing in these Unions. The objective of these interviews was to get insights into the vulnerability and livelihood dynamics experienced by these individuals. Key informant interviews were conducted with Non-Government Organisations (NGOs), community leaders, and local officials in order to validate the findings derived from other qualitative methodologies, such as focus group discussions (FGDs) and case studies.

3.3 Data analysis

In this study, an integrative approach was employed, involving the collection and analysis of both qualitative and quantitative data to underpin the scientific findings. A thematic analysis framework, as outlined by Braun and Clarke (2021a, 2021b), was adopted to delve into the intricate dynamics of fishing households' livelihoods and their vulnerability context. The process commenced by meticulously reviewing the interview content, iterating through them while keeping the research questions as a guiding compass. Subsequently, the transcriptions were distilled into concise meaning texts, laying the foundation for coding. This coding process was executed manually, adopting a descriptive coding strategy in accordance with Saldana (2015). Codes were amalgamated into categories based on similarities in meaning, ensuring that each category resonated with the research questions. The ongoing refinement process involved scrutinizing the categories to determine whether they could effectively address the research inquiries. Themes then emerged from the synthesized codes and categories, contributing to a higher-level theoretical abstraction and deepening the understanding of the data.

Simultaneously, the quantitative data were subjected to analysis to gauge livelihood resilience. Recognizing that the decision to remain was intrinsically tied to the households' capacity to withstand shocks, a Livelihood Resilience Index (LRI) was formulated. This index was informed by three central capacities—absorptive, adaptive, and transformative—which were articulated across ten significant components, as elucidated in Appendix Table 5.

In devising the LRI methodology, inspiration was drawn from similar indices such as the 'Climate Resilience Index (CRI)' (Asmamaw et al., 2019), 'Resilience Index' (Ha-Mim et al., 2019), 'Livelihood Vulnerability Index' (Antwi-Agyei et al., 2012; Hahn et al., 2009; Huong et al., 2018), and the 'Human Development Index (HDI)' (UNDP, 2007). These established frameworks informed the calculations and structure of the LRI, thereby grounding it within a broader research context and enhancing its reliability and applicability to the study's objectives.

3.3.1 Livelihood resilience index calculation

The formulation of the resilience capacity index was guided by a principle of equal weighting. In this approach, each of the three dimensions—absorptive, adaptive, and transformative capacity—was assigned an equal weight of 1/3. Within each dimension, major components were also accorded equal weights, distributing a weight of 1/6 to every major component. To ensure equitable distribution, the subsequent step involved attributing a weight of 1/42 to each individual indicator within a major component (1/6 ÷ 7).

Given the diversity in measurement scales for the major components and indicators, standardization was imperative. To address this, standard values for each component and indicator were computed using following equations Eqs. (1) and (2), in alignment with established scholarly literature (Antwi-Agyei et al., 2012; Hahn et al., 2009; Ha-Mim et al., 2019; Huong et al., 2018; UNDP, 2007). Equation (1) was employed for indicators demonstrating a positive correlation with resilience, while Eq. (2) was employed to standardise indicators exhibiting an inverse relationship with resilience. This approach draws on well-established methodologies to ensure robustness and coherence in the calculation of the resilience capacity index, aligning it with established practices within the scholarly domain.

$$\text{Index } l_a = \frac{S_r - S_{\min}}{S_{\max} - S_{\min}} \tag{1}$$

$$\text{Index } l_a = \frac{S_{\max} - S_r}{S_{\max} - S_{\min}} \tag{2}$$

where Indexl_a is the normalised index value and S_r is the original value of the indicator for household S, $S_{\max}$ and $S_{\min}$ are the maximum and minimum values of the indicator at the household level. We used Eq. (3) to calculate the value of major components for each household where indicators were averaged plugging the data into Eq. (3).

$$M_r = \frac{\sum_{i=1}^{n} \text{Index } l_{a^i}}{n} \tag{3}$$

where M_r represents the value of a major component for household S (Preparedness to climate extremes, Social capital, Income and food access, Health, Water, Sociodemographic status, Asset and livelihood diversity, Institutional capital, Empowered, Access to services), Index l_{a^i} is the normalized value of the ith indicator for household S, and n is the number of indicators under each major component or dimension. Once major components value for each of the household is calculated, Eq. (4) has been used to calculate Livelihood Resilience Index at household level.

$$\begin{aligned} \boldsymbol{LRI} = &\left(\text{PCE} \times W_i\right) + \left(\text{SC} \times W_{ii}\right) + \left(\text{IFA} \times W_{iii}\right) + \left(H \times W_{iv}\right) + \left(W \times W_v\right) \\ &+ \left(\text{SDC} \times W_{vi}\right) + \left(\text{ALD} \times W_{\text{vii}}\right) + \left(\text{IC} \times W_{\text{viii}}\right) + \left(\text{Em} \times W_{\text{ix}}\right) + \left(\text{AS} \times W_x\right) \end{aligned} \tag{4}$$

where, for Eq. (4), LRI = livelihood resilience index, PCE = value of major component preparedness to climate extremes, SC = value of social capital, IFA = value of major component Income and food access, IFA = value of major component health, HWSS = value of major component water, HE = value of major component sociodemographic status, ALD = value of major component asset and livelihood diversity, IC = value of

major component institutional capital, Em = value of major component empowered, and AS = value of major component access to services. Considering equal weight, the *W* terms refer to the weight that was multiplied with each major component.

4 Navigating adversity: the lived realities of communities near the Sundarbans

The examination of interviews conducted with fishing households from the Chila and Banishanta Unions has illuminated the uneven nature of vulnerability experienced among the communities residing in proximity to the Sundarbans. This variation in vulnerability is predominantly shaped by factors like differential land ownership, varying levels of access to extract resources from the Sundarbans, differing access to livelihood assets, and the extent of livelihood diversification. Through these interviews, fishing households articulated a comprehensive understanding of vulnerability, which encompassed five distinctive dimensions: environmental, physical, social, economic, and political. These dimensions were recognized to exert influence either at the individual/household level or collectively on the entire household and community structure (refer to Table 1). The aggregated findings derived from the thematic analysis underscore the persistent challenges and vulnerabilities entwined in the lives of fishing households. Notably, the recurring exposure to natural hazards, including flooding, cyclones, river erosion, extreme salinity, tidal surges, and thunderstorms, emerged as the paramount contributors to the heightened vulnerability of these communities. Intriguingly, this intensified vulnerability then becomes a catalyst for the manifold challenges encountered in the households' pursuit of sustainable livelihoods. Both the Chila and Banishanta Unions are situated in close proximity to the coastline, rendering them inherently susceptible to the encroachment of groundwater salinity. The severity of the salinity issue has reached alarming levels in the villages where fishing households are settled, including Joymonigol, Kanaimari, East Dhangmari, Rekhamari, Khejuria, and Vojonkhali Dhansagar. The pervasive impact of salinity extends to nearly every pond and shallow tubewell in these areas, significantly impairing access to safe water sources. Consequently, fishing households are compelled to source water from other locations, often incurring financial costs. This dependency on external water sources not only disrupts daily life but also generates a monetary burden.

In their quest for potable water, fishing households have increasingly turned to shallow tubewells. However, this practice brings forth a new set of health concerns, particularly a rise in hypertension levels among residents. The reliance on shallow tubewells for drinking water is a double-edged sword, addressing one need while inadvertently giving rise to another. Compounding these challenges is the inherent risk of inundation and waterlogging that plagues the living conditions of fishing households due to the low elevation of their settlements. High tides result in the overflow of river water onto the land, particularly affecting the low-lying areas where these communities reside. This recurrent inundation perpetuates a cycle of displacement and disruption, severely impacting livelihoods and quality of life.

The environmental vulnerability present in both Unions is of utmost importance due to the potential impact of climate-induced hazards on physical vulnerabilities, such as infrastructure degradation, and economic vulnerabilities, such as income instability. The households have indicated that the presence of damaged infrastructure is

Table 1 Challenges and livelihood vulnerabilities among the fishing households

Issue	Aspects of vulnerability	Issues identified by the fishing households	Dimensions of the major issue pointed by the households (aggregated)	Level of affectedness
Drivers of vulnerability	Environmental	Experiencing multiple climate-induced hazards	Tidal surge, cyclone, flooding, river erosion, salinity, increased temperature	Individual (or Household) + community
		Loss of fresh water	No water, water scarcity, lack of fresh water	Individual (or Household) + community
		Seasonality	Higher salinity, dry season, seasonal vegetables	Individual (or Household) + community
			Variability in resource extraction and income variability	Individual (or household)
	Physical	Location of the house, house near or on the waterbodies	Waterlogging	Individual (or Household) + Community
		Houses made by temporary construction materials	Damaged houses	Individual (or Household)
		Poor infrastructure	Road damaged, increased transport cost	Individual (or Household) + community
		Open pits or hanging latrines on the river	Health risks, high exposure to waterborne diseases	Individual (or Household)
	Political and Legal	Tenure insecurity	High risk of displacements Lack of willingness to invest for housing and basic services	Individual (or Household)
		Command and control measures of forest management	Restrictions on open water fishing, extraction of forest resources	Individual (or Household)
	Socioeconomic	Seasonality	Limit to Sundarbans' resources, limited work opportunities	Individual (or Household)
		Dependency on informal lending	Pushed to a debt cycle	Individual (or Household)
		Fear of robbery and wild animals	Loss of life, monetary loss	Individual (or Household)

Source Authors (complied from interviews from fishing households) 2020

the second most significant factor contributing to the vulnerability of the community's livelihood. This vulnerability is exacerbated by natural disasters and affects the households' livelihoods in both individual and collective ways. The dwellings inhabited by fishing households are characterized by their transitory nature, rendering them susceptible to limited or no resistance against cyclonic events, reduced protection from extreme temperatures, and vulnerability to the impacts of heavy precipitation. In recent years, thunderstorms have emerged as a concerning phenomenon because to their adverse impact on human and animal mortality rates. One of the most challenging aspects of thunderstorms in the Sundarbans region is their unpredictable nature, which poses difficulties in forecasting their occurrence. Furthermore, the lack of exact protective equipment or readily available shelters in the vicinity exacerbates the vulnerability of individuals in this area. Fishing households residing in *khas* land, which refers to uncultivated land under government ownership allocated based on government priority, sometimes own inadequately constructed latrines that exhibit substandard hygiene conditions. The inadequate state of road infrastructure frequently hampers the marketing prospects of impoverished fishing communities and constrains the diversification of their livelihoods. For instance, despite the close proximity of fishing towns to the Mongla Export Processing Zone (EPZ), there exist chances for qualified female employees. Nevertheless, the financial burden of frequent commuting, along with insufficient infrastructure assistance such as gender-specific restroom facilities, bus stops, and access to healthcare services, acts as a deterrent for educated young women in pursuing possibilities to provide for their family members.

The political and legal susceptibility of fishing households is interconnected with their tenure insecurity and the imposition of regulations on the extraction of natural resources, which all contribute to their physical and economic fragility. To begin with, the lack of job security in tenure arrangements amplifies the susceptibility of fishing households to physical risks associated with climate extremes. The presence of a significant risk of eviction discourages fishing households from making investments in housing, while access to essential amenities such as water supply and sanitation is limited. The task of elevating the living area to mitigate the risk of floods poses considerable challenges for many fishing households due to their precarious land tenure status. Moreover, numerous households erected residential structures and sanitary facilities along the river, utilizing stilts and substandard materials. Furthermore, the Bangladesh Forest Department (BFD) has implemented several command-and-control mechanisms in an attempt to efficiently manage forest resources. However, these initiatives have been largely ineffective in practice. Instead of facilitating the establishment of sustainable natural resource management practices, it inadvertently contributed to the marginalization of local resource users. In the Bengali months of Kartik and Agrahayan (October–November), a permit known as golpata (palm leaf) permit is available. However, this permit is predominantly obtained by individuals of higher socioeconomic status who possess the financial means to acquire large boats and bear the associated costs of obtaining the permit. The golpata business is not widely accessible to most fishing households mostly owing to the lack of financial resources. In addition, the Bureau of Fisheries and Development (BFD) has designated several regions as dolphin sanctuary zones. These locations are frequented by fishing households who rely on catching shrimp fry, crabs, and other fish species. However, the BFD has implemented regulations that pose a potential threat to the livelihoods of these fishing communities. Insufficient availability of resources hinders the successful shift from open-water fishing to other livelihoods. The third politico-legal issue pertains to the absence of an institutional structure that facilitates the transmission of the local community's perspectives to

local elected officials and other governmental entities, so enabling them to function as a pressure group.

The phenomenon of socioeconomic vulnerability exhibits a higher degree of idiosyncrasy; however, the covariate impacts of various dimensions of socioeconomic vulnerability have also been duly considered in this context. The investigation into the socioeconomic vulnerability of fishing households is a perplexing area of study, given their reliance on open water fishing activities and the subsequent accumulation of debt, leading to a reduction in their monthly income. The phenomenon of fishing communities becoming caught in a cycle of debt is a prevalent occurrence, characterised by a complex interplay between livelihood, risk, and informal lending. This interconnected process ultimately leads fishing households into a state of indebtedness. The interviews provide insights into the households residing in close vicinity to the Sundarbans, since they primarily engage in resource extraction activities from the Sundarbans, which serves as their main source of income. The establishment of livelihoods by fishermen or their predecessors in close proximity to the Sundarbans was founded upon the utilisation of the resources offered by the Sundarbans. In the past, numerous households derived their sustenance by engaging in the practice of harvesting timber from the Sundarbans and afterward selling it in the marketplace. Nevertheless, the government has recently implemented stringent regulations pertaining to deforestation, prompting individuals to transition from their wood-based occupations to alternative livelihoods such as shrimp fry collection or open water fishing. The primary occupation of fishing households predominantly revolves around the harvesting of shrimp fry, which is restricted to a narrow timeframe spanning four months: Falgun, Chaitra, Boishakh, and Jaistho (February to May). During the final phase of shrimp fry collection, fishing households encountered significant challenges and had to find ways to overcome this scenario. Fishermen frequently borrow money from informal moneylenders who impose exorbitant commissions based on a percentage of the fishermen's catch. In order to fulfil their commission obligations, individuals are required to surrender the entirety of their catches to the money lenders, rather than engaging in the direct sale of the fish. Following the completion of fish sales, financial intermediaries deducted their fees and disbursed funds to the fishermen. Nevertheless, determining the exact amount at which moneylenders sell the fish remains a challenge for fishing households. The moneylenders engage in the sale of fish, with each fish being priced at a thousand taka. A fee of one hundred taka is removed from the total sum received from the sale. Over the course of time, the commission frequently experiences increment without prior notification being provided to the fishing households. As per the stipulation, the entirety of the seasonal catches must be relinquished to the creditors, a practice that frequently persists over multiple seasons, hence leading to the accumulation of enduring financial obligations. Moreover, in the context of fishing and crab collection activities in the Sundarbans, it is frequently necessary for these households to get financial resources in order to construct boats and fabricate nets. The primary source of considerable investment for individuals is informal financing from local elites, a practice that frequently results in their entrapment within a long-term debt cycle. The cyclical nature of debt and the resulting interdependence of individuals' livelihoods consequently limit their ability to relocate in search of alternative alternatives for sustaining their livelihoods. Despite the fact that twenty-six pirate groups have surrendered to the authorities, there remain five to seven active groups that possess the capability to engage in kidnapping activities and demand ransom payments from their victims.

5 Resilient coping strategies: influences on fishing households' non-migration decisions

The investigation into the coping and adaptation strategies of fishing households in the Chila and Banishanta Unions, despite the multiple vulnerabilities they confront, reveals a resilient disposition toward climate-induced shocks and stresses, as outlined in Table 2. These coastal areas of Bangladesh exhibit a unique context where communities coexist with a gamut of hazards, fashioning strategies that resist the onslaught of cyclones and tidal surges. A distinct culture of resilience thrives among fishing households in these areas, where the fusion of conventional wisdom and traditional knowledge plays a pivotal role in crafting adaptive measures. Many of these strategies have proven effective in mitigating the adverse impacts of climate change.

As a case in point, when the cyclone season looms, residents reinforce their dwellings by securing joints and pruning tree branches that might pose risks. Furthermore, they raise their houses with sand and other materials to safeguard against flooding, even elevating cowsheds atop elevated bases. Such practices underscore their acute awareness of caution signals related to cyclones and rain, marking a shift from past behaviours of ignoring cyclone shelters. Instead, they now proactively seek refuge in these shelters, safeguarding vulnerable members such as women, elders, children, and the disabled.

Social bonds, attachments to place, community engagement, and collective ownership emerge as crucial factors aiding vulnerable individuals in adapting to extreme climate events. Respondents consistently express a strong bond with their families and communities, reflecting a cohesive communal ethos that drives financial and emotional support. This interconnectedness likely contributes to the tenacity with which fishing households persist in these areas, despite repeated exposure to climate-induced hazards. Notably, the aftermath of the devastating Cyclone Sidr in 2007 prompted the initiation of numerous development projects by Non-Governmental Organizations (NGOs) and Government Organizations (GOs), aimed at promoting forest conservation and resilience strategies tailored to the needs of fishing communities. These projects have yielded positive outcomes, bolstered household well-being, and acting as a deterrent against sliding into poverty. Notably, these interventions address freshwater scarcity by providing reservoir tanks and furnishing resources such as seeds, livestock, and poultry to enhance self-sufficiency and skills. However, a potential concern arises regarding the inadvertent reinforcement of a reliance on external support, which may influence the decision of fishing households to remain in vulnerable conditions.

Particularly noteworthy is the political legal vulnerability stemming from tenure insecurity, which holds more sway overfishing households than physical vulnerability. The prospect of eviction from khas land drives apprehension, pushing households toward migration. A critical strategy adopted by fishing households lies in cultivating connections and reciprocity with local elites, bolstering their resilience against eviction threats and even safeguarding them against piracy by paying extortion money, albeit at the cost of incurring debt. Faced with seasonality-driven adversity, fishing households rely on local elites for loans, albeit at exorbitant commissions, further underlining the dynamics of power and dependence in these relationships.

The complexity of this landscape manifests itself in the intricate web of socio-economic vulnerabilities. Fishing households sometimes turn to urban centres or other rural districts in search of better employment opportunities, embracing temporary migration as an adaptive manoeuvre. For instance, the proliferation of garments' factory employment and rice

Table 2 Relationship between vulnerability, coping strategies, and non-migration

Vulnerability Domain	Types	Coping or adapting	Factors influencing coping or adapting	Migration or non-migration
Socio-economic vulnerabilities	Limited livelihood options	Urban migration, remittances	Physical fitness, seasonal factors	Forced migration
		Informal lending	Social network Seasonal work patterns	Involuntary non-migration Seasonal migration
Politico-legal vulnerabilities	Inadequate housing Land tenure uncertainty	Connections with political figures	Social network	Involuntary non-migration
	Restrictions on fishing	Exploring alternative income sources	Asset transfer Willingness to adapt	Voluntary non-migration
Physical vulnerabilities	Extreme weather effects	Adopting new livelihood strategies	Government and NGO initiatives Preparedness programs	Voluntary non-migration
	Gradual environmental Changes selling land	Temporary shelter creation Attracting private investors	Private investors	Forced migration
	Poor Shelter, Basic Services	Structural Adaptations, Service Improvements	Cultural adaptation, knowledge	Voluntary non-migration
	Inadequate infrastructure	Non-commute solutions	Assistance from natural resources	Voluntary non-migration

Source Authors (complied from interviews from fishing households) 2020

harvesting serves as a coping strategy to mitigate their socio-economic vulnerability. Additionally, the fear of land loss due to river erosion compels some households to sell their land to private companies and relocate. The establishment of the Rampal Power Plant, positioned merely 14 kms north of the Sundarbans, has incited private investors from various regions to purchase land for industrial or tourism ventures near the riverbanks encircling the Sundarbans. This trend is particularly pronounced in the Chila Union, where the Hindu community, grappling with river erosion and dwindling agricultural returns, has resorted to selling land and migrating to India.

The landscape encapsulates a tangle of interwoven vulnerabilities, showcasing the intricate interplay of natural, socio-economic, and politico-legal challenges. The adaptive strategies adopted by fishing households exemplify their resilience and resourcefulness in the face of mounting environmental pressures. However, the cumulative effects of external interventions, political shifts, and the evolving socio-economic fabric warrant vigilant consideration. The migration dynamics and changing land ownership patterns underscore the multifaceted dimensions of vulnerability, resilience, and adaptation that collectively shape the trajectory of these communities amidst a landscape of environmental flux.

6 Livelihood diversification opportunities and non-migration nexus

Livelihood of the fishing communities mostly depends on Sundarbans' resources. We found that fishing households have Sundarbans' resources-related livelihood strategies in all the twelve months. The interviews with fishing communities show that they involve in shrimp fry collection for five months which starts from January and ends in June. Then, they involve in collecting craps and it starts from July and ends in February of the next year. Simultaneously, male members of the family also collected honey from the Sundarbans, and they often collect honey for four months from August to November. Some fishermen involve open water fishing in all the year round, but they engage in shrimp fry collect from January to June for earning more than other months. Simultaneously, they also collect Nipa palm and woods for meeting demand of cooking fuels. To avoid overexploitation of the Sundarbans' resources, Bangladesh Forest Department (BFD) imposed different restrictions on resource extraction that limit poor fishing households' access to the Sundarbans' resources although their livelihood strategies are mostly built on the resources of the Sundarbans. Although this, international donors, national NGOs, and the Bangladesh Forest Department (BFD) collaboratively work to develop alternative livelihoods for the forest-dependent communities. The fishing communities who are considered in this research also got financial grants to develop alternative livelihoods. Additionally, the project also arranged different skill-development training for the fishing households to engage them with alternative livelihoods. The most significant changes have been observed in the qualitative studies (e.g. interviews and FGDs); it shows how fishing households had built up at least one alternative livelihood option for each family by using the skill training project. It is found that the training components of the project helped the beneficiaries to cope up with alternative income generation activities (AIGAs). The AIGA-specific training helped the beneficiaries for the smooth operation of their livelihood strategies. Apart from the skills gained through different training under the project, diversification of livelihood opportunities of the beneficiaries is another significant attribute of human capital enhancement process. During the discussion with the beneficiaries, it has been

observed that beneficiaries are creating more than one income-generating opportunities upon receiving the support from the project. Diversified income from other household members of the fishing communities and operating more than one income-generating activities by the fishing households are quite common. This particular attribute can be presented through the following quotes of one of the respondents, and the interview was conducted with Mallick et al. (2020) (pseudonym):

> My husband was struggling a lot while working in the forest. I am married for last eight years and I have seen that my husband was struggling to secure livelihood by extracting different resources from the forest. I bought a van utilising the project money and everyday my husband is earning 500 BDT (5.88 US$) per day. I was involved in fish fry collection and my husband was doing fishing. This income was very much seasonal, and we could get involved for six months. But after receiving money from this project, we are now doing goat rearing and poultry with the daily savings from the auto-van.

The scenario explained in the aforementioned paragraph cannot be generalised. During the FGD, few determining factors have been identified which are associated with such diversification of livelihood opportunities. The determining factors are land ownership, number of income-earning household members and support received from other aided projects. Beneficiaries who have access to those assets have more than one income-generating activities. It has also been revealed during the FGDs that beneficiaries often learn about income-generating opportunities from their neighbours and the initial venture happens in partnership. The form of partnership varies with monetary involvement, labour; sharing assets that include homestead land. The form of such partnership has been explained through a case in the following.

> I started tea stall and clothing business. We are operating this business on our relative's land attached to our house. My husband used to work in road construction. Due to the rainy season my husband is not earning anymore and helping me in the shop. As our house is in the middle of the neighbourhood, we started selling different fritters in the evening. This additional income helped us a lot and we bought three goats from the earning of our shop (Interview with Rokeya, 2020 (pseudonym).

The findings illustrate that existing road condition is the major challenge associated with livelihood opportunities and housing can be instrumental for enhancing livelihood strategies. The livelihood resource base (physical capital) was not changed due to the intervention of alternative income-generating activities (AIGAs). But few fishing households who had better housing infrastructure are using those facilities for creating diversified income-generating activities on top of the AIGAs they started as home-based income-generating opportunities. Although it has been identified during the FGDs that fishing households are not extracting any resource from the Sundarbans illegally, their life really depends on the Sundarbans. While discussing with them, it was identified that they obtain legal permit for fishing in the designated areas of the Sundarbans for six months in a year. Though the AIGAs are in function, it has been identified during the FGDs that this fishing profession for six months is still a major livelihood strategy of a significant number of beneficiaries. Apart from fishing, honey and collecting the crab are most common resources the beneficiaries collect from the Sundarbans. Moreover, the life of the beneficiaries depends on the Sundarbans. This claim can be explained with the following quote of one of the beneficiaries:

> Our life depends on the Sundarbans. Our women go for fishing on the river side for six months and our men earn money by fishing in the river for six months. The money we get from six months fishing, we use that money for living for another six months. We do not need to but any fuel for cooking, fish for eating, what else the Sundarbans can offer (Interview with Pintu Hawaladar, 2020 (pseudonym)).

The livelihood outcomes can be summarised through the following table (see Table 3). This table identifies that the grant received by the beneficiaries in the form alternative livelihoods is a new pathway of livelihood opportunities. It was identified that the beneficiaries had no idea that apart from the resource extraction from the Sundarbans what other forms of livelihood opportunity they can avail. The major change that has been observed through this project is to create a level of awareness among the fishermen that they can live their livelihood without destructing the protected resources of the Sundarbans. This level of awareness is creating some form of self-actualisation. As beneficiaries during the FGDs claimed that they now have a sense of belongingness with the Sundarbans and the training they have received to about the conservation of natural resources and alternative livelihood opportunities is a pathway of sustainable co-management of the Sundarbans.

The findings of the FGDs reveal that there is some indication that the resource base of livelihood opportunities has been enhanced the human capital and financial capital have been enhanced drastically though the project interventions. The impact of such capital enhancement is investing the skill and money for more than one income-generating activities (IGAs). Therefore, the sustainability challenges associated with this two resource bases are associated with graduation rather than declination. Here graduation refers growing up the AIGAs and opening other IGAs. Declination refers that due to the lack of that resource base the existing AIGA can be hampered and will not last long to support the livelihood of the beneficiaries. During the stakeholder workshop, it was revealed that government is going to launch another project with Department of Fisheries, linking these fishing households with that proposed project can be instrumental to tackle the sustainability challenges. Thus, support for livelihood diversification directly impacts the non-migration of these households as they wanted to continue their new livelihoods rather than fishing in the sanctuary areas. Additionally, they wanted to live here to get one hundred thousand takas from the government to build a house as Bangladesh Government has launched a house building project for the landless poor living in the government khas land.

7 Social capital and non-migration nexus

The projects examined the aspects pertaining to social capital. The identification of the Sustainable Livelihood Group (SLG) and Community Management Committees (CMCs) as key actors in the social network of project beneficiaries was established through the utilisation of Focus Group Discussions (FGDs) and stakeholder meetings. During the focus group discussions (FGDs), it was discovered that neighbours and relatives play a significant role in providing assistance to beneficiaries during times of crisis, highlighting their importance as key actors in social capital. Beneficiary homes exhibit a prolonged residence within a shared neighbourhood, hence fostering the development of trust and social cohesiveness among community members residing in the vicinity. In addition to interpersonal relationships, computer-mediated communication (CMC) plays a significant role in the establishment and institutionalization of social capital. The primary objective of this platform is to provide legal protection to fishermen engaged in resource extraction activities

Table 3 Asset-specific sustainability challenges of alternative livelihoods

Livelihood capital	Asset-specific livelihood outcome	Sustainability challenges	Pathways to sustainability
Human capital	Skills gained through training on AIGAs Diversified IGAs	Post-project feedback from the expert	Peer learning
Financial capital	Initiation of AIGAs Diversified use of financial capital to launch more than one IGA	*Dadon* from the local money lender Finance for expanding AIGAs	Community-based group savings programme '*Amar Bari Amar Khamar*' project
Natural capital	Resource extractions from the Sundarbans	Cooperation from law enforcement agency Diversified AIGAs	Access to *khas* land Co-management of forest resource
Physical capital	Diversified IGAs	Higher cost of input materials Natural hazard	Home-based income-generating opportunities Resettlement of case-specific beneficiaries
Social capital	Diversified IGAs	Social safety net Community-based organisation	AIGA-specific community-based organisation

Source Authors (complied from FGDs and interviews' findings) 2020

inside the Sundarbans region, thereby mitigating potential legal issues they may encounter. Regarding the institutional environment of alternative livelihoods for fishing households, it has been recognized that Community Management Committees (CMCs) play a crucial role as the sole entity capable of advocating for the local community's interests to local elected officials and other government organizations, effectively functioning as a pressure group. Various asset-based interventions, carried out by governmental organizations (GOs) and non-governmental organizations (NGOs), have been found to have positive effects on the livelihood outcomes of fishing households. These interventions include training programs focused on income-generating activities (IGAs), encouraging membership in formal organizations, establishing community-based savings initiatives, and facilitating connections with legal and community-based organizations. These interventions have been shown to enhance the ability of fishing households to adapt and transform their livelihoods. Specifically, they contribute to the development of a regular source of income, facilitate access to formal lending processes, enable the acquisition of assets for further livelihood opportunities, and promote the recognition of fishing households as legitimate occupational groups rather than illegal users or forest invaders. The findings indicate a significant degree of overlap between vulnerability and resilience within the fishing households, and the decisions made by these households regarding non-migration have had an impact on the resilience of their livelihoods in the face of external shocks. Previous studies have examined the connection between vulnerability and resilience, as evidenced by the works of Akter and Mallick (2013), Hamim et al. (2020), and Usamah et al. (2014). These studies have highlighted the interrelated nature of vulnerability and resilience, which may have implications for decision-making about non-migration in the context of the environment. However, it is worth noting that the existing research in this area has a narrow scope. The findings of our study indicate that households engaged in fishing, while encountering many forms of physical, socio-economic, and politico-legal vulnerabilities, exhibit resilience. Individuals demonstrated a capacity to leverage their local environments and occupations to develop strategies for mitigating the impacts of severe weather occurrences and rebounding from adverse consequences, hence reducing the need for relocation. Assets have a significant role in shaping non-migration patterns, as evidenced by research conducted by Moser et al. (2010). The study highlights that families' asset portfolios are susceptible to depletion either as a result of harsh weather events or sudden shocks and pressures. This phenomenon is observed not only among migrants but also among individuals who choose to remain in their original location. The decision of fishing households to not migrate is influenced by their adaptation to climate-induced shocks in their livelihoods. This adaptation can be facilitated by several means, such as government-initiated projects, community actions, and projects headed by non-governmental organizations (NGOs).

8 The interplay between livelihood resilience and non-migration: unveiling connections

The assessment of livelihood resilience, utilizing a capacity-based resilience framework, can elucidate strategies for addressing the susceptibility of fishing households to climate-induced shocks and stressors, which in turn influence their decisions regarding migration or non-migration. There exists an inverse relationship between individuals' level of resilience and their likelihood of engaging in migration. Conversely, individuals with higher levels of vulnerability exhibit a stronger propensity for mobility. Table 4 presents the

Table 4 Household resilience clusters by Unions

Resilience capacity index	Chila union		Banishanta union		Total	
	No. of HHs	Percent	No. of HHs	Percent	No. of HHs	Percent
≤0.33	0	0	1	0.3	1	0.3
0.34–0.67	150	52.1	137	47.6	287	99.7
0.68–1.00	0	0	0	0	0	0
Total	150	52.1	138	47.9	288	100

degree to which fishing households demonstrated resilience subsequent to their participation in alternative income-generating endeavours. The analysis of the livelihood resilience index examines three distinct clusters: (1) individuals with low resilience who lack sufficient capacity to manage vulnerability, indicated by the Resilience Capacity Index (RCI) value of ≤0.33; (2) households with moderate resilience who rely on temporary assistance to cope with climate shocks, characterized by an RCI value ranging from 0.34 to 0.67; and (3) highly resilient individuals who possess the ability to manage shocks and stresses without requiring assistance (Mudasser et al., 2020; Okafor et al., 2017). It is noteworthy that the majority of households are classified as moderately susceptible. The proportion of households classified as less vulnerable is only 0.3%, whereas very resilient households are completely absent (see to Table 4 for further information). The mean resilience index is 0.4583, indicating a modest level of resilience. Furthermore, the standard deviation of the livelihood resilience index is 0.06113, suggesting that the variability in resilience levels is not excessively high (Fig. 3).

According to the concept of absorptive ability, over half (50%) of the total households fall into the low resilience category, whereas nearly half (48.6%) of the sampled homes belong to the moderately resilient category. Only a small proportion of households (merely 1.4%) exhibit a significant absorptive ability in response to climate-induced shocks. The mean absorptive capacity (0.3535) exhibits a comparatively lower value in relation to the mean livelihood resilience (0.4583). Nevertheless, it is worth noting that the average adaptive capacity has the greatest magnitude when compared to the absorptive and transformative capacities. The majority of households (98.6%) fall into the moderately adaptive

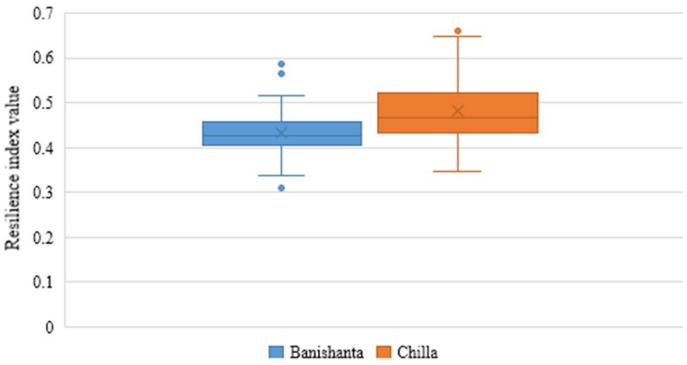

Fig. 3 Comparative boxplot of RCI between Chila and Banishanta

ability category, as they possess financial and human capital assets that enable them to engage in alternative revenue-generating activities, thereby positively influencing their income, assets, and food security. The findings indicate that among the three dimensions of LRI, the health condition component exhibits the highest percentage contribution (42%) to LRI, as illustrated in Fig. 4. The analysis reveals that the contribution of empowerment to LRI amounts to 20%, while the contribution of preparedness to climate extremes to LRI stands at 13%. Additionally, the contribution of income and food access to LRI is estimated to be 12%, followed by sociodemographic status at 11%. Social capital contributes 5% to MPI, while asset and livelihood diversity contribute 4% to LRI. Lastly, institutional capital is found to contribute 2% to LRI. The average score for transformative capacity (0.4893) is comparatively higher than that of absorptive capacity (0.3535). The majority of households in both Unions (97.2%) possess a moderate transformative capacity score due to their participation in community-based savings groups, inclusion in the 'Amar Bari Amar Khamar' program by the government organisation and receiving financial assistance to enhance their self-enterprises. Additionally, these households have obtained membership in the village conservation forum, which has facilitated their involvement in a community-based governance framework and established a partnership with the Bangladesh Forest Department as part of a co-management process. The upward trend in the resilience of livelihoods has advantageous implications for mitigating unforeseen disruptions to the customary existence of fishing households, hence impacting their voluntary choice to refrain from migrating.

The phenomenon of limited migration observed among fishing households residing along the riverfront of the Sundarbans can be elucidated through an examination of the interdependent dynamics between hazards, livelihoods, and the management of natural resources. The decision to migrate to the Sundarbans region is a significant choice for fishermen and their predecessors, driven by their desire to establish a livelihood cantered around the Sundarbans ecosystem, irrespective of the potential adversities posed by climate-induced shocks and stressors. After establishing their settlement, the inhabitants engaged in the year-round extraction of resources from the Sundarbans.

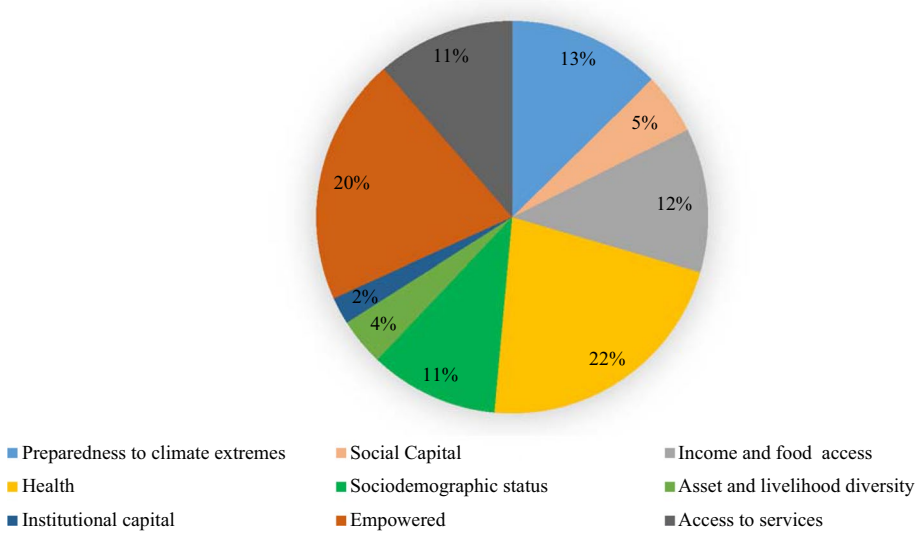

Fig. 4 Contribution of each major component to livelihood resilience index (LRI)

However, their access to forest resources such as wood and golpata was subject to certain restrictions. Moreover, the rent-seeking behaviour exhibited by relevant government authorities in relation to the issuance of legal permits for forest resource extraction, such as fishing or crabbing, Nipa palm (known as golpata in Bengali), or honey collecting, has resulted in the marginalization of poor fishing households' access to these resources. The livelihoods of fishing households have become seasonal and reliant on informal lending, leading to a cycle of debt. This can be attributed to various socio-political and socio-economic factors, including restrictions on the collection of forest resources, rent-seeking behaviour by government authorities in relation to forest access permissions, and a decrease in labour demand as a result of the transition from rice farming to shrimp or crab farming. The debt cycle and interdependency of livelihoods consequently impose limitations on individuals' ability to relocate in search of other alternatives for sustaining their livelihoods. The decision of fishing households to remain in vulnerable locations rather than opting for migration as a last resort to address their livelihood challenges can be attributed to involuntary circumstances or a sense of being trapped. These households lack the necessary assets, such as financial resources, to relocate from vulnerable areas or to repay their debts. Additionally, they may lack human capital assets, such as the necessary skills to access livelihood opportunities in urban areas or may not have able-bodied male members who can seek employment elsewhere. Despite being a rare occurrence, a small number of young individuals who contribute to the family's income or adult children may temporarily relocate to urban areas for jobs in the industrial sector or to rural regions for the purpose of engaging in rice harvesting activities. Categorizing these fishing households as 'involuntary' (Mallick, 2019) or 'trapped' (Foresight, 2011) presents challenges. Drawing on the capability-aspiration model (Mallick, 2019; Schewel, 2019), it is evident that these individuals possess a desire to relocate but lack the necessary resources and abilities to do so. Nevertheless, the situation becomes more complex when considering fishing households, as their choice to remain in vulnerable areas instead of migrating is often motivated by the hope of receiving support from governmental organizations (GO) or non-governmental organizations (NGOs). These entities have implemented projects aimed at imposing restrictions for biodiversity conservation in the Sundarbans and enhancing the well-being of communities residing in close proximity to the Sundarbans. The presence of several projects aimed at addressing social, economic, and political marginalization has been observed in fishing households, leading to a certain degree of enhancement in livelihood resilience. Furthermore, the alternative livelihoods and natural resource conservation project aimed to mitigate the dynamic pressures that render fishing communities vulnerable. This was achieved through the implementation of income-generating activity (IGA) trainings, establishment of formal organizational memberships, creation of community-based savings programs, and fostering connections with both formal and community-based organizations that directly contribute to improving the unsafe living conditions experienced by fishermen. These efforts included providing regular sources of income, implementing formal lending procedures, facilitating the acquisition of assets for expanding livelihood opportunities, and recognizing the legitimacy of the occupational group rather than categorizing them as illegal users or forest invaders. All of these elements significantly contribute to the strategic decision-making process of fisherman communities to persist in precarious circumstances.

9 Conclusion

Investigating the intricate interplay between assets, livelihood diversification, and the complex decision of migration, this article illuminates the nuanced factors that steer vulnerable populations toward non-migration. Migration emerges as a last recourse, a desperate measure adopted when local opportunities have been exhausted. Within this context, case study of fishing communities in the Sundarbans unravels a crucial narrative—even within vulnerable settings, avenues to access assets and forge livelihood diversifications exist, presenting a counterforce to the pull of migration. Nonetheless, the ability to seize these opportunities is profoundly influenced by the institutional underpinnings in which the vulnerable populace operates.

The dynamic nature of household asset portfolios is apparent, since they are subject to fluctuations caused by unexpected external events as well as internal adjustments. The sudden decline in assets, resulting from unforeseen circumstances or changes such as mortality or the aging process, gives rise to a perilous situation, which may potentially force households to engage in migration. The unpredictability of the fishermen households' condition is underscored by their inherent vulnerability. The issues faced by individuals are supported by the presence of fragile dwelling constructions that are vulnerable to storms, as well as insufficient access to water supply and inadequate sanitary conditions. Moreover, although alternative livelihood activities do provide some degree of alleviation, their effectiveness is limited, and they do not offer a full solution to mitigate vulnerabilities.

The effective conservation and management of forest resources are impeded by many governance obstacles. The existence of informal customs, shown by the issuance of 'Boat Licensing Certificates (BLC),' presents a barrier to the lawful access of local fishermen to engage in open water fishing activities. Similar obstacles are evident in the allocation of legal authorisations for the gathering of honey and other resources found within forests. Unfortunately, the involvement of community-based groups such as CMC in the decision-making process pertaining to permissions for open water fishing and crab gathering has not been established. The anticipated conservation effects of initiatives like community-based forest management (CBFM) through community-managed conservation (CMC) have not been fully realized, thereby diminishing their effectiveness.

In light of the intricate nature of the subject matter, this article suggests a wide range of preventative strategies aimed at strengthening alternative income-generating activities (AIGAs) and guiding individuals toward a sustainable livelihood trajectory. The proposed initiatives include the creation of peer-learning platforms for recipients, the development of financial mechanisms to promote group savings, the promotion of co-management of forest resources, and the relocation of displaced households. Simultaneously, it is crucial to prioritize the establishment of public services, the creation of income-generating opportunities for adolescents, and the implementation of housing support programs for fishing households. In light of broadening the scope of potential opportunities, community-based tourism and climate-smart agriculture emerge as feasible avenues.

The core principle underlying these suggestions is the cultivation of sustainable livelihoods within fishing households, which is contingent upon the development and empowerment of community-based organizations. The conversion of these committees into legally recognised institutions, positioned as crucial participants in co-management initiatives, arises as a guiding principle in ensuring the long-term viability of these

communities' livelihoods. By formalizing the establishment of these committees and allocating them a substantial role in co-management activities, we provide the foundation for the cultivation of resilience and sustainability. Within the intricate framework of these diverse suggestions lies the potential for establishing a more sustainable balance for these at-risk fishing households. Every idea, akin to a thread, serves as a valuable component in a robust fabric that effectively withstands the destabilizing impacts of migration, thereby strengthening the means of subsistence and fostering a strong connection between these communities and their surrounding environment. The decision of non-migration is influenced by the availability of livelihood opportunities for households at risk. In order to improve livelihood prospects in vulnerable contexts, it is important to expand the stock of critical capital assets, including natural capital, social capital, and human capital. Ensuring the sustainability of alternative livelihoods is crucial for households at risk. While it may be premature to assert the long-term viability of these alternative livelihoods, the empirical evidence suggests that the fishing households are exhibiting signs of self-actualization. Individuals residing inside the designated protected areas exhibit a genuine concern for the well-being of dolphins, hence fostering a sense of personal dignity and pride in their active participation within various alternative livelihoods. The process of self-actualization is frequently characterized by various vulnerabilities and shocks that are linked to the daily experiences of marginalized fishing communities. Hence, the long-term sustainability of alternative livelihoods necessitates strategic assistance from diverse stakeholders.

A major constraint arises from the lack of comprehensive quantitative and qualitative analyses pertaining to the interconnection between vulnerability, livelihoods, and non-migration in rural settings. This limitation hinders the capacity to compare the findings of this article with previous research outcomes. As a result of the absence of a comprehensive census of fishing communities, this study was compelled to utilize pre-existing lists of fishing households compiled by the CODEC for the specific objective of intervening in fishing communities within the Sundarbans. It is crucial to remember that these lists might not include every type of fishing household found in the Sundarbans, which could limit the diversity of the fishing communities taken into account. The study relied on local gatekeepers to facilitate the selection of participants for life-history interviews and focus group sessions. Although the gatekeepers possessed prior experience collaborating with researchers, the utilization of this selection approach may potentially add bias, since gatekeepers might potentially employ their own set of criteria when choosing participants. The utilization of theoretical sampling and theoretical saturation has the potential to mitigate participant selection biases. The article may utilize quantitative analysis to establish a correlation between assets and livelihood strategies of households at risk and non-migration decisions which could provide a full explanation for the relationship between vulnerability, livelihood, and non-migration.

Appendix

See Tables 5, 6, 7.

Table 5 Resilience capacities, components and indicators, and their interrelationship with livelihood resilience

Resilience Capacity	Major components	Indicators	Hypothesised relationship with livelihood resilience
Absorptive capacity	Preparedness to climate extremes	Exposure to shocks	Negative
		Access to mobile phone or radio	Positive
		Vehicle ownership	Positive
		Access to cyclone shelters	Positive
		Condition of house	Positive
		Access to cash saving	Positive
		Location of the house	Negative
	Social capital	Adult members in the family	Positive
		Migrant workers and having access to remittances	Positive

Table 5 (continued)

Resilience Capacity	Major components	Indicators	Hypothesised relationship with livelihood resilience
Adaptive capacity	Income and food access	Per-capita annual income that satisfies national average income for well-being	Positive
		Number of earning members	Positive
		Status of food consumption level	Positive
	Health	Health shocks	Negative
	Socio-demographic component	Sex of household heads	Positive
		Dependency ratio	Negative
		Age of household heads	Positive
		Education	Positive
		Number of members have secondary or above	Positive
	Asset and livelihood diversity	Livestock holding	Positive
		Access to productive agriculture land	Positive
		Number of skill trainings	Positive
		Number of alternative income-generating activities (AIGAs)	Positive
		Size of cash savings	Positive
		Asset value of AIGAs	Positive
		Having sewing machines	Positive
		Livelihood diversity index	Positive
		Reduced illegal livelihood strategies	Positive

Table 5 (continued)

Resilience Capacity	Major components	Indicators	Hypothesised relationship with livelihood resilience
Transformative Capacity	Institutional capital	Access to government-sponsored projects	Positive
		Access to NGOs' micro-finance projects	Positive
		Size of loan or grant	Positive
	Empowered	Feeling confident to continue AIGAs	Positive
		Feeling self-reliant	Positive
		Satisfaction with current AIGAs	Positive
		Women engagement to the AIGAs	Positive
	Access to services	Distance to health centre	Positive
		Access to improved toilet	Positive
		Own water sources	Positive
		Access to secondary school	Positive
		Access to major road	Positive
		Having electricity supply in the household	Positive

Table 6 Livelihood resilience index (LVI) sub-component values and minimum and maximum sub-component values for Chila and Banishanta Unions, Bangladesh

Resilience Capacity	Major components	Indicators	Units	Banishanta	Chila	Maximum value in both union	Minimum value in both union
Absorptive capacity	Preparedness to climate extremes	Exposure to shocks	Yes = 1 /No = 0	0.04	0.10	1	0
		Access to mobile phone or radio	Yes = 1 /No = 0	0.99	0.96	1	0
		Vehicle ownership	Yes = 1 /No = 0	0.15	0.21	1	0
		Access to cyclone shelters	Yes = 1 /No = 0	0.13	0.07	1	0
		Condition of house	Yes = 1 /No = 0	0.01	0.01	1	0
		Access to cash saving	Yes = 1 /No = 0	0.41	0.61	1	0
		Location of the house	Meter	114.55	78.93	4000	0
	Social capital	Adult members in the family	Rank	1.72	1.96	5	1
		Migrant workers and having access to remittances	Yes = 1 /No = 0	0.04	0.23	1	0
Adaptive capacity	Income and food access	Per-capita annual income that satisfies national average income for well-being	Yes = 1 /No = 0	0.36	0.33	1	0
		Number of earning members	Count	1.27	1.39	3	0
		Status of food consumption level	Rank	4.20	4.10	5	1
	Health	Health shocks	Yes = 1 /No = 0	0.01	0.01	1	0

Table 6 (continued)

Resilience Capacity	Major components	Indicators	Units	Banishanta	Chila	Maximum value in both union	Minimum value in both union
	Socio-demographic component	Sex of household heads	Yes = 1 /No = 0	0.86	0.95	1	0
		Dependency ratio	Ratio	1.46	1.34	8	0
		Age of household heads	Years	44.36	42.72	83	22
		Education	Count	3.07	2.89	16	0
		Number of members have secondary or above		0.56	0.37	8	0
	Asset and livelihood diversity	Livestock holding	Count	19.11	11.01	205	0
		Access to productive agriculture land	Katha	0.47	0.59	1	0
		Number of skill trainings	Count	1.14	1.24	3	1
		Number of alternative incomes generating activities (AIGAs)	Count	1.09	1.26	4	0
		Size of cash savings	Amount	3348.55	5786.55	100,000	0
		Asset value of AIGAs	Amount	34,027.17	21,593.50	239,800	0
		Having sewing machines	Yes = 1 /No = 0	0.06	0.05	1	0
		Livelihood diversity index	Index value	0.35	0.33	0.5	0.142857
		Reduced illegal livelihood strategies	Yes = 1 /No = 0	0.03	0.03	1	0

Table 6 (continued)

Resilience Capacity	Major components	Indicators	Units	Banishanta	Chila	Maximum value in both union	Minimum value in both union
Transformative Capacity	Institutional capital	Access to government-sponsored projects	Yes = 1 /No = 0	0.05	0.05	1	0
		Access to NGOs' micro-finance projects	Yes = 1 /No = 0	0.12	0.07	1	0
		Size of loan or grant	Amount	7532.61	4493.33	120,000	0
	Empowered	Feeling confident to continue AIGAs	Rank	3.78	3.79	4	1
		Feeling self-reliant	Yes = 1 /No = 0	0.96	0.97	1	0
		Satisfaction with current AIGAs	Rank	3.59	3.59	4	1
		Women engagement to the AIGAs	Yes = 1 /No = 0	0.83	0.93	1	0
	Access to services	Distance to health centre	Meter	1407.19	3421.07	3500	0
		Access to improved toilet	Yes = 1 /No = 0	0.76	0.69	1	0
		Own water sources	Yes = 1 /No = 0	0.01	0.01	1	0
		Access to secondary school	Yes = 1 /No = 0	0.03	0.99	1	0
		Access to major road	Yes = 1 /No = 0	0.01	1.00	1	0
		Having electricity supply in the household	Yes = 1 /No = 0	0.83	0.88	1	0

Table 7 Indexed sub-components, major components, and overall LRI for Banishanta and Chila Unions, Bangladesh

Indicators	Banishanta	Chila	Major components	Banishanta	Chila	Resilience Capacity	Banishanta	Chila
Exposure to shocks	0.96	0.90	Preparedness to climate extremes	0.52	0.54	Absorptive capacity	0.32	0.38
Access to mobile phone or radio	0.99	0.96						
Vehicle ownership	0.15	0.21						
Access to cyclone shelters	0.13	0.07						
Condition of house	0.01	0.01						
Access to cash saving	0.41	0.61						
Location of the house	0.97	0.98						
Adult members in the family	0.18	0.24	Social capital	0.11	0.23			
Migrant workers and having access to remittances	0.04	0.23						

Table 7 (continued)

Indicators	Banishanta	Chila	Major components	Banishanta	Chila	Resilience Capacity	Banishanta	Chila
Per-capita annual income that satisfies national average income for well-being	0.36	0.33	Income and food access	0.52	0.52	Adaptive capacity	0.53	0.53
Number of earning members	0.42	0.46						
Status of food consumption level	0.80	0.78						
Health shocks	0.99	0.99	Health	0.99	0.99			
Sex of household heads	0.86	0.95	Socio-demographic component	0.46	0.47			
Dependency ratio	0.82	0.83						
Age of household heads	0.37	0.34						
Education	0.19	0.18						
Number of members have secondary or above	0.07	0.05						
Livestock holding	0.09	0.05	Asset and livelihood diversity	0.15	0.15			
Access to productive agriculture land	0.10	0.13						
Number of skill trainings	0.07	0.12						
Number of alternative incomes generating activities (AIGAs)	0.27	0.32						
Size of cash savings	0.03	0.06						
Asset value of AIGAs	0.14	0.09						
Having sewing machines	0.06	0.05						
Livelihood diversity index	0.59	0.54						
Reduced illegal livelihood strategies	0.03	0.03						

Table 7 (continued)

Indicators	Banishanta	Chila	Major components	Banishanta	Chila	Resilience Capacity	Banishanta	Chila
Access to government-sponsored projects	0.05	0.05	Institutional capital	0.08	0.05	Transformative Capacity	0.45	0.53
Access to NGOs' micro-finance projects	0.12	0.07						
Size of loan or grant	0.06	0.04						
Feeling confident to continue AIGAs	0.93	0.93	Empowered	0.89	0.92			
Feeling self-reliant	0.96	0.97						
Satisfaction with current AIGAs	0.86	0.86						
Women engagement to the AIGAs	0.83	0.93						
Distance to health centre	0.60	0.02	Access to services	0.37	0.60			
Access to improved toilet	0.76	0.69						
Own water sources	0.01	0.01						
Access to secondary school	0.03	0.99						
Access to major road	0.01	1.00						
Having electricity supply in the household	0.83	0.88						

Overall Resilience value

Resilience value Banishanta: 0.43

Resilience value Chila: 0.48

Data availability Data will be made available upon request to the author.

Declarations

Conflict of interest The authors declare no conflict of interest in publishing this article.

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