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Livelihood diversification as key to long-term non-migration: evidence from coastal Bangladesh

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Abstract

Understanding how livelihood diversification contributes to long-term non-migration decisions of people at risks is innovative and timely in the context of future climate change adaptation planning. This study particularly examines this question and explores how and to what extent livelihood diversification in the face of climate change can support long-term non-migration for people living in the southwest coastal region of Bangladesh. We employed a cluster random sampling method to select the respondents and interviewed a total of 183 households by using a structured questionnaire. Analysis indicates that the tendency of livelihood diversification based on shrimp-farming has been intensified in recent years as the land use pattern also changed due to the frequent occurrence of environmental hazards. The Poisson regression model states that belonging to a religious minority and shrimp farming determines the extent of livelihood diversification, i.e., if the person belongs to a minority religion and possesses a shrimp-farm they will have more diversified sources of income compared to others living in the society. Moreover, therefore, one in every three households in these studied communities' practices seasonal migration as an alternative livelihood strategy so that their family can stay put. The outcome of this study motivates the government and non-government organizations to take policies and programs in a direction that may reduce the dependency on seasonal migration and introduce locally adoptable diversified employment opportunities.

Keywords Livelihood diversification · Long-term non-migration · Seasonal migration · Coastal Bangladesh

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1 Introduction

Livelihood diversification is a process by which people increase the number of income-generating activities to improve the livelihood quality and well-being of the family. It is the process by which every household persists and develops their standard of living (Ellis 1998). It indicates a variation in income-generating activities (Fabusoro et al. 2010; Paavola 2008). In particular, income diversification is the core strategy of rural livelihoods. Diversification is sectoral, for example, from farm to non-farm activities, and a process of structural transformation of the rural economy (Mertz et al. 2009; Stark and Lucas 2011; Islam et al. 2014; Tompkins et al. 2020).). However, the common understanding of livelihood diversification refers to increasing the number of income-generating activities in any sector. So, people who work in the traditional farming sector, simultaneously, can work in secondary or tertiary sectors, for example, in small entrepreneurship-related activities (Avila-Foucat and Rodríguez-Robayo 2018). However, the opportunities and level of livelihood diversification depend on the regional, local and individual household socio-ecological contexts. The socio-ecological context offers the available ecosystem services for the people living in a socio-ecological unit. Exemplary, the livelihood activities of people living near mangrove dependent socio-ecological systems are fishing and resources extraction from the mangrove forest (Adams and Kay 2019; Mallick 2019), whereas people who live in rain-fed agriculture-dependent socio-ecological systems are farmers (Mallick 2019; Mistri and Das 2020; Tompkins et al. 2020). However, such natural resource-based livelihoods are extremely vulnerable to extreme events and other environmental threats (Mistri and Das 2020; Tompkins et al. 2020). And therefore, these households have poverty-related problems, and they need to find alternative income opportunities for the survival of their household members. Seasonal or circular migration is one of these alternative income opportunities.

Though livelihood diversification through temporary migration is very primitive and traditional, it has been increasing due to the influences of climate change consequences, globalization and development. Importantly, in the early 80s poor people used to go to their nearby communities or cities for employment, but recently as transport, infrastructure and information, communication and technology (ICT) sectors have improved, the dimension and scope of seasonal and temporary migration has also enlarged from local to national, and even national to international levels. For example, in Bangladesh there were 1.2 million, 1.3 million, 1.4 million and 2.2 million international migrants in 2005, 2010, 2015 and 2019, respectively (Migration Data Portal 2020). The change in employment from farming to non-farming sectors has increased as the share of the agriculture sector in GDP contribution has declined, from about 58% in 1973–1974 to 17% in 2012–2013 (Pramanik et al. 2014). Importantly, almost 75% of households in Bangladesh have at least one migrant family member (Litchfield et al. 2015). Here, migrants refer to the employment migration, like people whose dependents stay in rural areas. Households having a migrant member (national or international) are socially and economically well managed in their rural settlements, and therefore, they prefer to stay instead of migrating. This research has a particular interest in analyzing this seasonal migration as a livelihood diversification strategy linked to social well-being that is necessary for long-term non-migration. Here, ‘long-term non-migration’ refers to the duration of the residence in the same place. Notably, they are termed as ‘long-term non-migrants,’ who have been living in the same place for generation, and also hope that their descendants will also continue living in the same place. Particularly, this research focuses on the livelihoods of people living in vulnerable environments,

and their ways of livelihood diversification. In doing so, this research uses the number of income-generating activities to examine the livelihood diversification process of a particular household. Based on an empirical survey conducted in two remote coastal villages in southwest Bangladesh, this study addresses three core research questions: (1) what influences people at risk to diversify their sources of livelihood? (2) how and to what extent does livelihood diversification differs amongst households with or without migrant members? And consequently, (3) how does livelihood diversification contribute to their well-being as a part of long-term staying? Findings of this study will contribute to future policy formulation and development regarding people at risk in coastal Bangladesh.

The next section describes the background of this research, comprising an extensive literature review and the analytical concept for this research. Section three explains the empirical methods and data analysis. Section four presents the results, and section five concludes the paper.

2 Background of the research

2.1 Diversification is key to sustain the livelihood of people at risk

In general, the rural livelihood in agrarian countries like Bangladesh, the Philippines, Tanzania and Mexico is built on three central strategies: agricultural amplification, livelihood diversification and relocation (Hussein and Nelson 1998; Avila-Foucat and Rodríguez-Robayo 2018). For example, diversification of rice farming into rice-carp farming is beneficial for the 'Gher' system in Bangladesh (Rahman et al. 2011; Islam et al. 2014). Instead of the specialization of rice cultivation, farmers in Eastern Visayas, Philippines, decided to diversify their livelihood activities by taking up vegetation cultivation to sustain their households and farm enterprises (Bernados 2019). In the case of semiarid regions in Tanzania, low- and middle-income groups are more vulnerable due to fewer alternative opportunities compared to the well-off groups (Lyimo and Kangalawe 2010). Similarly, the production of agricultural commodities is decreasing because of increasing salinity in farm-lands in coastal Bangladesh (Uddin and Nasrin 2013; Islam et al. 2014) and affecting the marginalized poor landowners by reducing their adaptive capacity (Karim and Mustari 2015). People living in vulnerable coastal communities in Bangladesh are coping with climate consequences through the diversification of livelihoods, searching for additional employment within and outside their community, i.e., migrating (temporary or permanently) (Masud-All-Kamal 2013; Mallick and Vogt 2013). On the contrary, in rural Senegal the majority of people choose livelihood diversification due to the influence of their local politics and social conditions instead of climate change influences (Mertz et al. 2009).

Moreover, the assets and capital strength of the household influences livelihood diversification. In their recent study, Avila-Foucat and Rodríguez-Robayo (2018) employed an assets approach to analyze how wildlife tourism as a diversification strategy is helpful for people in coastal communities in Oaxaca, Mexico. Their results suggest that economic assets and capital only cannot help in the livelihood diversification process, but political and institutional facilitation is required. Similarly, people in El Faouar, Tunisia, cope with uncertain crop production limiting their daily expenditure by selling livestock and other capital resources (Sobczak-Szelc and Fekih 2020). During the drought season, they migrate to nearby cities for additional sources of income, and such seasonal or even permanent migration has become part of an extensive process of socioeconomic transformation

in Tunisia (Sobczak-Szelc and Fekih 2020). Similarly, the rural communities in the Sahelian zone of West Africa have to diversify their livelihood strategies in a way which enables them to constantly cope with and adapt to the adverse livelihood situation caused by an erratic climate, severe crop failures and changing policies at local to global levels (Mertz et al. 2009). Besides this, crop diversification, adoption of new technologies in farm and off-farm activities, trade and political and institutional changes also play a vital role in the livelihood strategies of households. Usually, household income and capacity for labor positively impact the choice of livelihood activities (Dai et al. 2019). However, the type and scope of their livelihood diversification depends on the socio-demographic characteristics of the household, environmental awareness, community cohesion, social networks and associations, and political and institutional facilities (Avila-Foucat and Rodríguez-Robayo 2018). In sum, people living in vulnerable rural communities are practicing livelihood diversification to improve their well-being, and to stay in their own communities.

2.2 Migration as a livelihood diversification strategy

It is undeniable that migration is one of the best livelihood diversification strategies for people living in rural settlements all over the world. There is ample evidence that people migrate to cope with and adapt to adverse livelihood situations (Harris and Todaro 1970; Hugo 2012; Adger 1999; Carling 2002; Bakewell 2008; Hunter 2005; McLeman and Hunter 2010; de Haas 2007; Black et al. 2011; Czaika and Vothknecht 2014; Mallick and Vogt 2013; Martin et al. 2007; Ayeb-Karlsson 2018). Here, a migrant is one who has moved from their place of residence to a new one, irrespective of their legal status, their movement type (voluntary or involuntary) and their driving forces (economic, social, political or environmental).

However, how migration has been evolved as livelihood strategy lies in the two most famous school of thoughts on migration, i.e., ‘migration optimists’ and ‘migration pessimists’ (de Haas 2010). The ‘migration optimists’ views or so-called the neo-classical theory of migration perceives ‘migration as a form of optimal allocation of production factor’ (de Haas 2010). The development theory (McDowell and De Haan 1997; Skeldon 1997) considers migrants as ‘important agent of change and innovation, as they bring not only remittances but also new ideas and knowledge,’ and in this way, they bring development to their place of origin. But the school of ‘migration pessimistic’ views migration as a ‘flight from misery,’ i.e., migration is seen as ‘aggravating problems of underdevelopment’ thus contributes to the ‘migrant syndrome’ (Reichert 1981; de Haas 2010). The migrant syndrome explains the vicious circle of migration, i.e., migration generates more underdevelopment and in turns, this causes more migration. This is the outcome of ‘cumulative-causation theory of migration’ that supports that migration brings disparities in wealth and equality in the society (Massey 1990). However, the development impact of migration is heterogeneous, and that under a favorable social, economic and political conditions migration play a decisive role in the development of the place of origin of the migrants (de Haas 2010). And this dimension of ‘development theory of migration’ (McDowell and De Haan 1997; Skeldon 1997) is related to the general shift of the social theory of migration. For example, in the 1980s and 1990s, the New Economics of Labor Migration (NELM) theory (Stark 1985) stands on the development thinking of so-called livelihood approaches, and social, environmental and anthropological research on migrants. This new NELM approach increased the scope for integrating risk-sharing factors into the migration (McDowell and De Haan 1997; Ellis 1998), where migration is seen as an adaptation strategy of risk-sharing behavior of

an individual, household or families. It minimizes the income-risks by diversifying their resources and labors. The assumption is that migration is a part of livelihood diversification and depends on livelihood capitals (Carling 2002; de Haas 2010; Carling and Schewel 2018; Mallick and Schanze 2020). But it is not well-explained under which livelihood conditions people choose to migrate or decide to stay—keeping in mind that the people also migrate due to family reunion, marriage, education, health, trade and tourism (Best et al. 2020). However, not everyone migrates or could migrate due to their capital strength, termed as ‘trapped’ in the migration discourse (Black et al. 2011; Adams 2016), and the people who voluntary stay are voluntary non-migrants (Mallick 2019; Mallick and Schanze 2020).

Again, there are challenges in categorizing the migrants, who are what type of migrants—economic, environmental, social or political, temporary or permanent, voluntary or trapped. The ample body of migration and livelihood literature can be separated into the socioeconomic (Ellis 1998; Carling 2002; de Haas 2007, 2010; Czaika and Vothknecht 2014; Carling and Schewel 2018; Dai et al. 2019), environmental (Hunter 2005; McLeman and Hunter 2010; Black et al. 2011; Adams 2016; Mallick 2019; de Campos et al. 2020) and political or cultural context (Collyer 2010; Betts 2013; Abel et al. 2019). Such simplifications of migrants’ typologies are out of the scope of this research; instead, this study primarily focuses on the livelihood diversification of the economic and environmental migrants. In general, the economic migrants are those who want to escape poverty, gain better opportunities for their children and obtain job security which may be lacking in their communities or countries of origin. They are mostly skilled and highly educated, and migrate from rural to urban (regional or national level), global south to global north industrialist countries (international level) (Haberfeld et al. 1999; Amrith 2013). Hence, the increasing number of rural to urban migration, industrialization and rapid economic growth creates extreme labor shortages in the peak agricultural season in rural areas (Aryal et al. 2019).

On the other hand, an ‘environmental migrant’ is one who migrates to adapt to the severe impacts of climate change and extreme environmental threats. Recent reports and studies show that more people are migrating due to natural hazards and disasters (Hunter 2005; Black et al. 2011; Bennet et al. 2017) and migration is also one of the numerous consequences of climate change and extreme events (Perch-Nielsen, et al. 2008; Bohra-Mishra et al. 2014; Call et al. 2017). When people fail to cope with the prevailing condition, they choose to migrate to other places (McLeman 2018). For instance, income and asset allocation possessed a central role in migration decision making for the people affected by cyclone Aila of 2009 in Bangladesh (Mallick and Vogt 2012). Similarly, insufficient incomes from agricultural sectors push people to migrate in Tunisia (Sobczak-Szelc and Fekih 2020); existing social networks, historical linkages and economic opportunities tend to be the main pull factors for the migration in delta regions (de Campos et al. 2020).

Food security perspectives in the context of livelihood diversification are primarily concerned with access to food and coping strategies in response to food insecurity, whereas livelihood approach refers to the ways of securing the necessities of life including food, clothing, education, security and health (Mertz et al. 2009; Islam et al. 2014; Tompkins et al. 2020). Until present, there has been a shift from material perspectives to social perspectives that focuses on the empowerment and enhancement of people’s capacities to secure their own livelihoods. For that purpose, this study discusses the influences of the migrants on the empowerment and well-being of their households of origin, followed by the relationship between livelihood diversification and long-term staying opportunities. This sedentary approach of migration debates stands on the belief that the locales where

the people living should be improved in quality of livelihood so that the people can stay at their place of origin (Bakewell 2008).

2.3 Analytical concept: livelihood diversification as key to non-migration

The aforementioned literature review states that livelihoods can be diversified through different farm and off-farm activities, where migration is one of the best alternative strategies for livelihood diversification. However, not everyone can migrate due to resource (capital as well as social) scarcity, but those who realize their migration aspiration usually can improve the livelihood conditions for their dependents staying in places of origin. Again, migration is not mandatory for everyone living in a vulnerable region, rather there is a group of people who are capable enough to maintain their livelihood and can diversify their income opportunities so that they can stay. The main reason people can stay is their capital strength, and thus, it is almost certain that poor people (who lack capital) practice 'migration as livelihood diversification strategy' in response to climate risks. Now the question is how migration contributes to the well-being of their families, to the extent that they do not see any reasons for permanently out-migrating in near future despite climate risks. In answering this question, it is important to analyze the income differences between the households with and without migrant family members, and then review other livelihood dimensions like education, health and security in general.

In sum, this research hypothesizes and empirically addresses the notion that climate changes factors in cooperation with other social, economic and political factors influence the changes in livelihood opportunities in places of origin, and therefore, the marginal and poor households practice out-migration. Again, the climate change factors mainly impact land uses, for example, decreasing agriculture and increasing aquaculture practices, where the aquaculture practices are less labor intensive compared to agriculture practices. This results in lower wage rate and a surplus of daily laborers in the communities, which influences the regular circular or seasonal migration as an alternative employment option. This allows for long-term staying of the dependents in the place of origin. However, we consider that not everyone practices migration and not everyone is involved in different income-generating activities. The following section explains these based on empirical evidence from Bangladesh.

3 Methodology

3.1 Bangladesh as a case study

In Bangladesh by 2050, around 13.3 million people are expected to be displaced because of food insecurity and climate change (Rigaud et al. 2018). But, in their study de Campos et al. (2020) reported a negative net migration for the coastal districts in Bangladesh, although there exist unequal spatial development, socioeconomic transformation and environmental stressors along with high rates of urbanization in the country. Again in coastal Bangladesh, shrimp farming is beneficial for a small group of people; it negatively affects the surrounding environment, including both the mangrove and local areas, and reduces the chances of income opportunities for landless and marginal farmers (Rahman et al. 2008; Karim 2006). People involved in shrimp farming and other aquaculture related activities gain comparatively more social and economic benefits, but unplanned and large-scale

shrimp farms negatively affect rice and other crop productions (Rahman et al. 2013; Islam et al. 2002). Shrimp farms contribute few overall economic benefits to the coastal community and lead to a continuation of extreme poverty for a more significant portion of the people in southwest Bangladesh (Swapan 2007; Bashirullah et al. 1989). The continuous floods, variation of temperature, erratic rainfall, drought and salinity deleteriously impact agricultural crops (Sikder and Xiaoying 2014; Rahman et al. 2013) and put pressure on the existing livelihoods of the poor, decreasing the ability to depend on agricultural production (Paavola 2008) and forcing them to opt for short-term labor migration on a regular basis (Ackerly et al. 2015; Kartiki 2011; Haberfeld et al. 1999). Taking these into consideration, this study selected two villages in Koyra Upazila, Hariharpur and Padmapukur, located in Khulna district in the southwest region of Bangladesh for the study area (Fig. 1). The village Hariharpur is located close to the largest mangrove forest (Sundarbans) and surrounded by the rivers Ray and Kapotaksha. On the other hand, a small western portion of the village Padmapukur is on the bank of the river Kapotaksha. Both of these areas are vulnerable to climate consequences and severely affected by different natural disasters (cyclone, flood, tidal-surges, storm, heavy rainfall and river bank erosion). Studies provide evidence of a wide range of migration practices in these villages (Mallick 2019; Rahman and Gain 2020).

3.2 Data collection and analysis

The numbers of total households living in Hariharpur and Padmapukur villages are 163 and 322, respectively. Although the main occupation of the people in these two villages is shrimp farming, some people seasonally migrate to the nearest cities and join different

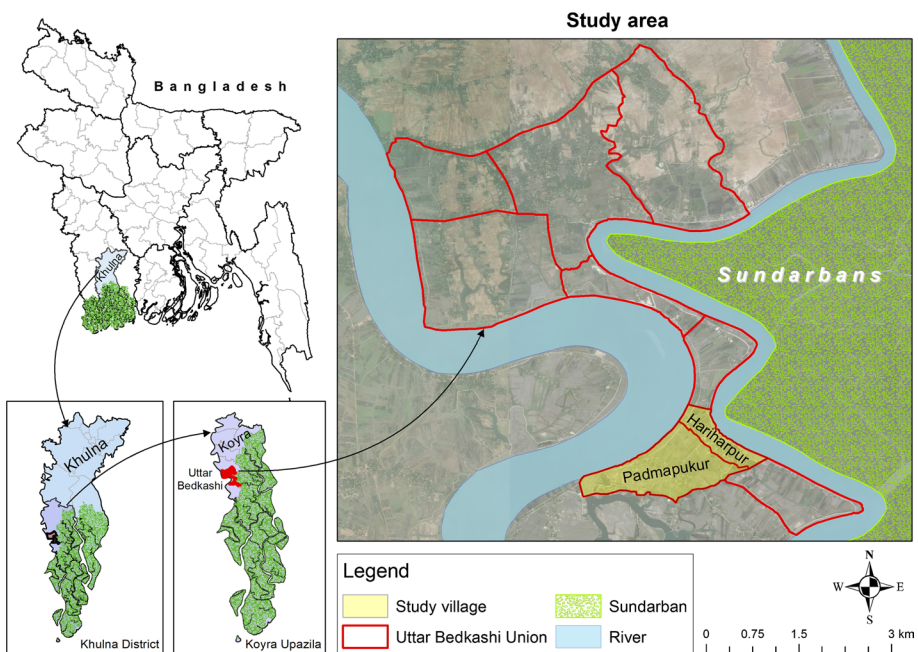


Fig. 1 Study villages. *Source:* Authors illustration 2020

informal sectors to sustain their families. A large number of households in Hariharpur were dependent on the mangrove forest and on fishing in the two rivers Kapotaksha and Ray. On the other hand, the people of Padmapukur village were mostly dependent on prawn cultivation and business.

The first author of the paper has collected the primary data through a cluster random sampling method from both villages. The household survey has been conducted using a structured questionnaire and with the help of two research assistants during August 2017. For the data collection, each village was divided into three blocks, and 27 randomly selected households were surveyed from each of the three blocks of village Hariharpur, and 34 households were surveyed from each of the three blocks of village Padmapukur (see Table 1).

The field team interviewed a total of 200 households by using a structured questionnaire, 110 from Pamapukur and 90 from Hariharpur, respectively. At the time of field survey, the household heads were asked questions regarding their livelihood activities and their migration status along with the socio-demographic and economic questions. Each interview lasted around 20–25 min. During the data mining stage, we discarded 17 questionnaires due to insufficient information. We used the statistical software MS Excel and STATA₁₄ for data analysis. Quantitative data have been used to show different numerical results mainly using livelihood diversification indices, regression models and mean comparisons of migrant and non-migrant households. As the climatic and environmental conditions are similar for both the study villages, we do not include climatic and environmental variables in the regression models.

3.3 Livelihood diversification indices

The livelihood diversification index shows that the people of this area are involved in several economic activities, which have been categorized into eight primary income sources: (1) cultivation of crops, (2) cultivation of fish, (3) catching fish, (4) business (both small and large scale), (5) collecting resources form Sundarbans, (6) wage earners, (7) formal employee, i.e., jobs and (8) other income sources (like tutor, *mechanic, smith, tailor, driving*, etc.). There are several indexing methods for the measurement of livelihood diversification such as the Simpson index, Herfindahl index, Ogive index, Entropy index, Modified Entropy index, Composite Entropy index and Index of maximum proportion (Joshi et al. 2004). For the simplicity of measurement, in this research, we have used the ‘Ogive index’

Table 1 Sample size distributions. *Source:* Author’s compilation based on the field survey 2017

Name of villages	Blocks	Number of samples	
Hariharpur (163)	B ₁ = North and eastern part	27	Total = 81 samples
	B ₂ = Middle part	27	
	B ₃ = Western part	27	
Padmapukur (322)	B ₁ = Eastern part	34	Total = 102 samples
	B ₂ = Southwestern part	34	
	B ₃ = Western part	34	
	Total = 6 blocks		Total = 183 samples

and ‘Simpson index.’ When there exists an unequal distribution of sectoral activity, the result of the ‘Ogive index’ will be higher (Raj Sharma 2008). The formula of the ‘Ogive index’ is given below.

$$\text{Ogive index} = \sum_{i=1}^N \frac{(S_i - 1/N)^2}{1/N}, \quad (1)$$

where N =number of economic sectors in this coastal economy, S_i =sectoral share of the economic activity. With N sectors, an equal distribution denotes that S_i is equal to $1/N$ then the ‘Ogive index’ equals to zero, meaning perfect diversity.

We also use the ‘Simpson index’ to measure the livelihood diversification of the coastal people. The Simpson Index of Diversity (SID) is the quantitative measurement of diversified income sources in the community (Fabusoro et al. 2010).

$$\text{Simpson index (SID)} = 1 - \frac{\sum_{i=1}^S n(n_i - 1)}{N(N - 1)}, \quad (2)$$

where N =total number of income sources in the coastal economy, S =number of activities, and n =number of individuals with each income source. It takes a value between 1 and 0. When the value of the SID tends toward to 1, the level of livelihood diversification increases. On the other hand, when the value of SID is 0, there is complete specialization (Liu 2018). The changes in diversification of the coastal livelihood opportunities are measured over two periods, i.e., before shrimp cultivation and at present. Cases where the age of the household head is above 35 years are considered for assessment.

3.4 Regression analysis

The Poisson regression model is used to estimate the total number of income sources (cultivation of crops, farming of fish, catching fish, business and others) and the number of livelihood sources for each household in order to investigate the causes of livelihood diversification. We use the Poisson regression model because the count-dependent variable in our data does not take the value of zero and the mean value does not exceed the variance of the response variable. In our data, all households head have more than one income source, and the conditional mean is more substantial than the variance. Zero-inflated Poisson (ZIP) and negative binomial regression model (NBR), therefore, are not suitable in this case. Thus, estimating this count data model, Poisson regression model (Wickramasinghe 2016) has been used.

$$\text{Prob}(X_i) = \frac{e^{-\lambda} \lambda_i y_i}{y_i}, \quad (3)$$

where Y_i is the number of income sources (0, 1, 2, 3, ... n) participated in by coastal people and λ_i is the parameter indicating the mean and variance of Y_i . In the specification, the value of the parameter λ_i is as follows.

$$E(y_i|X_i) = \lambda_i = e^{X_i\beta}, \quad (4)$$

where X_i is independent variables, representing the household characteristics (household size, education of the head, number of school-going children and age of the household head) and household socioeconomic characteristics (religion, ownership of land, ownership

of the shrimp farming and monthly income). Because the study areas are not spatially segregated, the consequences of climate change and extreme events are not significantly different between the two study villages, and that is why we tried to find only the socioeconomic factors that influence livelihood diversification at the present time.

In order to determine the age group of people who are involved in more diverse income opportunities, the variable 'age' has been categorized into four ranges ($a_1=15-32$, $a_2=33-50$, $a_3=51-68$ and $a_4=69-86$) taking a_1 as references or omitted category and hypothesizing that younger people are involved in a larger number of activities. The 'religion' variable has also been considered for observing the group, as in the study area, there are only two types of religion (X_5), Muslim and Hindu. To see a larger number of participants between two types of religion, we use this as a dichotomous variable, '1 for Hindu' and '0 for Muslim and assumed that the people who are Hindus are involved in more income-generating activities. Education of the household head (X_2), household size (X_1) and the amount of income (X_8) are major determinants of livelihood diversification (Fabu-soro et al. 2010). In this study, we assumed that a large number of school-going children (X_3) belong to a household that has been practicing a larger number of income-generating activities. Ownership of the land (X_6) and ownership of shrimp farming (X_7) are independent variables that influence diversification of livelihood opportunities. We assumed that the people who are involved in shrimp farming are more diversified than those who are not. Using the statistical software STATA₁₄, the count Poisson regression model has estimated and calculated the marginal effect of livelihood diversification.

4 Results

4.1 Summary of the socioeconomic and demographic profile

Table 2 shows the descriptive statistics of the interviewed households. The mean age of the household head is about 47.10 years with minimum age being 16 years and maximum age being 90 years. Average household size is 4.69 where the numbers of male and female members on average are 3 and 2, respectively. The average years of education of the household head (male) is 5.47 and housewife is 4.68, indicating lower literacy level, i.e., most of the present household owners in the studied community did not complete their secondary school education. The results indicate that the mean number of school-going children is about 1.16 at present. Almost 50% of the respondents in the studied communities are shrimp cultivators and one-third of the total respondents practices seasonal and circular migration.

Land ownership is vital for income as well as power and social respect in these vulnerable communities. Accordingly, findings show that the bigger landowners have been practicing shrimp farming. The average amount of land owned by the respondents is 110.66 decimals, which varies between 6.60 and 1320.00 decimals. This range of land ownership also indicates a high level of inequality in the context of land ownership in the studied communities. On average, in every family, both the household head and housewife are involved in income-generating activities (the mean number of earning members in a family is 1.55), and they are mostly engaged in more than two income alternatives (the average number of activities practiced by the household head is 2.78). Data show that 39% of the respondents confirmed their female members' participation in income-generating activities outside.

Table 2 Summary of the socioeconomic and demographic profile of the respondents ($N=183$) *Source:* Author's compilation based on the field survey 2017

Variables	Unit	Obs.	Mean	SD	Min.	Max.
Age (years)	(Years)	183	46.93	1.04	16.00	80.00
Household size	(Numbers)	183	4.69	2.08	2.00	17.00
Gender	(Numbers)	183				
Male			2.51	1.27	1.00	8.00
Female			2.18	1.25	1.00	9.00
Education	(Years of schooling)	183				
Family head			5.47	4.30	0.00	17.00
Housewife			4.68	4.26	0.00	17.00
School-going children	(Numbers)	183	1.16	1.02	0.00	6.00
Religion	(Numbers)	183				
Hindu			4.58	1.67	2.00	12.00
Muslim			4.90	2.71	2.00	17.00
Land	(Decimal)	183	110.66	11.30	6.60	1320.00
Number of shrimp cultivators	Yes=1, No=0	183	0.54	0.04	0.00	1.00
Number of migrant households	Yes=1, No=0	183	0.33	0.47	0.00	1.00
Number of earning members	(Numbers)	183	1.55	0.81	1.00	5.00
Number of activities	(Numbers)	183	2.78	0.07	1.00	5.00
Women as earning members	(Numbers)	183	0.39	0.04	0.00	1.00
Income (monthly)	(BDT)	183	11,261.2	6413.74	2500.00	35,000.00
Expenditure (monthly)	(BDT)	183	7948.08	4299.41	1500.00	30,000.00

The average monthly income and expenditure of the studied households were reported as 11,261 BDT (134.60 US\$) and 7948.08 BDT (95.04 US\$). The minimum household income was 3500 BDT (41.85 US\$) and maximum income was 35,000 BDT (418.50 US\$), again indicating a high level of income inequality in the studied villages. The inhabitants of these communities were not dependent on single income, relying on alternatives and somewhat diversified activities including seasonal or circular out-migration practices. The following section describes the main reasons that contribute to diversifying the livelihood opportunities in the studied communities.

4.2 Factors that affect livelihoods

According to the respondents, frequent river-bank erosion (77.60%) was the primary reason for choosing alternative livelihoods, followed by the intensity of salinity intrusion to the agricultural land (60.11%), larger household size (30.60%), desire for higher economic benefits (21.31%) and extreme rainfall (14.75%) (Table 3). In addition to these, the lack of proper irrigation facilities was one of the main reasons for the changes and diversifications of the coastal livelihoods. In the rainy season, when there is high rainfall, the water level of both sides of the river and the inland fish farm is high. If river bank erosion takes place at that time, it destroys the total harvest. Rasel et al. (2013) found that in the dry season the soil salinity increases the harm to crop yielding. Again, the water of the surrounding area is not suitable for the cultivation of rice and vegetables due to its salinity. The fertility of the land is decreasing because many elite groups are cultivating shrimp by

Table 3 Major reasons that affect the livelihood. *Source:* Author's compilation based on the field survey 2017

Reasons	Explanations	Respondents (%)
River erosion	The primary cause of change and diversification of coastal livelihood is river erosion. Frequently, river erosion damages coastal agriculture production	77.60
Intensity of salinity	In summer, the soil of this area becomes barren and salty with no way to produce crops. Also, for most of the year the water of the ponds, canals and other sources of water remain salty so that is not perfect for production	60.11
Increased number of household members	Over time, because of increasing family size people have been obliged to diversify their existing economic activities for the survival of their family	30.60
A desire for high economic benefit	For achieving high-profit people cultivate shrimp instead of growing crops	21.31
Heavy rainfall during monsoon	In the rainy season, when there is high rainfall significant land is flooded by high water and the harvest of the coastal people destroyed	14.75
Lack of irrigation facilities	Lack of the irrigation of suitable water means most of the people stopped production of crops in the dry season	6.01

introducing intruding saline water into the inland rice fields (Karim and Mustari 2015). The livelihoods of the people who are living in the environmentally vulnerable region are adversely affected by storm surges, water logging, cyclones, land erosion and flooding as well as the intrusion of salinity in the soil and water (Tasneem and Shindaini 2013). Similarly, Khanom (2016) stated the intrusion of salinity severely impacts the agricultural livelihoods through soil and ground water degradation, health effects and long-term effects on the ecosystem. The respondents claimed that shrimp farming was more profitable than rice farming, and it was less labor intensive.

Therefore, most of the people living in these villages were involved in shrimp farming. A large number of respondents argued that although their income and consumption have increased at present, they were not happy because frequently natural disasters destroyed their assets and forced them to live on subsistence again and again. However, as their family size increases, people have been obliged to become involved in a wider portfolio of activities to feed their families. However, not all of the people studied were able to diversify their livelihoods.

4.3 Differences in livelihood opportunities between migrant and non-migrant households

Here, 'migrant household' refers to those households which reported that at least one of their family members migrates seasonally or has already migrated permanently, and 'non-migrant household' is one which has no migration experiences. Data show on average a single member migrated per household, where the maximum was reported was three. Table 4 shows the comparison between migrant and non-migrant households. The average household size of migrants (5.25) is more than that of non-migrants (4.42). The t test shows that there is a significant difference between migrant (0.38) and non-migrant (0.61) families involved in shrimp farming practices, i.e., the shrimp cultivators in this area are not as interested in practicing migration compared to other livelihood groups.

The average number of women participants in outdoor work from the non-migrant households is 0.46, which is larger than the migrant households' 0.25. Women who work outside were mostly involved in fishing and farming activities, and they earned wages. Women involved directly and indirectly in the cultivation of fish significantly contribute to the household income as well as the socioeconomic development of the country (Islam et al. 2002). Although migrant households have a higher average salary (12,653.33 BDT/151.32 US\$) compared to non-migrant households (10,582.11 BDT/126.40\$), results show that migrant families have less diversified livelihood opportunities compared to non-migrant households. The following sections describe the factors that influence the livelihood diversification decisions.

4.4 Livelihood diversification across the studied communities and sectors

The livelihood diversification across the studied villages has been calculated using Ogive and Simpson indices (Table 5). Analyzing existing sectoral participations of 69 households in village Hariharpur, the *Ogive index* and the *Simpson index* show the results 0.36 and 0.83, respectively. On the other hand, analyzing sectoral participations of 81 households in village Padmapukur, the *Ogive index* and the *Simpson index* show the results 0.41 and 0.83, respectively.

Table 4 Mean comparison between migrant and non-migrant households. *Source:* Author's compilation based on the field survey 2017. US\$ = 78 BDT (dated on 17.04.2017)

Variables	Migrant people ($n = 60$)		Non-migrant ($n = 123$)		t test for mean comparison	
	Mean	Std.	Mean	Std.	t test	$\Pr(T > t)$
Number of family members	5.25	2.70	4.42	1.64	2.59	0.01
Number of activities participated by the household head	2.72	0.99	2.80	0.87	-0.61	0.73
Years of schooling of household head	5.08	4.56	5.66	4.16	-0.85	0.80
Amount of own land	106.01	190.00	112.92	131.95	-0.29	0.61
Number of shrimp cultivators	0.38	0.49	0.61	0.49	-2.93	0.99
Number of women participant in outdoor work	0.25	0.44	0.46	0.52	-2.65	0.99
Income	12,653.33	7019.60	10,582.11	6009.92	2.07	0.02
Expenditure	8325.00	4969.25	7764.23	3940.82	0.83	0.20

Table 5 Livelihood diversification indices and sectoral share of income. *Source:* Author's compilation based on the field survey 2017

Categories	Hariharpur (<i>n</i> = 69)			Padmapukur (<i>n</i> = 81)		
	(% Share of activities)		Sectoral share of income (BDT)	(% Share of activities)		Sectoral share of income (BDT)
	Before shrimp farming	At present	At present	Before shrimp farming	At present	At present
Cultivation of crops	81.16	56.52	1089.74	72.84	53.09	1576.74
Breeding of fish	13.04	65.22	4700.00	16.05	50.62	4951.22
Fishing	37.68	63.77	3027.27	27.16	35.80	2610.35
Business	8.70	15.94	5590.91	12.35	30.86	5700.00
Resources form Sundarbans	1.45	18.84	3692.31	2.47	9.88	2125.00
Day laborer	44.93	55.07	3939.47	49.38	70.37	4921.05
Jobs	4.35	17.39	16,500.00	1.23	8.64	14,857.14
Others	2.90	10.14	2742.86	3.70	11.11	1800.00
Total	194.20	302.90	41,282.56	185.19	270.37	38,541.50
Ogive index	1.18	0.36	–	1.08	0.41	–
Simpson index	0.73	0.83	–	0.74	0.83	–
Overall livelihood diversification of the coastal people [Hariharpur + Padmapukur]						
Total	189.33	285.33	–	–	–	–
Ogive index	1.12	0.35	–	–	–	–
Simpson Index	0.74	0.83	–	–	–	–

These results indicate that the livelihoods of the people of the village Hariharpur are more diversified compared to the village Padmapukur at present. In the analyses of the sectoral participation of both communities, the value of the *Ogive index* and the *Simpson index* are 0.35 and 0.83 at the current time, respectively, and 1.12 and 0.74, respectively, in the past. These results of the *Ogive index* and the *Simpson index* indicate that at present the livelihood of the people of the studied villages is more diversified than before when most of the people were involved in agriculture. It has been seen that there have been changes in participation in all sectors over the time, and the involvement of households has increased in each sector except agriculture. Although the households generating higher income mainly practice shrimp cultivation, catching fish, collecting resources from Sundarbans and business, they are dilapidating natural resources, which is supported by previous findings by Goswami and Nautiyal (2020).

As mentioned, due to the effects of climate change and loss of income sources, a total of 32.79% of people practice migration in this study area. Table 6 shows that 62.8, 53.6 and 47.5% people are involved in day labor, cultivation of fish and fishing from a river and other places, respectively. Although 52.4% of people are engaged in crop production, the share of sectoral income is about 1363.54 BDT (US\$16.30) which is lower than the other sectors. This indicates that people at present do not entirely depend on agricultural products. When shrimp farming grows vastly, a large number of people lost

Table 6 Livelihood activities and sectoral participations ($n = 181$). *Source:* Author's compilation based on the field survey 2017

Livelihood categories	List of livelihood activities	No. of household	The sectoral share of income (BDT)	The percentage share of households (%)
Cultivation of crops	Rice farming, Livestock, Pumpkin, Gourd, Cucumber, Vegetables	96	1363.54	52.46
Breeding of fish	Prawn, Golda, Tilapia, Vatke, Crabs, Harina, Passe, Rui	98	4770.41	53.55
Fishing	Prawn Renu, Golda Renu, Harina Shrimp, Passe, Vatke, Vanagon	87	2873.56	47.54
Business	Agricultural products, Prawn Renu, Galda, Renu, Prawn, Crabs, Poultry, Shopkeeper, Other whitefishes	46	5347.83	25.14
Resources from Sundarbans	Honey, Crabs, Whitefish, Shrimp	24	3083.33	13.11
Day laborer	Dressing road of Gher, Cleaning out grass, House building, Bricklaying, Woodcutting, Agency of fish, Duty in Ghar	115	4549.57	62.84
Jobs	Govt., NGO, Company	22	15,227.30	12.02
Others	Tuition, Medical science, Mechanic, Smith, Tailor, Driving	20	2245.00	10.99
	Total	508	39,460.50	

their places of work in the villages, and therefore, they migrate seasonally outside their communities for work.

Table 7 represents that about 31.7% of people studied migrate from October to March and work in the brickfields, whereas 28.3% migrate September to April for cutting soil for making bricks, Gher and ponds. During July–August, around 10% of people usually migrate to different villages near Khulna for planting rice. Similarly, during November–December, they migrate to different places in Gopalganj district for harvesting paddy.

4.5 Livelihood diversification model

The above results and discussions raise the importance of estimating the determinants that affect people's livelihood diversification. To do so, we have used a Poisson regression model. In this model, the dependent variable is a count variable. The mean and standard deviation of this count variable are 2.78 and 0.91, respectively. It suggests that this is not over-dispersion, and therefore, the Poisson regression model is appropriate rather than the negative binomial regression. In analyzing the co-linearity, the model has been run two times: firstly, excluding the variable X_7 (ownership of the land) and secondly, including all variables. Both models estimated the coefficient and marginal effect $\left(\frac{\partial y}{\partial x}\right)$.

The marginal effect of Model 1 and Model 2 shows that the inclusion of variable X_7 (Ownership of the land) in Model 2 increases the value of the marginal effect of X_6 (Ownership of shrimp farms) from 0.46 to 0.48. The relationship between religion and land ownership indicates that Hindus possess a larger portion of land compared to Muslims. In this model, the age group ' $a_1=15-32$ ' is a reference value. Table 8 shows that the expected number of livelihood diversification for groups $a_2=[33-50]$, $a_3=[51-68]$ and $a_4=[69-86]$ increases by about 0.13, 0.27 and 0.07, respectively, in comparison with the ages between $a_1=[15-32]$. This result predicts that people aged between $a_3=51-68$ have more diversified opportunities of income compared to other categories.

The results of the Poisson regression model state that the variables X_5 (Religion) and X_6 (ownership of shrimp farming) are statistically significant, thus suggesting that the people who are Hindu practice more alternative income opportunities compared to Muslims. On the other hand, people who possess shrimp farms also have more diversified income opportunities. The predicted number of diversified livelihood opportunities is about 2.75.

5 Discussion

5.1 Summary of the findings

This empirical study of coastal Bangladesh shows that people have been obliged to diversify their livelihoods because of five primary reasons: river erosion, increasing saline intensity, high rainfall, the temptation of high profit and larger household size. Findings also indicate that the diversification of livelihood varies across religion, land ownership and practices of agriculture or aquaculture. This finding supports the previous study conducted by Mistri (2019). The result of the Poisson regression model shows that people who are Hindu and have shrimp farms have more diversified livelihoods compared to people who are Muslim and have no shrimp farm; this results support the findings of Ahmed et al. (2015). Again, the chances of diversification of livelihood are

Table 7 Livelihood choices of the migrant households (32.79%). *Source:* Author's compilation based on the field survey 2017

Categories of activities	Places of work (districts)	Seasons of work	Number of participants (%)
Brickfield	Barisal, Chittagong, Dhaka, and Mymensingh	(October–March)	31.67
Earthwork	Barisal, Chittagong, Dhaka, Khulna	(September–April) (they cut soil for making brick, Gher, pond, cropping)	28.33
Paddy harvesting and Planting rice	Gopalganj (for harvesting paddy) Khulna: Dumuria, Koiya, Noliyan (for planting rice)	November–December (for harvesting Amon paddy) April–May (for harvesting Boro paddy) August—(for planting Amon Paddy) February—(for planting Boro paddy)	10.00
Woodcutting	Barisal	October (for 1 month)	18.33
Informal and formal job	Dhaka, Khulna, Satkhira	–	23.33

Table 8 Result of the Poisson regression model. *Source:* Author's own compilation based on the field survey 2017

Name of the variables	Poisson model (1)		Poisson model (2)	
	Coeff.	Marginal effect (dy/dx)	Coeff.	Marginal effect (dy/dx)
X_1 , (Household size)	0.02 (0.02)	0.05 (0.06)	0.02 (0.02)	0.05 (0.06)
X_2 , (Education of household head)	-0.01 (0.01)	-0.03 (0.03)	-0.01 (0.01)	-0.03 (0.03)
X_3 , (Number of school-going children)	0.002 (0.05)	0.01 (0.13)	0.003 (0.05)	0.01 (0.14)
X_4 , (Age of the household head: a_2, a_3, a_4) [$a_2 = 33-50$]	0.05 (0.14)	0.12 (0.39)	0.46 (0.14)	0.13 (0.39)
[$a_3 = 51-68$]	0.10 (0.15)	0.27 (0.43)	0.10 (0.15)	0.27 (0.43)
[$a_4 = 69-86$]	0.02 (0.2)	0.05 (0.54)	0.03 (0.20)	0.07 (0.55)
X_5 , (Religion) 0 for Muslim and 1 for Hindu	0.21*** (0.11)	0.56 (0.28)	0.22*** (0.11)	0.57*** (0.29)
X_6 , (Ownership of the shrimp farming)	0.17** (0.10)	0.46** (0.27)	0.18** (0.10)	0.48** (0.28)
X_7 , (Ownership of the land)			-0.0000915 (0.00034)	-0.00025 (0.00094)
X_8 , (Income of the household head)	0.00 (0.00)	-0.0000261 (0.00003)	0.00 (0.0000109)	-0.0000248 (0.000003)
Constant	0.76*** (0.17)		0.75*** (0.17)	
$y =$ Predicted number of events		2.74		2.74
The number of obs.	183		183	
LR χ^2	13.07		13.15	
Prob > χ^2	0.16		0.22	
Pseudo R^2	0.022		0.023	

Table 8 (continued)

Name of the variables	Poisson model (1)		Poisson model (2)	
	Coeff.	Marginal effect (dy/dx)	Coeff.	Marginal effect (dy/dx)
Log-likelihood	- 284.18		- 284.14	

***Significant at $p < 1\%$; **significant at $p < 5\%$; reference category of the age= 15–32

proportionate to the amount of land ownership, as it seems that landless people have minimal choice of income opportunities. Ahmed et al. (2015) found that farmers from the middle classes have diversified their livelihood more compared to landless and land-holding people. Additionally, people age between 51 and 68 were more diversified than other age groups of people. Results also show that people in the studied communities now have comparatively more diversified income opportunities than the past. In their studies, Rahman and Gain (2020), and Mallick (2019) mentioned that people are now changing their occupation and reducing their dependency on Sundarbans. The people who were involved in shrimp cultivation on their own land earned higher incomes compared to others. People with fewer opportunities for agriculture or aquaculture were obliged to practice seasonal migration to different cities and worked in different informal sectors. In sum, the findings of this study can be presented in a causal relationship as presented in Fig. 2.

Importantly, people who are involved in shrimp cultivation may get enough time in their day to have opportunities to do other work (which might be the cause of higher diversity). Moreover, some people living in this adverse situation are cultivating different agricultural crops in their high land for themselves as well as for selling purposes. Due to the frequency of natural hazards, some people cannot survive through these means; therefore, they practice seasonal and circular migration (Rahman and Gain 2020; Mallick 2019). However, a large number of people are staying in the vulnerable area and exercising alternative income-generating activities, diversifying livelihood practices in order to stay in place. Similar observations are noted in the previous study of Mallick (2019) that people living in mangrove dependent socio-ecological areas usually practice seasonal and circular migration for additional income sources.

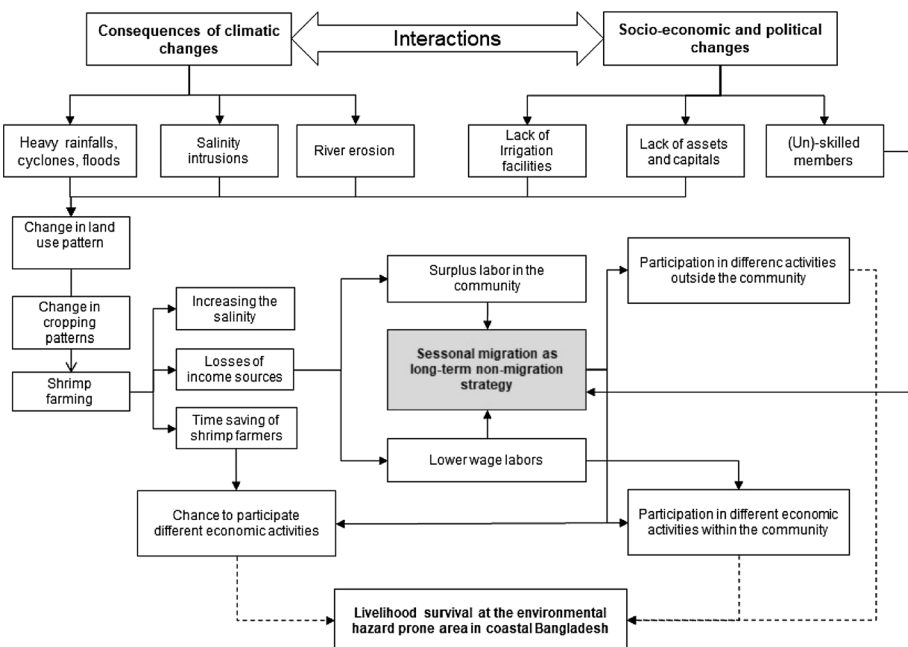


Fig. 2 How livelihood diversification promotes long-term non-migration. Source: Authors’ illustration 2019

5.2 Conclusions

Diversification of livelihood is one of the best ways to combat livelihood risks. At present, a large number of coastal people practice different activities for maintaining their households. Before the Gher system (i.e., shrimp farming), most of the people in south-west coastal Bangladesh were involved only in agricultural activities. However, facing frequent natural hazards, mainly river erosion and high rainfall, people were obliged to change their land use pattern. The cultivation of shrimp leads to a decrease in the production of crops and negatively impacts the environment (Karim 2006). As a consequence, many people lost their earning sources within the community and began to practice seasonal migration. Again, due to lessening income in the agricultural sector, seasonal migration is a common affair in developing countries (Shonchoy 2015), people practice migration as a strategic method to cope with hostile situations created by severe natural hazards (Mallick and Vogt 2012). However, there is still very little knowledge on how and to what extent migration (permanent or temporary), as a livelihood diversification strategy, contributes to the long-term non-migration strategy. Again, a large number of people staying in place are involved in shrimp farming, business, extracting natural resources from Sundarban, catching fishes from river and so forth. Even migrant families practice these activities when they stay at home. Though a number of people practice migration, it is usually not permanent. Now, future research endeavors should focus on the questions such as why people stay when they are at risk.

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