UNRAVELLING THE DYNAMICS: UNDERSTANDING EROSION-LED VULNERABILITIES AT SELECTED LOCATIONS OF SIRAJGANJ BANGLADESH

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Abstract

People differ in their ability to cope with risks and hazards, so identifying and protecting vulnerable groups in the case of riverbank erosion hazards generally reveals the current conditions of rural communities and provides an excellent insight into how vulnerabilities may progress in the future. In order to present a completer and more accurate picture of vulnerabilities and vulnerable groups, this article advocates for the identification of various vulnerability dimensions in studies of vulnerable populations in the erosion-prone Belkuchi upazila of Sirajganj through a mixed method approach and using the Kobo toolbox. It then calls for systematic solutions to each vulnerability as a guiding principle in vulnerability reduction and risk management. This can assist national and local governments in tailoring guidelines, recruiting experts to address specific requirements, and communicating with vulnerable groups in a manner that acknowledges the diversity that may exist within those groups. Local people in the two selected unions are traditionally connected to agricultural activities over generations. However, with frequent riverbank erosion, much of the arable land has been swallowed up, and some parts are converted into residences or factories. During rainy seasons, erosion is exacerbated, and a significant proportion of individuals in all communities experience long-term unemployment issues. As a result, many have taken up low-paying jobs like rickshaw pulling, brick field labor, daily labor, etc. When it comes to the economy, the ability of landless people to support themselves remains vulnerable and outmigration is taking a serious shape there. It is crucial for authorities to develop income-generating activities for the erosion-affected people to improve the current situation. Engagement in locally based organizations, whether governmental or non-governmental, can enhance the existing situation. Practitioners and community leaders need to work together to protect the vulnerable homes and livelihoods of the local community from riverbank erosion by improving readiness and resilience.

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Social Science Review [The Dhaka University Studies, Part-D], Vol. 41, No.2, December 2024
DOI: https://doi.org/10.3329/ssr.v41i2.80891

Keywords: Riverbank Erosion, Ecological Vulnerabilities, Risk Reduction

Introduction

For a long time, people have looked to the ideas of 'vulnerability' and 'resilience' to help them make sense of the ways in which environmental processes and occurrences either aid or hinder growth. Multiple geological, social, political, and economic variables interact to cause riverbank erosion and the resulting vulnerabilities among impacted people. Soil erosion near the bank is a recognized and documented problem that may hasten deforestation due to over-cultivation and poor farming methods etc. (Borrelli et al., 2017).

Riverbank erosion poses significant threats to households residing in vulnerable areas, especially in deltaic countries like Bangladesh. The local channels of the fierce Jamuna River have periodically and impulsively migrated people throughout the landscape, eroding banks of susceptible districts like Sirajganj, destroying everything in their courses, and accreting land elsewhere (Mollah et al., 2015), pushing local communities into vulnerable conditions. Frequent riverbank erosion led poverty (Rabbi et al., 2013) and cause families to move, leaving them even more vulnerable (Bhuiyan et al., 2017; Rahman and Gain, 2020). Non-agricultural assets are more susceptible to market changes, business acumen gaps, and financial constraints faced by rural businesses (Sultana & Mahmud, 2018; Haque & Nahar, 2021). In the event that river bank erosion becomes a real scenario and impacts a community, the socio-economic circumstances encounter difficulties. The lack of prompt reaction and recovery assistance in the impacted community worsens community vulnerabilities in general, and the undermines overall economy in particular. In crises, addressing vulnerabilities caused by a lack of social capital requires community-based methods that prioritize community insights, decisions, and mutually beneficial relationships (Sultana & Mahmud, 2018; Hossain et al., 2021). When riverbank erosion occurs, the land is the first to be engulfed by water, leading to erosion or the uprooting of trees. Many occupational groups work as temporary day labourers in this field, cultivating rice, fruits, and vegetables. Consequently, many individuals in the area have lost their jobs, leading to economic vulnerability. The challenge of riverbank erosion poses a threat to their sustainability. The good soil conditions in the study villages contribute to boosting crop production, but the arable land is decreasing due to the increase in small business endeavours. This shift poses a threat to the livelihood of the people living in this region since the space designated for vegetable growing has also been decreased. When previously submerged areas resurface as small islands in

different locations, it can lead to conflicts over land ownership. On the other hand, respondents perceive increased land ownership as a reflection of their improved economic status. Moreover, the need for strategies that tackle both prevention and repair is underscored by the fact that riverbank erosion has been shown to exacerbate recurring poverty in Bangladesh as a result of population relocation and resettlement (Rana, 2017).

In recent years, there has been a shift in the way we understand natural hazards. Instead of focusing solely on the hazards themselves, researchers have started to take into account the vulnerability of communities and the social factors that contribute to these hazards (Rahman et al., 2022). Understanding and assessing vulnerability can be beneficial in terms of predicting and reducing the effects of potential risks (Durand et al. 2018).

For a long time, people have looked to the ideas of "vulnerability" and "resilience" to help them make sense of the ways in which environmental processes and occurrences either aid or hinder economic growth. Various research indicates that vulnerabilities, such as riverbank erosion, play a crucial role in driving seasonal migration in Bangladesh (Mollah, 2015; Barman et al., 2012; Walter, 2015; Tanim & Roy, 2013).

To understand the seriousness of a danger, and the probable future threats, observing the changing conditions of people and their vulnerabilities is essential. According to many sources (Fussel, 2007; Greiving et al., 2006), the number of corrective efforts and coping mechanisms implemented by a community or person may be used to estimate their vulnerability level in the context of a natural catastrophe. There are very few studies addressing changing scenarios of vulnerabilities in areas like riverbank erosion prone. Vulnerability has been conceptualized as dynamic by social sciences, based on the idea that it depends on multiple factors including income, gender, race, level of schooling, etc. (Orru et al., 2022; Fuchs et al., 2020). This study conceptualizes the dynamics of vulnerability in terms of land, livelihood, agricultural and non-agricultural assets, occupational, which are unravelled in this paper.

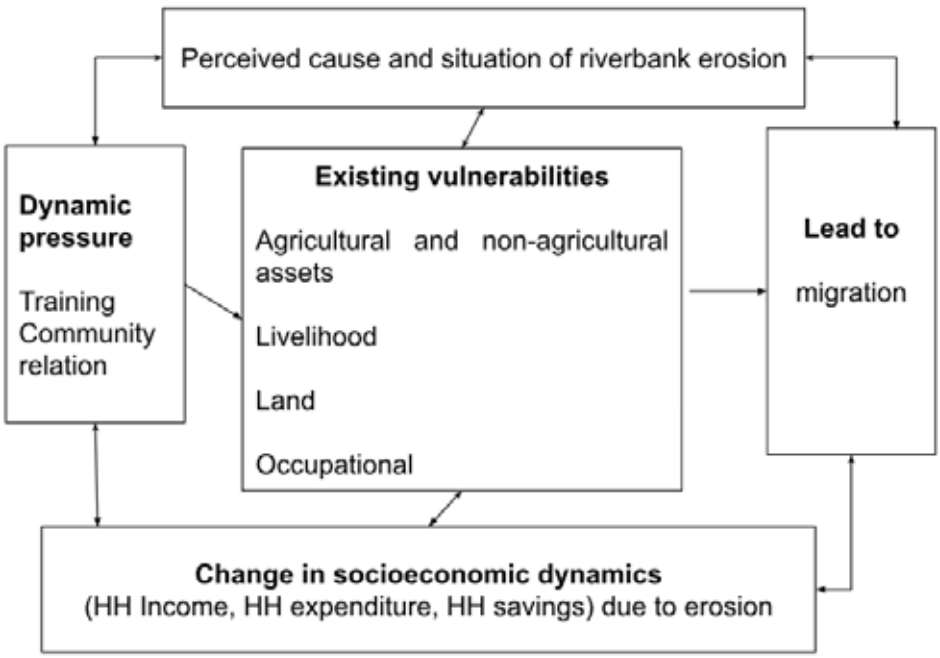

Figure 1: Conceptual Framework of the study

Objectives

When rivers wash away homes and crops, it may have a devastating effect on people's income, social connections, and other socioeconomic factors (Siddik et al., 2017). Communities may be better predicted and categorized according to their susceptibility to natural hazard when physical and geographical data are integrated with socioeconomic factors (King, 2001).

By extracting socioeconomic data and considering natural repercussions, this research will provide a clear understanding of dynamic pressures that progress the vulnerabilities in this area. Community vulnerability can be assessed in terms of land as its degradation serves as an anthropogenic factor, (Imbrenda, 2013) and a lack of stability in property ownership, especially in the wake of natural hazard, might make people even more vulnerability to harm (Reale, 2011). Besides, agricultural and non-agricultural assets are another area of vulnerability to be investigated in this study as evidence from Saini (2015) and Bhuiyan (2017) shows that agricultural assets may be used to determine the vulnerability of river banks to erosion (2017) more specifically.

The broader objective of the study is to understand the evolving conditions in the context of livelihood vulnerability experienced by the local community as a result of severe erosion. The primary goal of this study is to investigate dynamic pressure erosion-led vulnerabilities in the study region.

- To understand the perceptions of local communities about riverbank erosion
- To figure out the dynamic pressures that progress erosion induced vulnerabilities in the affected study community
- To explore the elements that affect people's readiness for reducing the effects of Riverbank erosion.
- To investigate the existing livelihood and occupational vulnerabilities in the study areas

Study Area and Method

The study was conducted in a very susceptible and heavily impacted region by erosion in Bangladesh, namely in the Belkuchi Upazila of the Sirajganj district, located in the Rajshahi Division. The first phase of data collecting included a methodical examination of secondary materials, such as scholarly literature and articles, pertaining to the topic of refugees and children who are refugees. Data was gathered in October 2023, from two unions Rajarpur and Daulatpur located in in Belkuchi Upazila in order to assess the community's susceptibility to disasters and their vulnerability in the aftermath.

To achieve the study goals, a survey was conducted using a well-planned research approach that relied on both qualitative and quantitative data. The quantitative technique used a sample survey instrument and organized a planned interview schedule. A survey was created using Kobo Toolbox, a mobile app-based data collection tool and completed following a trial run. The qualitative data includes face to face interviews with the local community people while verifying the quantitative findings

In order to carry out the survey, ranIfm and purposive sampling methods were used to collect select respondents from the study area having a sample size of 269. For the better precision the total sample size has been considered 303 for this current study.

$$n = \frac{N \times (z^2 \times \sigma \times q)}{\{\varepsilon^2 \times (N-1) + z^2 \times \sigma \times q}$$

z is the z score which is 1.645 at 90% confidence level

ε is the margin of error which is 5%

σ is the standard deviation 0.5

q is 1- σ

N is the population which is 35000 (for two unions)

n is the sample size

Every participant in the study received clear instructions regarding the purpose of the research, the extent of the information required, the time limit for the interview, the confidentiality measures in place, and the procedures for obtaining permission to take photos or recordings before the interview commenced. Furthermore, all participants were given the option to decline participating in the interview as they were fully informed about the subject matter. Prior to conducting any interview, we obtained verbal consent from each respondent who expressed a willingness to participate in the study.

Results and Discussion

Socio-demographic Features

Table 1 presents a comprehensive overview of the socio-demographic characteristics of respondents in the study area, delineating the distribution of them across sex, residency area, age, education, ownership of HH etc. This table furnishes crucial insights into the extent of respondents from each demographic group within the two unions. The sex of the respondents reveals half male and half female, almost 82 percent of the respondents lived in close proximity to river, and almost 83 percent of them are internally displaced and in case of educational qualification majority of the respondents are either without any formal education or primary passed or could not sign.

Table 1: General characteristics of respondents

Characteristics		Frequency	Percentage
Respondent's Sex	Male	154	50.83
	Female	149	49.17
Age	(Mean 59.10)		
Marital status of the respondent	Married	274	90.43
	Unmarried	18	5.94
	WiIfwed	11	3.63
Residency area	Close proximity to Riverbank	246	81.19
	Area protected by embankment	40	13.2
	Far from erosion-prone area (Risk free)	17	5.61
Family internally displaced	Yes	251	82.84
	No	52	17.16
Types of housing facility	Kaccha/non-brick	213	70.3
	Semi Pucca/ Corrugated tin	83	27.39
	Pucca/ Brick-built	7	2.31
Ownership of this house	Own	166	54.79
	Khas land	117	38.61
	On roads/embankments	15	4.95
	Tenant	4	1.32
	Relative house	1	0.33
Family type	Nuclear family	186	61.39
	Joint Family	110	36.3
Respondent's level of Education	Primary/Equivalent	91	30.03
	No formal education	84	27.72
	Can sign only	63	20.79
	High School/Equivalent	45	14.85
	HSC/Equivalent	8	2.64
	Graduation/Equivalent	6	1.98
	Undergraduate/Equivalent	6	1.98

(Source: Field Survey 2023)

Influencing factors of vulnerability

Income, expenditure and saving vulnerabilities

In December 2022, the annual household income per capita in Bangladesh reached 995.873 USD, which is an increase from the previous number of 602.549 USD in December 2016 (Bangladesh Economic Review, 2023). As national income continues to rise, it is evident that the majority of respondents in this studied unions earn between 50 USD to 120 USD per month having a mean of **15014.40** BDT.

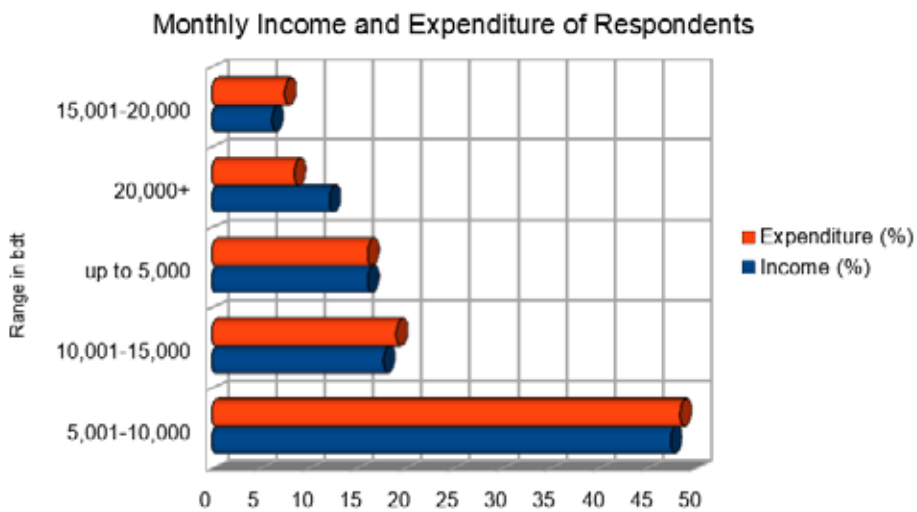

Figure 2: Status of monthly HH income and expenditure of respondents

On the other hand, the mean expenditure BDT 11661.16. It can be observed that people's income level has not increased, suggesting a lack of alignment between income opportunities and the country's economic progress. This discrepancy can be attributed to the severe impacts of hazards.

Table 2: Income and Saving Vulnerabilities

Characteristics	Attributes	Frequency	Percentage
Number of earning member(s) in your household	1	228	75.25
	2	58	19.14
	3	10	3.3
	6+	4	1.32
	5	3	0.99
Monthly HH Savings in BDT **(mean 1205.06)**	Cannot save monthly	256	84.49
	up to 5,000	32	10.56
	5,001-10,000	6	1.98
	20,000+	4	1.32
	10,001-15,000	3	0.99
	15,001-20,000	2	0.66
Respondents-defined socioeconomic status	Poor	185	61.06
	Lower middle class	78	25.74
	Middle class	35	11.55
	Upper Middle class	5	1.65
If lend money to other people?	No	227	74.92
	Yes	76	25.08
If borrow money from relatives?	No	111	36.63
	Yes	192	63.37
If you/HH have an income source during the seasonal famine (Monga)?	No	251	82.84
	Yes	52	17.16

(Source: Field survey 2023)

During conversations with the respondents, it became evident that the savings of individuals are negligence or extremely limited, amounting to less than $10 per month. This situation is becoming increasingly critical for those living in extreme poverty, as the cost of living continues to rise in our country.

In addition, the current level of savings is inadequate for considering investments in income-generating ventures. This heightened vulnerability amplifies the potential impacts of erosion on communities.

Occupational vulnerabilities

The primary occupation is the income-generating opportunity people seek throughout the year on the basis of his/her skills and expertise. The respondents' main sources of income, as found from the field study, are handloom workers (89%), small businesses (41%), and rickshaw pullers (37%). And agriculture related works (45%). According to them, once agriculture and fishing though were

primary occupations, but due to bank erosion and the establishment of handloom industries in the arable lands, they were forced to change occupations.

Table 3: Primary and secondary occupations of respondents

Characteristics	Value	Frequency	Percentage
HH's main occupation/ income source	Handloom worker	89	29.37
	Small Business	41	13.53
	Rickshaw/ Van puller	37	12.21
	Others (specify)	31	10.23
	Self-Agricultural Farming	29	9.57
	Agricultural Day Laborer	26	8.58
	Homemaker	15	4.95
	Boat/ Fish Seller	10	3.3
	Salaried Job/ Non-Govt.	9	2.97
	Salaried Job/ Govt.	4	1.32
	Unemployed/ Searching job	4	1.32
	Retired	3	0.99
	PWD/ Sick/ Unable to work	3	0.99
	Sharecropper	1	0.33
	Livestock/Poultry	1	0.33
HH's Secondary occupation/ income source	Others (specify)	198	65.35
	Unemployed/ Searching job	22	7.26
	Agricultural Day Laborer	14	4.62
	Homemaker	13	4.29
	Self-Agricultural Farming	13	4.29
	Handloom worker	12	3.96
	Small Business	11	3.63
	Rickshaw/ Van puller	8	2.64
	Sharecropper	4	1.32
	Boat/ Fish Seller	4	1.32
	Livestock/Poultry	2	0.66
	PWD/ Sick/ Unable to work	1	0.33
	Salaried Job/ Govt.	1	0.33

(Source: Field survey 2023)

Training and community cohesion

The findings from the current study reveal that even though the community has been affected by many natural calamities, it still lacks awareness and knowledge

of climate change (74.92%). On the other hand, more than half of the respondents (56%) believe that erosion of the Jamuna River basin has been caused by human interventions. Regarding training related to climate change, almost all the respondents (95.05%) responded negatively, and again, 96.7 percent of respondents stated that they had no training regarding combating Jamuna Riverbank erosion (Table 4).

Table 4: Perception, training and community relationship of respondents

Characteristics	Value	Frequency	Percentage
If HH has been affected by flood (in the last five years)	No	207	68.32
	Yes	96	31.68
Whether the HH head aware of climate change	No	227	74.92
	Yes	76	25.08
If HH attends any training related to climate change	No	288	95.05
	Yes	15	4.95
If human activities are a major cause of the river-bank erosion	No	135	44.55
	Yes	168	55.45
If the summer period increased in the last 10 years	No	42	13.86
	Yes	261	86.14
If HH ever had any training to cope with river-bank erosion/flood	No	293	96.7
	Yes	10	3.3
If HH allows female family members to work outside the home	No	239	78.88
	Yes	64	21.12
If any HH is involved in a farmer's organization	No	289	95.38
	Yes	14	4.62
If any HH is involved in any NGO	No	224	73.93
	Yes	79	26.07
If the women/girls of your HH can make decisions independently	No	255	84.16
	Yes	48	15.84

(Source: Field survey 2023)

Agricultural and non-agricultural assets related vulnerabilities

In order to design and outline practices that will make erosion-affected regions resilient in the future, it is crucial to understand the vulnerabilities that these areas experience in relation to agricultural and non-agricultural assets. These vulnerabilities are caused by factors such as climate change impacts, purchasing power, economic fluctuations, and so on.

Individuals were compelled to engage in manual labor in the agricultural fields beyond their designated areas, including sub-district or district centers, even inside the capital city. The alteration in land use has resulted in a decline in job prospects within the agricultural and fishing industries, leading to a significant issue of unemployment in this region. The community in the study area mostly owns poultry (36.3%) and goat/sheep (23.43%). And cows (19.14%). Among the non-agricultural assets, water pump/ power-driven irrigation machines (9.9%), and rice husking machines (1.98%) are noteworthy (Table 5).

Table 5: Agricultural and non-agricultural assets of respondents

Agricultural assets	Value	Frequency	Percentage
Cows	No	245	80.86
	Yes	58	19.14
Ox/ Bulls? Buffalos (Shar/ Mohish)	No	295	97.36
	Yes	8	2.64
Calves	No	293	96.7
	Yes	10	3.3
Poultry (>5)	No	193	63.7
	Yes	110	36.3
Goats/sheep	No	232	76.57
	Yes	71	23.43
Horse	No	299	98.68
	Yes	4	1.32
Non-Agricultural Asset			
Rice-husking machine	No	297	98.02
	Yes	6	1.98
Power-tiller	No	301	99.34
	Yes	2	0.66
Water pump/ power-driven irrigation machine	No	273	90.1
	Yes	30	9.9
Boat/ Trawler (engine boat)	No	299	98.68
	Yes	4	1.32

(Source: Field Survey 2023)

Livelihood Vulnerability

The identification of susceptible persons and the contextual background of natural hazards may be accomplished by using socioeconomic procedures and considering the natural consequences of these events.

While fishing in fresh water and rivers, engaging in agricultural activities, and pursuing informal jobs are the most prevalent means of income generation in the study area. Based on the feedback from the respondents, the erosion over the past five years has had a negative impact on their overall employment situation. Many individuals who have been affected have resorted to selling their own resources, being compelled to switch occupations from their previous primary ones, taking on odd jobs, or remaining unemployed. In some extreme cases, they have even migrated to cities in search of alternative sources of income. In the current study, neither 18.15 percent of respondents did not own any means of production to run their livelihood nor they have access to fishing during erosion/flood (75.58%). Moreover, almost four fifth of the respondents revealed that they cannot get the access to natural resources like water, timbers, oil etc. in time of flood or riverbank erosion. It is a matter of great concern that 72.28 percent respondents cannot support his/her family in case of sudden riverbank erosion (and income opportunity fails).

Table 6: Livelihood related vulnerabilities

Characteristics	Value	Frequency	Percentage
If were involved in any kind of means of production	No	248	81.85
	Yes	55	18.15
If can support family in case of sudden riverbank erosion (and income opportunity fails)	No	219	72.28
	Yes	84	27.72
If farming depends solely on monsoon rainfall	No	291	96.04
	Yes	12	3.96
If cultivate more than one crop in a season	No	275	90.76
	Yes	28	9.24
If have access to natural resources during riverbank erosion/flood	No	237	78.22
	Yes	66	21.78
If have access to fishing during riverbank erosion /flood	No	229	75.58
	Yes	74	24.42

Source: Field survey 2023

Land vulnerabilities

For rural economies, land ownership is essential, particularly for farming. Due to their social influence, large farmers are able to force smaller farmers to sell their property at a discount. The loss of their revenue source is the first danger they face; the second is the need that they relocate to a neighbouring or capital city, both of which further increase their vulnerability. Because a government-stakeholder

integrated plan is necessary to recover from this condition, which is now non-existent, the change's severity is likely to grow in the near future (Rahman et al., 2022). In the current study, only 12.12 percent respondents hold land from 0.2 ha to 0.42 ha (50-100 decimal) and only 16.5 percent of them has own cultivable lands. The current findings also reveal that cultivable land get degraded by erosion/ flood.

Table 7: Land ownership and status of respondents

Characteristics	Value	Frequency	Percentage
If you/HH own any cultivable land	No	253	83.5
	Yes	50	16.5
If you/HH own cultivable land up to 0.2 ha (50 decimal)	No	266	87.79
	Yes	37	12.21
If you/HH own cultivable land from 0.2 ha to 0.42 ha (50-100 decimal)	No	287	94.72
	Yes	16	5.28
If you/HH face cultivable land degradation due to riverbank erosion/flood	No	258	85.15
	Yes	45	14.85

Source: Field Survey 2023

Seasonal Migration in the study area

Community development is greatly affected by seasonal movement induced by river bank erosion. This phenomenon disturbs economic stability, social cohesiveness, and access to key services, among other things. Poverty levels rise as a result of households losing their houses and means of subsistence. In this current study, it is alarming that almost 75 percent of respondents believe the uncertainties due to erosion in the occupation sector have led to seasonal outmigration.

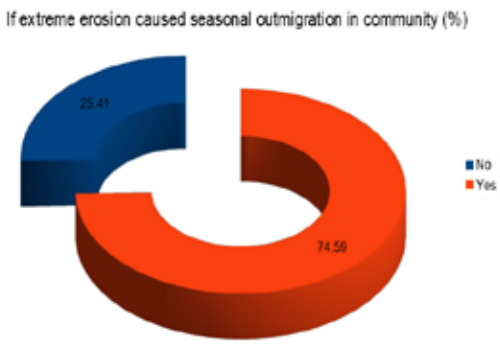

Figure 3: Erosion-led outmigration status of the community by respondents

Thus, the primary occupations in the locality have become diversified owing to the seasonal migration to neighboring countries.

Way forward

This heightened vulnerability underscores the imperative for focused interventions and policy measures tailored to address the specific needs of this region in order to bolster its adaptive capacity and resilience.

The overarching conclusion of this study points to differences in family characteristics, limited access to essential infrastructure, a restricted degree of livelihood diversification, and a dearth of accessible technologies as the key determinants responsible for variances in household vulnerability concerning climate variability and change. This elucidation contributes to our understanding of the intricate dynamics that govern vulnerability in the context of climate-related challenges, thereby providing valuable insights for policy formulation and intervention strategies in these vulnerable coastal regions of Bangladesh. In Bangladesh, Bhuiyan observed that riverbank erosion changed cropping patterns and turned agricultural area into barren land. Riverbank erosion affects agricultural assets and lives, as these studies show (Bhuiyan 2017).

Conclusion

Riverbank erosion induced vulnerabilities that have formed among local populations are more than simply a natural influencing element; rather, they are the result of a mix of a variety of geophysical, social, political, and economic variables as well. Hazards like this, receive little attention and impact vulnerable populations with distinct challenges for recovery, which are often overlooked in the existing literature on disasters. Community people exposed to and affected by bank erosion in the study upazila migrate to the locations where they are seeking sanctuary already have inadequate infrastructure and resources, and this makes matters worse. Not to mention that migrants may settle in areas with a history of natural disasters, making themselves even more vulnerable to such disasters in the future. It is critical to execute all-encompassing plans that include both short-term requirements and long-term growth objectives in order to effectively handle these repercussions. Systematic integration of resilient thinking and actions for the possible increased vulnerabilities of riverbank erosion is essential in making neighbourhoods more resilient. The study findings explicitly define the necessity of household, local government, and stakeholder engagement in long-term resilience plans for Riverbank erosion besides infrastructural mitigation at

riverbank areas in Bangladesh. There are need for more extensive research on the migration effects and identifying vulnerable areas and existing dynamic pressure in this erosion prone community. This research gives insights into improved and locally adapted readiness measures needed for combating Riverbank erosion and lays the groundwork for policymakers.

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