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Impact of Riverbank Erosion on Sustainable Livelihoods: A Case Study of Sirajganj Sadar Upazilla

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Abstract

Sustainability is a term that carries high importance in people's lives for carrying better living conditions. Sustainable livelihood is that type of livelihood which can manage present stress with its existing competency without threatening natural resources for the future. But there are a lot of hindrances that are preventing achieving sustainability in our livelihood. For the geographic location of Bangladesh, this country is facing many problems which are in the way of preventing achieving sustainable livelihood. Riverbank erosion is one of them. Riverbank erosion is greatly affecting many areas in Bangladesh. Among the affected areas by this natural disaster, Sirajganj Sadar Upazilla is one of the invaded areas by the Jamuna River. The study was intended to determine the impact of the erosion on the people's livelihood in the area to sustain their livelihood. To find out the impact both primary and secondary surveys were done. The questionnaire survey was conducted among 378 affected households for analysis. KII was also involved in the data collection method. From the analysis, it is seen that riverbank erosion is badly affecting the socio-economic status of the resident in the area. According to the study, to ensure the sustainability of the livelihood it is requisite to take proper steps. The outcome of the study can help the government and policy-makers to decide how to bring sustainability to the region with similar problems in Bangladesh.

Keywords: Sustainability, Livelihood, Impact, Riverbank erosion

Introduction

Bangladesh is prone to natural disasters. In our country, riverbank erosion is a well-known calamity. Every year, erosion kills standing crops, farmland, and homestead land, affecting millions of people. It is estimated that about 5% of the total floodplain of Bangladesh is directly affected by erosion. Some researchers have reported that bank erosion is taking place in about 94 out of 489 Upazillas in the country. Bangladesh is projected to lose around 2,270 hectares of land this year due to riverbank erosion. It is estimated that 300,000 displaced persons usually take shelter on roads, embankments, and government-requisitioned lands due to riverbank erosion (Riverbank erosion, 2015). The Jamuna River is flowing along the Sirajganj District. Riverbank erosion is a common hazard in this district. In Sirajganj Sadar Upazilla, river bank erosion is caused by the

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Jamuna River. This river is dynamic and continuously changing its way. Erosion and accrual are a natural part of the process. The Jamuna River Flood Plain encompasses the majority of Bangladesh's northern region. Local channels of the powerful Jamuna River have roamed over the area, eroding banks, destroying everything in their path, and accumulating land elsewhere. River bank erosion is frequent in this area, as well as the rest of the country's floodplains. It has the impact of speeding up erosion rates as a result of climate change. Riverbank erosion occurs at various intensities throughout the year, although it is most common between June to September when the monsoon season is in full swing (Das, 2014). The process of riverbank erosion is unpredictable and the losses that result from it proceed slowly and steadily. Riverbank erosion has far-reaching socio-economic consequences. It is regarded as one of Bangladesh's key sources of national poverty. In recent years, the extent of economic loss and population vulnerability as a result of bank erosion have been drastically exaggerated (Samsuzzaman, 2003).

Every year many parts of the riverbank of the district are eroded by the river. In the last 10 years, the Jamuna River eroded nearly 30 villages, one-third of the city, and 400,000 people became homeless (Das, 2014). In the last 3 years, huge chars or islands have been formed in the middle of the river causing more suffering to the people after the construction of the Jamuna Bridge (Shetu, 2020). During the monsoon season, the River Jamuna flows in great quantities and it averages about 40,000 cusecs. At this time the Jamuna became devastated and the Sirajganj District which is situated right on the bank of this river was severely damaged. Riverbank erosion has a significant impact on Sirajganj Sadar Upazilla. The calamity causes a big number of individuals to lose their living materials and agricultural grounds each year. Due to riverbank erosion, a great number became homeless in the Upazilla (Das, 2014). In Bangladesh, victims have been suffering due to a complete absence of institutional reaction in articulating and implementing change. Riverbank erosion is a recurring natural hazard that results in massive land loss, population displacement, and landlessness. In this context, the study intends to look into the issue of riverbank erosion and sustainable livelihood pattern.

Research Aim and Research Question

The study aimed to identify the impacts of riverbank erosion on sustainable livelihood. The research question of the study was how riverbank erosion is affecting the sustainable livelihood of the people living in Sirajganj Sadar Upazilla.

Study Area Profile

Sirajganj Sadar Upazila (Sirajganj District) has an area of 325.77 sq. km., and is located between 24°22' and 24°37' north latitudes and between 89°36' and 89°47' east longitudes. It is bounded by Kazipur Upazila on the north, Kamarkhanda and Belkuchi Upazilas on the south, Sarishabari and Kalkhata Upazilas on the east, Kamarkhanda, Raiganj and Dhunat Upazilas on the west. This area is highly affected by riverbank erosion as the Jamuna River is situated beside the Upazilla. Sirajganj Sadar Upazilla occupies the Jamuna-Karotoya Floodplain at the confluence of the Gangas and Jamuna Rivers and is characterized by a gently sloping flat topography with abundant low-lying depression

(Samsuzzaman, 2003). At present, the average literacy rate in the area is 47.44%. Among them 50.96% are male and 43.6% are female. Due to riverbank erosion, now 52.39% of the people become landless.

Source: Sirajganj Pourashava, 2021

Fig. 1: Map of Sirajganj Sadar Upazilla

Methodology

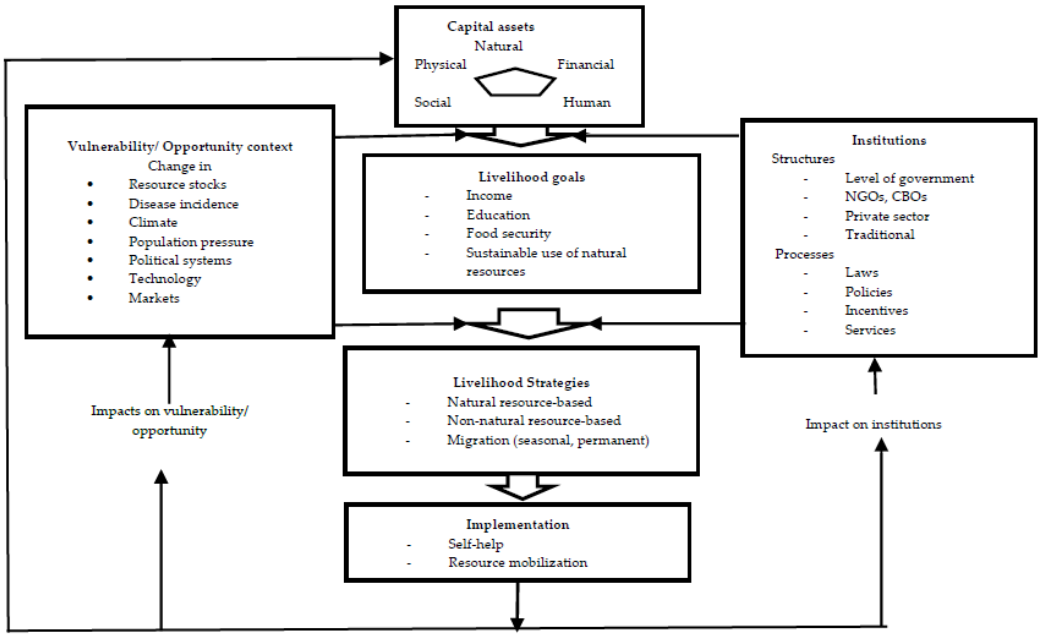
For this research, a multi-research approach method was selected as both qualitative and quantitative data were required for this study. The first stage of the study was sorting out relevant variables through a literature review. Then necessary data was collected by observation, questionnaire survey, and key informant interview. For this research, the sample unit is a household. As the population of the study is less than 50,000, the sample was taken for the research by using Cochran's sample size determination formula. The equation is- $n_0 = z^2 \times p \times (1- p)/ e^2$. And the determined sample size is 378. The field survey was conducted in March, 2021. The selected key informants for the study were the

municipal town planner of Sirajganj, the district relief and rehabilitation officer of Sirajganj, the assistant engineer, the sub-assistant engineer of the Bangladesh Water Development Board in Sirajganj, and the agricultural officer of Sirajganj Upazilla. The data had been carefully edited once it had been collected from various sources. Following the editing of the acquired data, the information was categorized according to its features. After that, the data were tabulated and analyzed with the help of SPSS. Later, this information was displayed in the form of tables and graphs to highlight the trajectory of riverbank erosion and its influence on long-term livelihood. Data was analyzed in certain situations using single and multiple tables to highlight the relationship between the various variables.

Literature Review

According to Carney (2003), "a livelihood" comprises the capabilities, assets (both material and social resources), and activities necessary for a means of subsistence. "A livelihood is sustainable if it can cope with and recover from crises and stocks, as well as preserve or improve its capabilities and assets in the present and future, without jeopardizing the natural resource base".

Sustainable Livelihood Framework



Source: Corney, 2003

Fig. 2: Sustainable livelihood framework

Khan, (2018) published a thesis on rural people's lives and livelihoods. They looked at the demographic profile of the respondents, such as income, age, and education to see how riverbank erosion affects people's livelihoods. Barua (2019) also studied the impact of riverbank erosion on the lives and livelihoods of displaced people in South-Eastern

Bangladesh. According to the report of Khan (2018), there was a negative correlation between riverbank erosion and the change in the amount of monthly income of the respondents, as well as a positive link between years of living and the number of livelihoods lost. They did not, however, attempt to investigate the repercussions of riverbank erosion from other social or environmental viewpoints, nor did they provide a viable solution to these issues. According to the research of Barua (2019), riverbank erosion is causing relocation, hidden hunger, poverty, and the loss of land and identity for coastal people. The findings of this study are crucial for policymakers to create and execute effective policies and programs to reduce vulnerability and encourage local adaptation processes to enhance the livelihoods of the affected families throughout Bangladesh. According to the conclusions of the study, people who have been affected have experienced severe socio-economic hardship. For studying the socio-economic effect of the area, this study looked at property loss amount, income, diminished quality of life, and Bangladesh Water Development Board (BWDB) metrics. There are no recommendations included about how to improve the situation. Those studies try to figure out the impact of riverbank erosion on human life and livelihoods. The relationship between sustainable livelihood and natural disasters can be more understood from the report of Hoon (n.d.). He mentions an analytical framework for sustainable livelihood where it is shown the relationship between nature and human life. He mentions approaches to determine sustainable livelihood. According to him, human ecology, coping strategy, potentiality, and capacity are major issues for decision-making on sustainable livelihood.

After reviewing relevant literature, some indicator was chosen for the research. The indicators were divided into dependent and independent variables. Social resilience, biodiversity, financial, social, and human conditions were taken as dependent indicators to analyze the impact of sustainable livelihood. Besides dependent variables, some independent variables were also considered for impact analysis. They are social bonds, right to political participation, percentage of loss of properties (land, trees, animals) due to riverbank erosion, savings, land value, employment opportunities, health and education condition, pure drinking water source, sanitation, roads, and infrastructure condition.

Findings

Riverbank erosion causing property loss in Sirajganj Sadar Upazilla is a common scenario. The percentage of people who did not lose their property directly caused by riverbank erosion is very low. From the survey (2021), only 3% of people denied losing their property directly to this disaster among 378 respondents. But they mentioned they are being affected by this natural disaster.

Table 1: Percentage of people who lost properties affected by riverbank erosion

Name of Properties	Percentage
Transport and communication system	100%
Water Bodies	54.76%
Homestead	97%
Machinery and other equipment	51.85%
Hatchery	30.95%
Livestock	24.60%
Poultry Farm	15.07%
Crops	88.62%
Agricultural Land	89.15%
Trees	100%
Home appliances	97%

Source: Field Survey, 2021

People are losing the property which is necessary for living a sustained life. The percentage from the table showed that most of the people lost their homesteads and productive properties due to riverbank erosion.

Homestead Shifting: The people living in Sirajganj Sadar Upazilla are changing their homestead multiple times. Displacement is a common scenario in this area. In this study, among 378 respondents, 97% lost their homesteads due to riverbank erosion (Field Survey, 2021). Among the respondents, the majority of the people lost their homestead one to three times (32.8%), and six times (32.5%) (Table 2).

Table 2: Frequency of Homestead Loss

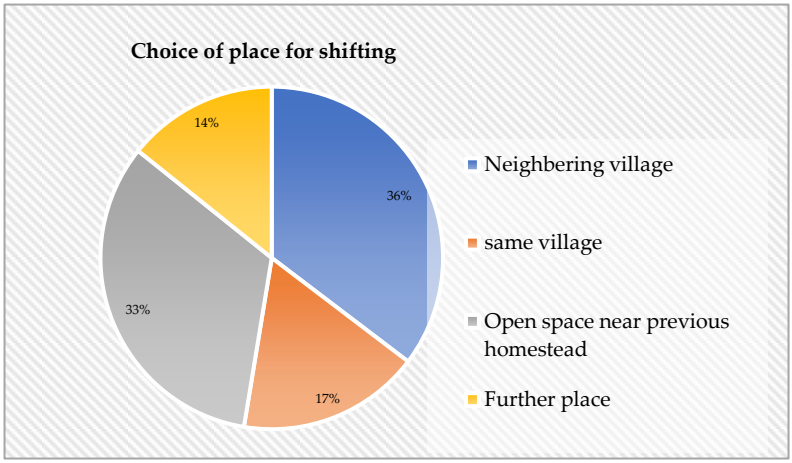
Homestead Loss		
Times of household lost	**Frequency**	**Percent**
1-3	124	32.8
4	54	14.3
5	67	17.7
6	123	32.5
7	10	2.7
Total	378	100.0

Source: Field Survey, 2021

Because of the frequent shifting, people are facing multiple problems. Some people take the loan for building new settlements. For this reason, a large number of their income goes to paying the loan. Besides, their living condition in the new settlement is far worse than before. Most of the people live in houses which are made of tin and thatch.

For shifting their household, the majority number of people choose open space near the previous homestead. Most people want to live near the place where their previous homestead was situated. So, when the bank erosion is minimized, they build their house in the open space beside the river again near their old house. There are some reasons for choosing nearby places for living by the respondents. Such as- for having poor economic conditions and in search of work, people choose nearby places to live on. It is known that

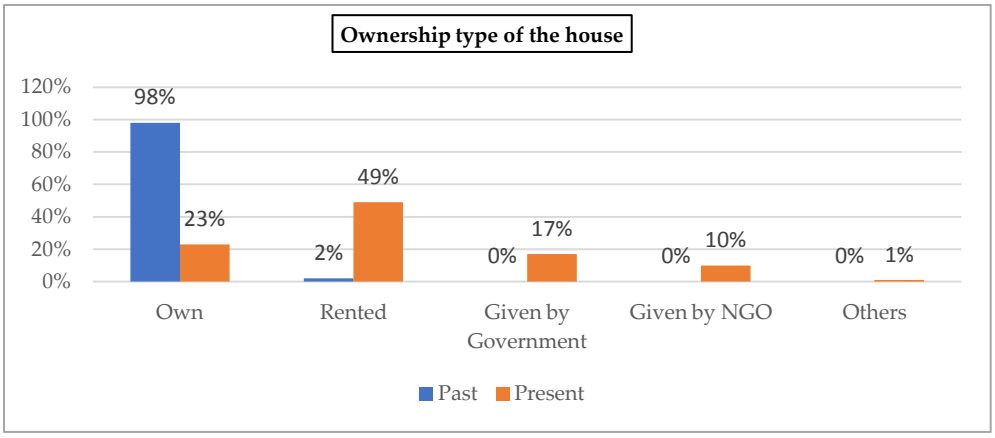
social bonding is an important issue in rural areas. Kinship and social networks are other main reasons behind this kind of new placement of houses. People do not want to destroy their social bonding. Settlement in a new place is one type of mental challenge and may cause many problems. Low-cost housing is another reason behind this. As many people chose it because they have no other places to go. This is a sign of extreme poverty in the area. Figure 3 shows the scenario of the place shift of the respondents.



Source: Prepared by Authors, 2021

Fig. 3: Choice of place for new settlement by the respondents

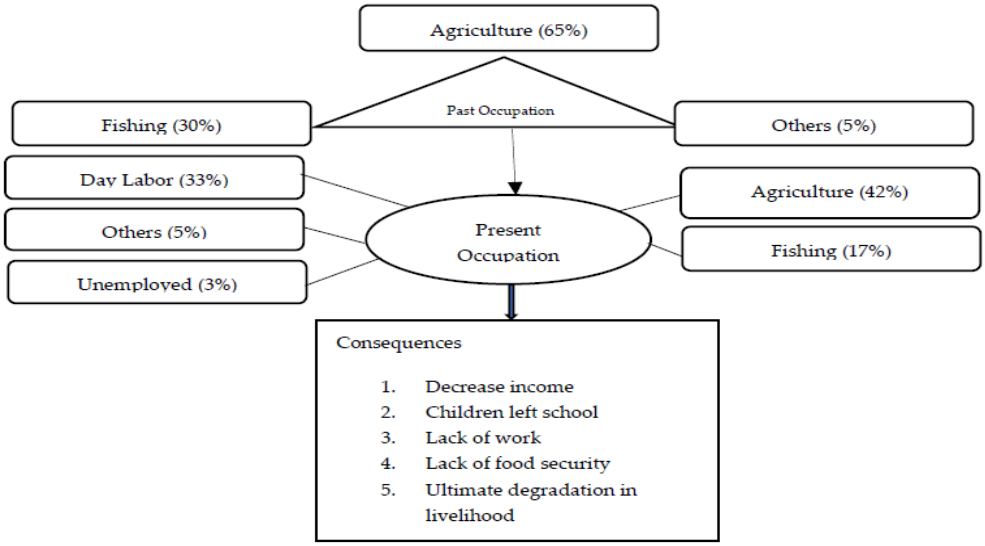
Present Ownership of the Living House: Living in a temporary shelter after displacement is very common in this area. Due to being affected by riverbank erosion, at present (Field survey, 2021), only 23% of the respondents have their own houses (Figure 4). As a result, homelessness is increasing day by day due to bank erosion.



Source: Prepared by Authors, 2021

Fig. 4: Ownership type of the respondents living in the study area

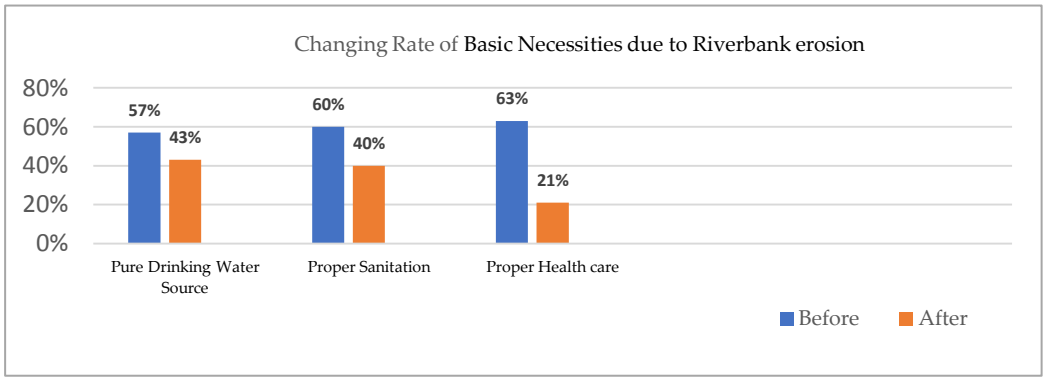
Income Situations: From Figure 5, it is noticeable that riverbank erosion is greatly affecting the income source of the people living in the area. As losing their valuable cultivable land and property many people at present remain unemployed. According to this research, 33% of the respondents are now engaged in very shocking day labor activities which state their unprivileged condition (Field survey, 2021).



Source: Prepared by Authors, 2021

Fig. 5: Past and present income situations of the respondents

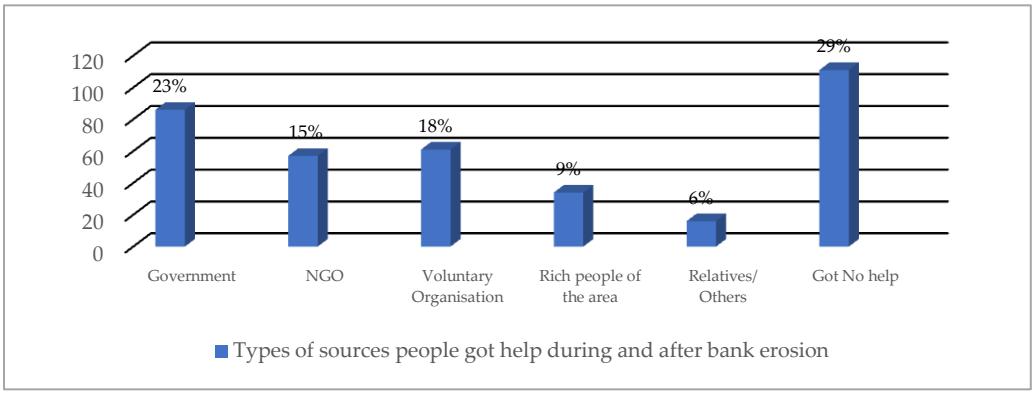
Education and Basic Necessities: It is shown that a major number of the respondents (66%) claim that they had to stop their children's education after being affected by riverbank erosion. Because their financial condition was not good as before of losing properties and income sources. And among the children who are being deprived of education, most of them are girls. Figure 6 states the condition of necessities before and after the riverbank erosion within the study area (Field survey, 2021).



Source: Prepared by Authors, 2021

Fig. 6: Changing rate of necessities due to riverbank erosion

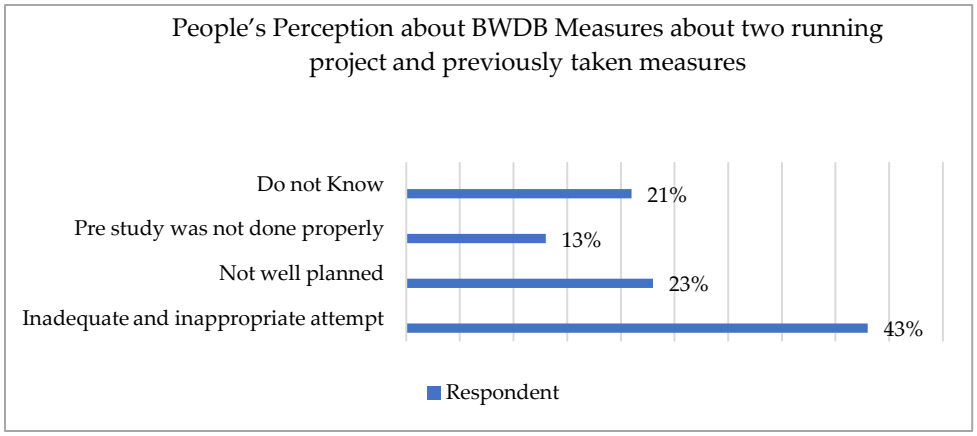
Most people are now lacking pure drinking water and sanitation system after losing their income opportunities. They drink water from the river and use unhygienic sanitary latrines. Another basic need is health care; people are also deprived of that. Women and children are more vulnerable in this area. Most of the children are facing malnutrition and woman had to face many difficulties as they are not empowered and most of them are dependent on the male members of the households. The two main reasons for this situation which is caused by riverbank erosion are lack of employment opportunities and lack of knowledge. The number and percentage whose social status degraded after being affected by riverbank erosion are great. Most people think they did not have equal rights to participate in political issues because of the new settlement and loss of income source. These coping strategies are still not enough to survive this disaster. The government and NGOs are always working for improving the living standards of the people of the study area. But due to a lack of proper coordination, the people are not receiving this help and so their situation is remaining unchangeable. From the survey (2021), 111 people mentioned that they did not get any types of help from the government, NGOs, or any other organizations (Figure 7).



Source: Prepared by Authors, 2021

Fig. 7: Number of assisted afflicted people in the study area

There are some reasons mentioned by the respondents for not getting the help services. People mentioned lack of information is the main reason for this problem. They were not informed properly about where and when the relief will be distributed. Misuse of political power is another reason behind this. The insufficient number of services and insufficient data about measuring damage due to erosion are responsible for this misery. Corruption in service delivery is a liable reason for people not getting proper help. From the survey (2021), it is clear that most of the respondents are not satisfied with the steps taken by BWDB. They think that these measures are not enough for all the people and are not fruitful to recover the stress on the area (Figure 8).



Source: Prepared by Authors, 2021

Fig. **8:** Respondent's opinion about BWDB taken measures

Impact Analysis

Multiple regression was used to assess the ability of variables to predict levels of impact. Preliminary analysis has been conducted for ensuring that there is no violation of the assumptions of normality, linearity, multi-collinearity, and homoscedasticity. Firstly, it has been found from the boxplot that each variable in the regression is normally distributed and they are free from univariate outliers. Secondly, the assumptions of normality, linearity, multi-collinearity, and homoscedasticity of residuals as well as the scatterplot of the standardized residuals against standardized perceived values have been found within acceptable ranges. Thirdly, "Mahala Nobis distance" did exceed the critical x^2 for df=3 at (a=0.001) of 13.82 for only two cases in the data file, df=16.27 for three cases, and df=18.47 for four cases indicating that the multivariate outliers are not of concern. Fourthly, relatively high tolerances for all the predictors in the regression model indicated that multi-collinearity is not going to interfere with the ability to interpret the outcome of the regression model. Table 3 shows the impacts of this natural calamity on the resources (on lands, trees, and animals).

Table 3: Regression analysis for impact on natural resources

Variables		**Dependent Variable (Impact on Natural Resources)**	
		Beta	**P(Sig.)**
Independent Variables	Loss of Lands	-.788	.586
	Loss of Trees	-.064	<.001
	Loss of Animals	-.001	.043

Source: Prepared by Authors, 2021

The hypothesis test shows that the loss of lands, trees, and animals due to riverbank erosion affects the natural condition of the area. In combination, the loss of trees, lands, and the animal accounted for 63.8% variability in impact on natural resources, where R^2= 0.638, adjusted R^2=0.635, F=219.453, p<.001, with the loss of trees scoring a less beta value

(beta=-0.064, p<.001) than the loss of animals (beta=-.001). The coefficient table depicts that the loss of trees has a significant impact on nature.

Table 4: Regression analysis of the financial condition

Variables		Dependent Variable (Financial Condition)	
		Beta	**P(Sig.)**
Independent Variables	Savings	.204	<.001
	Land Value	.073	.138
	Employment Opportunities	.587	<.001

Source: Prepared by Authors, 2021

Table 4 shows the impacts of this natural calamity on the financial condition of the people of the study area. In this model, the R^2 value is 0.526 which means that 52.6% of the change in the financial condition can be accounted for savings, land value, and employment opportunities. Here adjusted R^2=.522, F=138.280, p<.001, with employment opportunities scoring a higher beta value (beta=0.587, p<.001) than savings (beta=0.204). Though the overall model is significant, according to the coefficient table, savings and employment opportunities are more significantly affected by the financial condition of the people in the area.

Table 5: Regression analysis for physical impact

Variables		Dependent Variable (Physical Impact)	
		Beta	**P (Sig.)**
Independent Variables	Roads and Public Infrastructure Loss	-929	<0.001
	Pure water drinking source and sanitation	0.037	0.8

Source: Prepared by Author, 2021

The result of regression analysis for the physical impact of the riverbank erosion has been shown in Table 5. In this hypothesis test, losing of roads, infrastructure, pure drinking water sources, and sanitation carries a significant impact on the physical state of the area. Off the two, roads and public infrastructure are impacting more in the study area. In combination, all the independent variables accounted for 79.6% variability in impact on physical impact, R^2=0.796, adjusted R^2=0.795, F=732.161, p<.001.

Table 6: Regression analysis for social resiliency

Variables		Dependent Variable (Social Resiliency)	
		Beta	**P (Sig.)**
Independent Variables	Social Bond	-.425	<0.001
	Right of Participation in Political Issues	.386	<0.001
	Dependency on Government	-.068	0.024
	Capacity on Mitigation Issues	.247	<0.001

Source: Prepared by Authors, 2021

The analysis of the Table 6 depicts that, in combination, social bond, right of participation in political issues, capacity for mitigation issues, and dependency on government for aid are significant issues which are accounted for 67.9% variability in impact on social resiliency, where R^2=0.679, adjusted R^2=.675, F=196.780, p<.001. Among these four independent variables, social resiliency is more affecting by the people's bonding with each other in the community. People's migration pattern in the area and their dependency rate on the government for improving their present state after being affected by riverbank erosion are also significantly impacting social resiliency in the area.

Table 7: Regression analysis for impact on human

Variables		**Dependent Variable (Human Impact)**	
		Beta	**P (Sig.)**
Independent Variables	Education	-.263	<0.001
	Health	.284	<0.001

Source: Prepared by Authors, 2021

in Table 7, R^2= 0.567 means that the model can predict 56.7% of the variable in the dependent variable where adjusted R^2=.565, F=245.520, p<.001, with health scoring a higher beta value (beta=0.284, p<.001) than education (beta=-0.263). That means, 56.7% of the change in the standard of human life can be accounted for the education and health condition of people who are affected by riverbank erosion.

From the analysis, a significant impact is found among selected dependent and independent variables. From the regression analysis, it is shown that education and health conditions are degrading human life in the area. Caused by riverbank erosion, people are now being deprived of basic health facilities and the opportunity to gain knowledge within the study area. This hinders the way of achieving sustainable livelihood. Natural resources are also being destroyed by this natural calamity. Loss of agricultural land creates a scarcity of food security in the area. Due to riverbank erosion, natural resources are damaged, which is an obstacle to achieving sustainability in the study area. Lack of employment opportunities is another bad impact that is being generated due to riverbank erosion. For this reason, people living in the area spend their savings to meet the necessities of their daily life. Riverbank erosion is creating homelessness in the study area. People who were displaced by riverbank erosion used to flee as soon as possible for safety and then permanently for survival. People migrate because they believe that conditions will deteriorate in the future, posing a threat to their lives and livelihoods. The negative impact of rising riverbank erosion forces people to migrate from one location to another. Due to people's repetitive homestead changes and changes in income opportunities, their economic stability is degrading. People who are migrating due to riverbank erosion have poor social bonds and thus have decreased social status in the community. This is not giving them access to participate in political rights equally. Combining these two issues, the community is lacking the capacity to mitigate bank erosion. This increases dependency on the government to recover from their present condition. As a result, the study area is extremely weak as a disaster-resilient area.

Recommendations

Recommendations According to Responses of the Respondent

People living on the riverbank are suffering greatly. They are learning some coping strategies for handling this situation. These community-based coping strategies are mentioned below according to respondents' responses. They are- searching for social support, reducing the number of meal intake, looking for help from NGOs, preparing for the worst-case scenario**,** purchasing lands in a moderately safer place**,** looking for new sources of income**, t**aking out a loan against valuables or ornaments, **s**pending from savings, **taking** temporary shelter in another place, using bamboo revetment for erosion protection, producing high-yielding year-round base crops and vegetables, etc.

Recommendations According to the Key Informants' Opinion and People's Demand

- According to a study by the BWDB, two running projects of embankments in Sirajganj Sadar Upazilla will help to minimize the bank erosion problem. Based on the opinions of other key respondents, another project of the embankment is needed to completely stop the erosion in the area.
- Maintenance of the embankment is another necessary demand from the respondents. People complain about existing embankments that are damaged but not in consideration for repair. It endangers people who live on the side of the existing embankment.
- Besides physical solutions, a strategy to improve the social condition is badly needed. Most of the children are deprived of educational facilities due to the lack of schools and colleges in the nearby area. In particular, most of the girls did not go to school because their families do not allow them to participate in education with boys.
- The majority of the people's livelihoods are based on agriculture. Giving people training and loans with easy conditions can help to improve their financial condition. It is also necessary to monitor whether the services are being provided properly to the needy people or not.
- Using manpower as a resource is needed to ensure sustainability. Most of the female members of the households are unemployed. Creating small-scale businesses or handicraft businesses within the community can solve this problem. For this, the government and non-governmental organizations should organize training sessions to teach them about market-based knowledge.

Conclusion

In Bangladesh, riverbank erosion is a common natural disaster. And, as a result of the braided channels, the dynamic nature of the rivers, and the absence of structural solutions, this calamity is causing socio-economic deprivation among the disadvantaged and impoverished local people. Displacement is a big issue that has arisen as a result of his incident. Many of the study area's agriculture-dependent families have lost their houses. Many of the agriculture-dependent people of the study area have lost their homesteads and cultivable fields owing to erosion, making them socio-economically vulnerable and contributing to increasing poverty in the area. To deal with bank erosion, the government should develop long-term policies and plans that take into account social and institutional adjustment measures.

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