

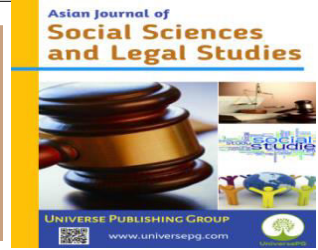


Publisher homepage: www.universepg.com, ISSN: 2707-4668 (Online) & 2707-465X (Print)

<https://doi.org/10.34104/ajssls.024.015400161>

Asian Journal of Social Sciences and Legal Studies

Journal homepage: www.universepg.com/journal/ajssls



Navigating the Ravages of Riverbank Erosion: Socio-economic and Environmental Impacts in the Nalua Union of Bakerganj Upazila

Marzia Sultana Shefa^{1*}, Md. Fuad Hasan^{2,6}, Mehedi Hasan Ovi³, SK. Mahedi Hasan Akash¹, Ahmed Parvez⁴, Fatima Rukshana⁵, Ayesha Akter⁶, and G.A.M. Ali Reza⁷

¹Faculty of Environmental Science and Disaster Management, Patuakhali Science and Technology University, Bangladesh; ²Dept. of Environment Protection, Faculty of Bio and Health Sciences, German University Bangladesh, Bangladesh; ³Dept. of Geology and Mining, University of Barishal, Bangladesh; ⁴Dept. of Environmental Science, Faculty of Environmental Science and Disaster Management, Patuakhali Science and Technology University, Bangladesh; ⁵River Research Institute, Faridpur, Bangladesh; ⁶Dept. of Emergency Management, Faculty of Environmental Science and Disaster Management, Patuakhali Science and Technology University, Bangladesh; ⁷Ministry of Shipping, Bangladesh.

*Correspondence: marziashefa25@gmail.com (Marzia Sultana Shefa, Faculty of Environmental Science and Disaster Management, Patuakhali Science and Technology University, Dumki, Patuakhali-8602, Bangladesh).

Received Date: 1 July 2024

Accepted Date: 3 August 2024

Published Date: 18 August 2024

ABSTRACT

The study delves into the persistent threats posed by climate change-induced phenomena, notably river bank erosion, within the Bengal Delta, focusing specifically on the Nalua Union in Bakerganj Upazila, Barishal District. Utilizing a multifaceted methodology encompassing satellite imagery analysis, field observations, and questionnaire surveys, the research aims to evaluate the potential displacement of residents due to river bank erosion and its attendant socio-economic and environmental repercussions. Nestled at the confluence of the Pandob and Karkhana rivers, the study area contends with recurrent and severe bank erosion, resulting in profound infrastructural and livelihood disruptions. Analysis of satellite imagery spanning 2016 to 2023 underscores the dynamic nature of erosion and accretion processes, with coastal erosion encompassing 2.15 sq. km and accretion covering 1.75 sq. km. Economic ramifications of erosion-induced damages amount to USD 300 million annually, disproportionately affecting agricultural sectors and rural communities. Beyond economic loss, the study investigates the non-economic consequences of river bank erosion, such as social disintegration and environmental damage. Displacement engenders social fragmentation, erodes communal ties, and imperils livelihoods, exacerbating vulnerability among impacted populations. Environmental impacts encompass soil degradation, biodiversity loss, and compromised access to potable water and fisheries resources. This study provides actual evidence for the complex relationship between natural dynamics and human vulnerabilities as a result of river bank erosion. The findings underscore the exigency for comprehensive mitigation and adaptation strategies to address the socio-economic and environmental exigencies precipitated by erosion-induced displacement in the Nalua Union and harmonious vulnerable locales. To develop long-term socioeconomic equilibrium and environmental resilience in coastal locations prone to riverbank erosion, such solutions must incorporate community resilience-building activities, ecosystem-centric approaches, and sustainable land management practices.

Keywords: Agricultural impact, Economic impact, Environmental impact, River erosion, and Social impact.

INTRODUCTION:

The Bengal Delta is frequently influenced by climate change, resulting in bank erosion and other natural
UniversePG | www.universepg.com

dangers. River bank erosion occurs over time when rock pieces are removed from the river bed and banks. The catastrophe presents a threat to the entire country,

but the coastline region is especially vulnerable (Islam et al., 2010). Coastal communities rely largely on natural resources, which can be severely harmed by River Bank erosion. As a result, many residents may become migrants as stream decay in Bangladesh is predicted to lead to up to 100,000 people to be uprooted annually (Faruque, 2007). Bangladesh is concerned about the potential of resident migration caused by degraded riverbanks. Every year, river bank erosion damages approximately 10,000 hectares of flood plain (Islam and Rashid, 2011; Bonna S., and Akter L., 2023).

Bangladesh's geographical and geological setting makes it highly vulnerable to calamities, including climate-related disasters (IPCC, 2007). It is a riverine country, with around 700 rivers, including channels and tributaries, flowing across the country, forming a water network of roughly 24,140 kilometers (Das et al., 2014; Islam and Rashid, 2011). Water volume and sedimentation are the primary causes of floods and river bank erosion in Bangladesh (Elahi et al., 1991; Sarker et al., 2003). It poses social and environmental concerns for 30-40% of the people that live near them. In Bangladesh, eroded riverbanks entail's a danger to over 2,400 km of river bank line, which includes 283 locations, 85 towns, and emerging central hubs. The current study seeks to determine the likelihood of

citizens abandoning Nalua Union in Bakerganj Upazila, Barishal District, due to river bank erosion. The study area experiences riverbank erosion due to its close proximity to the sea. It will give empirical information on river bank erosion to assess the hazard to evacuated residents. The findings will assist the Nalua community in identifying their susceptibility and taking suitable actions to mitigate it.

METHODOLOGY:

Study Area

Nalua (Fig. 1), in Barishal's Bakerganj district, is particularly vulnerable to river bank erosion due to the basin's diverse hydro-meteorological and topographical characteristics. The Pandob and Karkhana rivers near Nalua, Bakerganj, have been a source of concern for Barishal due to frequent bank erosion. The Pandob River borders the Union to the northwestern region, the Karkhana River to the east of it, and the Lohalia River to the south of it. Erosion in the basin is severe, frequent, and causes substantial damage. The study region is located between latitude 22 29 13 N and longitude 90 24 52 E. The Upazila comprises 14 Unions. Nalua Union is comprised of five mouzas, with a population of 9270 and an area of 1540 hectares (Bangladesh Bureau of Statistics, 2011).

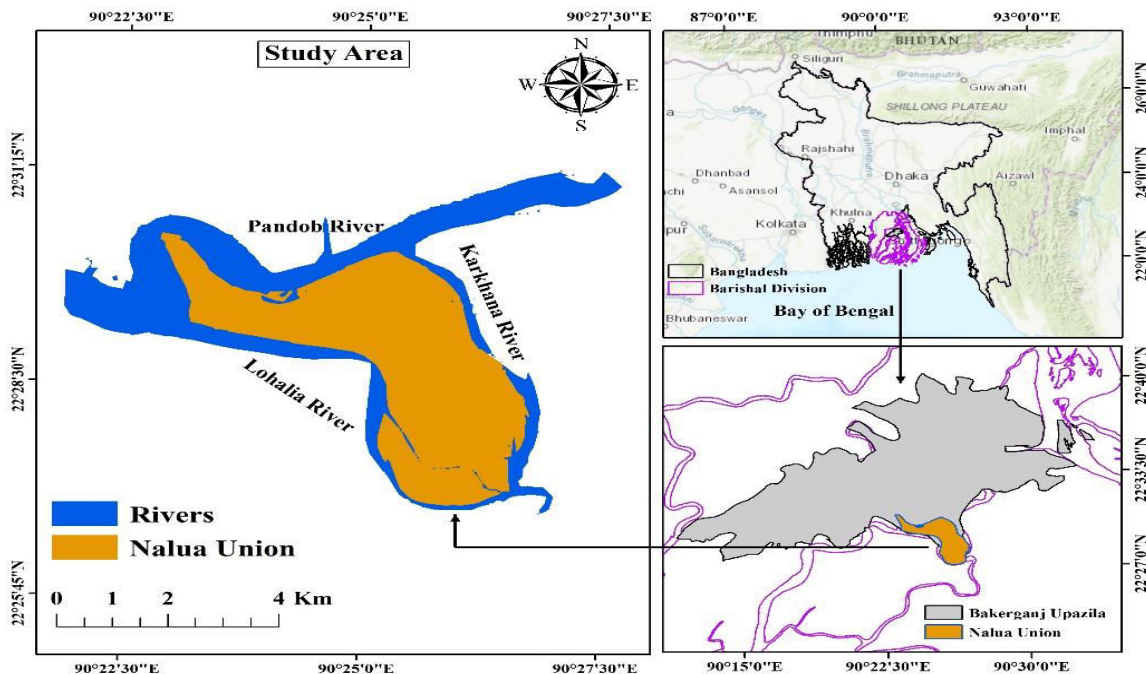


Fig. 1: Map of Study Area.

Data Collection

This research utilized Google Earth images, field observations, a questionnaire survey, and published documents as primary and secondary data sources. Following consultation with the Union Parishad secretary, 2157 households in the Union were identified as being affected by riverbank erosion. The

Raosoft sample size calculator was used to choose 92=>100 impacted homes with a 95% confidence level and 10% error rate. Data entry and analysis were performed with MS excel. To depict the erosion and accretion pattern, we have used Landsat satellite images of high resolution for the year of 2016 to the year of 2023.

Table 1: The details of satellite imageries used in the study.

Year	Satellite	Sensor	Path/Row	Source
2016	Landsat 8	OLI & TIRS	137/44	USGS https://earthexplorer.usgs.gov/
2023	Landsat 9	OLI & TIRS	137/44	

The available satellite images from 2016 to 2023 were initially utilized to represent river bank erosion and accretion in the area of interest. Satellite raster images collected for selected 2 different years from the United States Geological Survey (USGS) websites. By using USGS images are also applied to understand the current status of the riverbank in comparison with past records. After collecting the images, it was pre-processed to remove data errors and anomalies.

Questionnaire Development

As this is a survey based research, a structured questionnaire has been developed to conduct the household interview. The total number of questions is twenty (20) in this questionnaire. It is a close ended questionnaire where we used parameter from the study of Maruf et al., 2017.

Calculation

The Normalized Difference Water Index (NDWI) was used to aid in the extraction of water bodies within the study region. Landsat 8 and Landsat 9 (OLI & TIRS) data from 2016 and 2022 were used, therefore the relevant bands were band 3 (Green) and band 5 (Near-Infrared), as indicated in the equation below (Gazi et al., 2020).

$$NDWI = (Green - NIR) / (Green + NIR) = (band\ 3 - band\ 5) / (band\ 3 + band\ 5) \text{ (McFeeters, 1996).}$$

RESULTS AND DISCUSSION:

Status of Landform Change of Nalua Union

Rivers are dynamic systems that move sediment and transport water to maintain balance. Rivers must constantly respond to the new dimension, pattern, and profile formed by dynamic hydraulic processes in

order to regain their original balance. Erosion and deposition are required for free-flowing rivers to reach equilibrium (Das et al., 2014). The study discovered an ancient canal (the Karkhana River) in the study region, which has mostly been closed. As a result, the Karkhana River's main stream is diverted and enters the Pandob River. As a result, the Pandob River's volume, velocity, and flow have all increased, causing river bank erosion throughout the surrounding area, especially in the study area. The following table depicts the magnitude of erosion and accretion in the rivers from 2016 to 2023, and maps have been generated to help understand the trend. Over the seven-year period, coastal erosion amounted to 2.15 sq. km, whereas accretion encompassed 1.75 sq. km of the coastal landscape. Additionally, an area spanning 10.94 sq. km remained relatively unchanged during this timeframe. The net erosional effect, calculated as the difference between erosion and accretion, amounted to 0.40 sq. km. Furthermore, the erosion percentage, indicative of the proportion of the total coastal area affected by erosion, was determined to be 3.07%. Status of Landform change of Nalua Union is shown in **Table 2** and **Fig. 2**. The observed dynamics of coastal erosion and accretion underscore the intricate balance between erosional and depositional processes along the study area. While erosional forces have exerted a discernible influence, the concurrent occurrence of accretion highlights the multifaceted nature of the area's geomorphological dynamics. The discovered areas of insignificant change point to limited stability in the coastal landscape, which could be influenced by a variety of factors including sediment supply, wave energy, and anthropogenic interventions (Hapke et al., 2020).

Table 2: Status of Landform change of Nalua Union.

Year	Erosion (sq. km)	Accretion (sq. km)	Unchanged Area (sq. km)	Total Erosion (sq km)	Erosion %
2016 - 2023	2.15	1.75	10.94	0.40	3.07

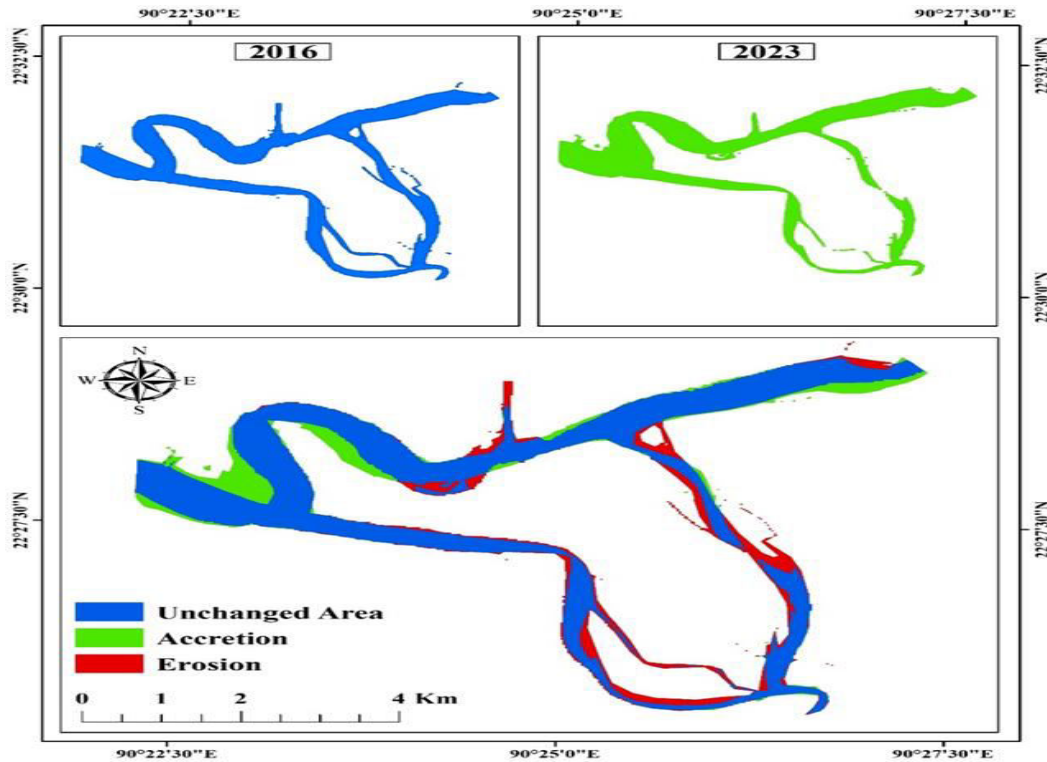


Fig. 2: Status of Landform change of Nalua Union.

Assessment of Economic Damages and Losses

In the Nalua union, losses and damages to residences, homestead areas, trees, ponds, tube-wells, latrines, and cultivated fields were closely related to economic costs. Recent years have seen an increase in economic loss and suffering, with an estimated annually monetary loss of USD 300 million (Hasan, 2022). The monetary value of a satangsa homestead area is esti-

imated to be around 50,000 taka, whereas a residence costs 90,000-1,00,000 taka, a pond costs 40,000 taka, a tube well costs 75000-100000 taka, a tree costs 75,000 taka, a latrine costs 25,000 taka, The satangsa for cultivated land is around 80,000 taka. **Table 3** represents the approximate estimations of their economic losses.

Table 3: The approximate estimations of their economic losses.

	Monetary Value (Approximately)
Residence	90,000-1,00,000
Homestead areas	50,000 per satangsa
Trees	75,000
Ponds	40,000
Tube wells	75,000-1,00,000
Latrines	25,000
Cultivated fields	80,000

Source: Field Survey, 2023

Riverbank erosion causes many farmers to become impoverished overnight. Losing cultivable areas can

make individuals economically vulnerable, as agriculture is often their primary source of income. Most

farmers become day laborers due to a lack of other options. They can struggle to adapt to new circumstances. Plants and trees can serve as an alternative source of income for rural communities. Many households have mango, jackfruit, and papaya trees. They consume the fruits and sometimes sell them in the local market. Trees also offer wood. To

meet household demands, they sell trees for money. Bamboo trees are prevalent in rural Bangladesh, with practically every household having one. Bamboo provides both domestic and economic benefits. However, due to erosion, the victims lose all scopes. **Fig. 3** depicts the rough estimates of their economic losses.

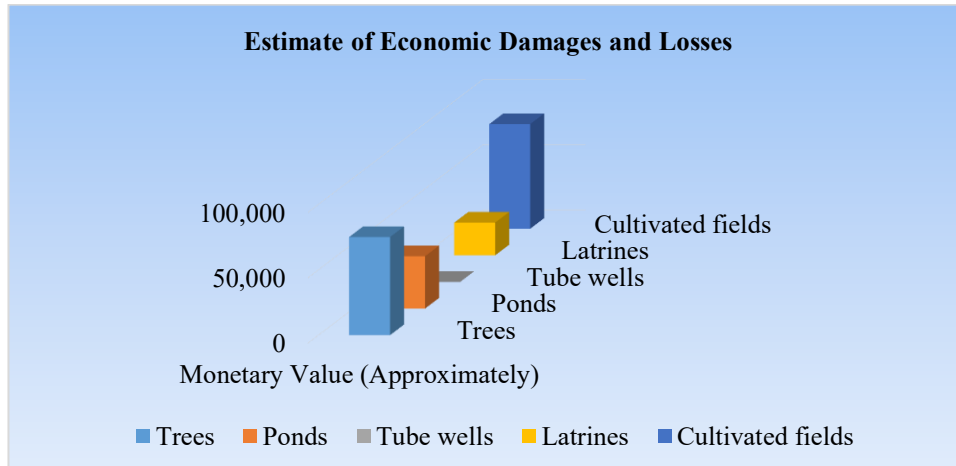


Fig. 3: Estimate of Economic Damages and Losses (Loss in Taka).

Impact of Agriculture

River bank erosion in Bangladesh causes the loss of thousands of hectares of land each year (Baki, 2014; Hossain and Ferdousi, 2004). Certainly, it is not a low-profile tribe that lost their last piece of territory and entered the union with bare hands. Bank erosion causes a significant loss of land to the river. The investigation found few agriculture potential in the area under consideration. Farmers can only plant 2-3 crops per year, including subsistence homestead

gardening. Abnormal flooding and bank erosion are the main reasons for limited cultivation. Crop productivity declines, standing crops are damaged, and crop diversity and patterns change, leading to losses and damages. Riverbank erosion and deposition affect both of the Rivers. When comparing the two events (**Fig. 3a**), it is obvious that river erosion has had a considerable impact on the agricultural sector, with crop damage ranging from 1 to 5, putting standing crops at risk.

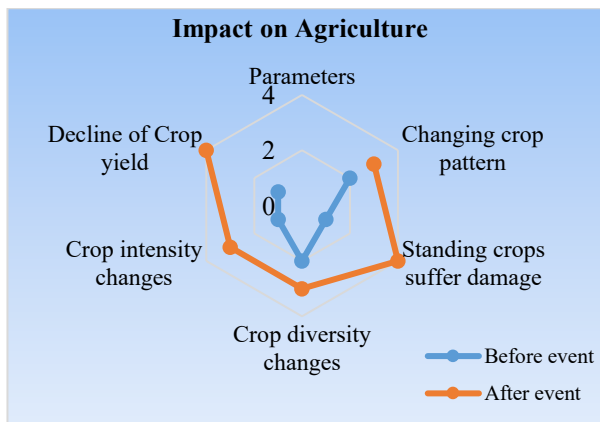


Fig. 3a: Impact on Agriculture.

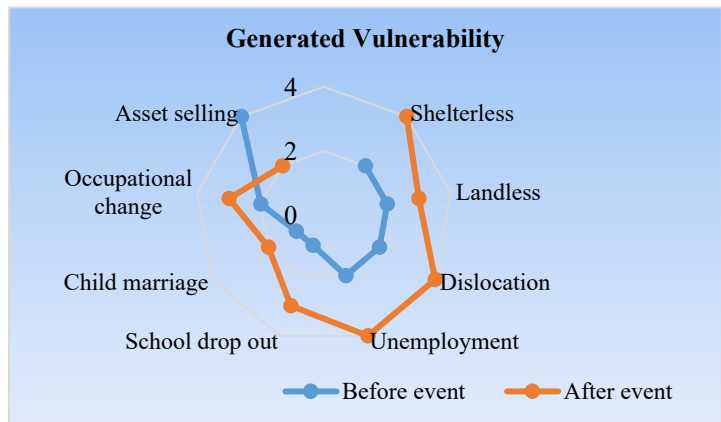


Fig. 4a: Generated Vulnerability.

Assessment of Non-economic Damages and Losses

In addition to economic losses, the affected people have suffered non-economic losses, which have had a

substantial influence on their livelihood and other results. This community's key challenges are social decline, environmental devastation, and levels of vulnerability.

Generated Vulnerability

No society can be considered entirely resilient in the global context since humans have the power to deal with disasters rather than prevent them. When natural calamities hit, the poor survive by selling land, animals, building materials, and personal items, all of which contribute to their poverty (Islam, 1998). Riverbank erosion displaces large numbers of people, many of whom are permanently relocated. Riverbank erosion has significant demographic and socio-economic effects in our country (Islam et al., 2011). Riverbank erosion affects 50% of homeless people, who are unable to reconstruct their homes due to poverty and limited resources (Islam et al., 2011). When comparing the generated vulnerability (Fig. 4a), before and after the occurrence, Dislocation, unemployment and shelter less family increase.

Social Degradation

Erosion causes victims to lose their agricultural and homestead holdings, leaving them isolated from their society and severing familial ties and social bonds. Pandob riverbed erosion causes societal deterioration by destroying social and family bonds, lowering one's social status, and causing migration. When people have to compromise on their basic requirements, their quality of life suffers. When revenue sources are lost or eroded, people's standard of living often decreases. Despite being away from society, many individuals nonetheless miss their social bonds. Social ruin has occurred among households. Many combined families have been split into little families. The newly formed chars serve as new settlement borders for people from both banks, but they continue to be a subject of contention among claimants (Zaman, 1989). When comparing the two occurrences (Fig. 4b), it is obvious that river erosion has significantly impacted the society, from 1 to 5, making family relation most vulnerable.

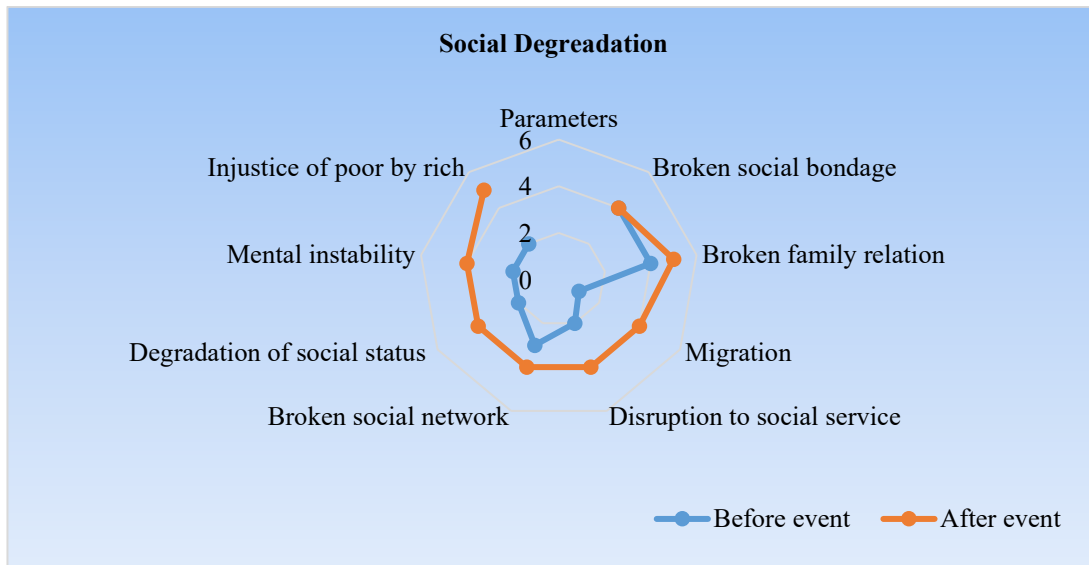


Fig. 4b: Social Degradation.

Impacts on Environment

Every disaster has a negative influence on the ecology, and humans can exacerbate the situation. The chosen location was already affected by climate change as part of a disaster-prone country, but riverbank erosion has exacerbated the adverse impacts even further. Respondents share their perspectives on the effects of sand deposition on agricultural land. As a result, agricultural productivity decreases. Bank deterioration

and char formation are ongoing processes in the Pandob River that alter the soil characteristics of the area. The river's depth is gradually decreasing, and fish habitats like the well-known Pandob's Hilsha are disappearing. According to the comments, certain fish species have become extinct. As seen in (Fig. 4c), River erosion has reduced the supply of safe drinking water and fish, while increasing crop damage from sand deposition.

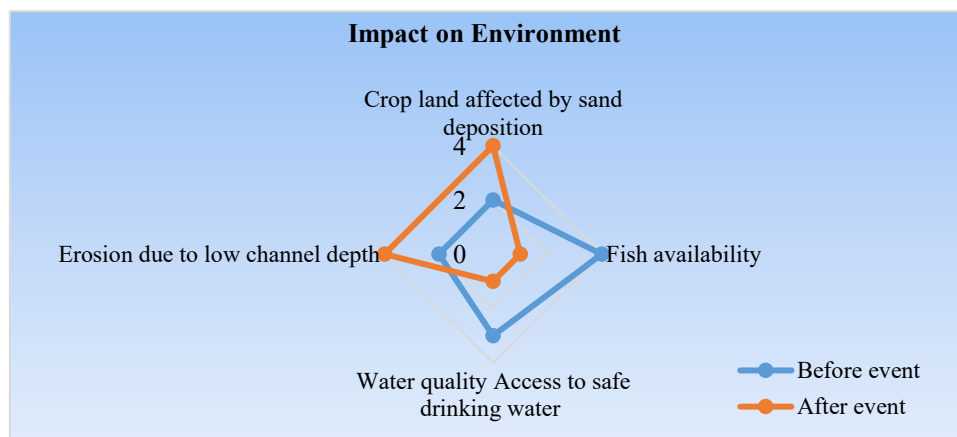


Fig. 4c: Impact on Environment.

CONCLUSION:

The comprehensive assessment of landform change in the Nalua Union underscores the profound impacts of river dynamics on both the environment and society. The study reveals a significant alteration in the hydrological regime, precipitated by the diversion of the Karkhana River and subsequent intensification of flow in the Pandob River. This hydraulic imbalance has catalyzed widespread riverbank erosion, exacerbating vulnerabilities and losses within the community. Economically, the repercussions are stark, with an estimated annual monetary loss of USD 500 million attributed to erosion-related damages. Farmers, once reliant on agriculture for sustenance, face sudden impoverishment as cultivable lands succumb to river encroachment. Furthermore, the loss of vegetation, including valuable fruit and timber trees, deprives households of alternative income sources, exacerbating economic hardship. The impacts extend beyond mere economic losses, manifesting in profound social and environmental upheaval. Social cohesion deteriorates as families are uprooted from their ancestral lands, severing ties and fragmenting communities. Displaced individuals face heightened vulnerability, with limited resources constraining their ability to rebuild lives and homes. Additionally, environmental degradation compounds existing challenges, with erosion-induced changes altering soil characteristics and disrupting aquatic habitats, leading to the decline of vital fish species and diminishing agricultural productivity. The study highlights the multifaceted nature of riverbank erosion, with far-reaching consequences for both human livelihoods and ecological integrity. Urgent interventions are warranted to

UniversePG | www.universepg.com

mitigate losses, restore ecological balance, and enhance community resilience. Effective strategies must integrate socio-economic considerations with environmental conservation efforts to address the complex interplay between natural processes and human activities, thereby safeguarding the well-being of affected populations and promoting sustainable development in the Nalua Union and similar vulnerable regions.

AUTHOR CONTRIBUTIONS:

M.S.S. Conceptualization, writing the original draft, reviewing, editing and corresponding of the manuscript, M.F.H. Investigation, reviewing, editing and writing the original draft of the manuscript. M.H.O. Investigation and writing the original draft of the manuscript, S.M.H.A. Writing the original draft of the manuscript, AP. Reviewing, supervision and writing the original draft of the manuscript, F.R. Reviewing, supervision and writing the original draft of the manuscript, A.A. Writing the original draft of the manuscript, G.A.M.A.R. Writing the original draft of the manuscript.

ACKNOWLEDGEMENT:

The authors are grateful to the faculty of Environmental Science and Disaster Management, Patuakhali Science and Technology University, Dumki, Patuakhali and the River Research Institute, Faridpur-7800, Bangladesh and others who directly or indirectly contribute to conduct this study as well. Last but not the least, we also acknowledge anonymous reviewers and the journal editor for their thoughtful suggestions and comments which helps to improve the manuscript.

CONFLICTS OF INTEREST:

The authors declare that there are no conflicts of interest.

REFERENCES:

- 1) Baki, A. T. M. (2014). Socio-economic impacts of Gorai riverbank erosion on people: A case study of Kumarkhali, Kushtia. (Doctoral dissertation, BRAC University).
<http://hdl.handle.net/10361/3532>
- 2) Billah, M., Tarannum, T., & Ansary, M. A. Risk Assessment of Displaced Inhabitant due to River Erosion and Looking for Relocation as a Sustainable Solution in Lebukhali Union, Patuakhali, Bangladesh.
- 3) Bonna S., and Akter L. (2023). Socio-economic status of pineapple growers in Bangladesh: a study on Tangail district, *Asian J. Soc. Sci. Leg. Stud.*, 5(3), 67-76.
<https://doi.org/10.34104/ajssls.023.067076>
- 4) Das, T. K., Haldar, S. K., & Sen, S. (2014). River bank erosion induced human displacement and its consequences.
- 5) Elahi, K. M. (1991). Riverbank erosion, flood and population displacement in Bangladesh. *Riverbank Impact Study*, 14.
<https://cir.nii.ac.jp/crid/1571698599767474688>
- 6) Faruque, A. (2007). Resettlement policy resettlement policy development: The case of development: The case of Bangladesh. *Asian Development Bank Bangladesh, Resident Mission, PowerPoint Presentation*.
- 7) Gazi, M. Y., Hossain, F., & Uddin, M. M. (2020). Spatiotemporal variability of channel and bar morphodynamics in the Gorai-Madhumati River, Bangladesh using remote sensing and GIS techniques. *Frontiers of Earth Science*, 14, 828-841. <https://doi.org/10.1007/s11707-020-0827-z>
- 8) Hasan, M. M., Ali, M. R., & Talukder, M. F. (2022). Effect of Embankments on Climate-Induced Loss and Damage in Selected Coastal Villages of Bangladesh.
- 9) Hossain, M. M., & Ferdousi, S. (2004). Assessment for role of GIS Based Natural Disaster Database in Environmental Management and Planning Activity in Bangladesh. *Environ. Informatics Archives*, 2, 119-125.
- 10) Islam, N. (1998). Human settlements and urban development in Bangladesh. University of Dhaka.
- 11) Islam, M. F., & Rashid, A. B. (2011). Riverbank erosion displacees in Bangladesh: need for institutional response and policy intervention. *Bangladesh Journal of Bioethics*, 2(2), 4-19.
- 12) Islam, M. N. (2012). Riverbank erosion induced migration by the char-dwellers in Bangladesh: towards a better strategy. *Asian Journal of Environment and Disaster Management*, 4(3).
- 13) McFeeters, S. K. (1996). NDWI BY McFEETERS. *Remote Sensing of Environment*, 25(3), 68-711.
<https://doi.org/10.1080/01431169608948714>
- 14) Metz, B., Davidson, O., & Meyer, L. (2007). Climate Change Mitigation. Contribution of working group III to the fourth assessment report of the intergovernmental panel on climate change. <https://unfccc.int/sites/default/files/metz.pdf>
- 15) Nalua (Union, Bangladesh) - population statistics, charts, map and location. (n.d.).
- 16) Sarker, M. H., Huque, I., & Koudstaal, R. (2003). Rivers, chars and char dwellers of Bangladesh. *Inter J. of River Basin Management*, 1(1), 61-80.
<https://doi.org/10.1080/15715124.2003.9635193>
- 17) Zaman, M. Q. (1989). The socioeconomic and political dynamics of adjustment to riverbank erosion hazard and population resettlement in the Brahmaputra-Jamuna floodplain.
<https://doi.org/10.17730/humo.48.3.v55465j651259835>

Citation: Shefa MS, Hasan MF, Ovi MH, Akash SKMH, Parvez A, Rukshana F, Akter A, and Reza GAMA. (2024). Navigating the ravages of riverbank erosion: socio-economic and environmental impacts in the Nalua union of Bakerganj upazila, *Asian J. Soc. Sci. Leg. Stud.*, 6(4), 154-161.

<https://doi.org/10.34104/ajssls.024.015400161> 